An acoustical analysis of the merger of /ɲ/ and /nj/ in Buenos Aires Spanish

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Buenos Aires Spanish (BAS) is well known for the sound change that led the palatal obstruent to become a post-alveolar fricative. However, that obstruent is not the only palatal phoneme undergoing sound change in BAS. The present study investigates the production of /ɲ/ and /nj/ in BAS, which have been reported as merging (Malmberg 1950). Previous research suggests that some speakers produce a 'traditional' (alveolo)palatal nasal, while other speakers realize /ɲ/ with two distinct non-simultaneous constrictions: alveolar/post-alveolar and palatal (Kochetov & Colantoni 2011). An acoustic analysis is based on the speech of 33 speakers (15 males, 17 females; from four age groups: 15–19 years old, 20–29 years, 30–45 years and 45+ years) and was obtained by measuring duration and formant contours in the tautosyllabic vocalic portion. Results reveal that /ɲ/ and /nj/ are not fully merged, as some speakers produce differences. Specifically, the results indicate that production differences between men and women disappear as age decreases, with female speakers being more innovative. Findings provide evidence that the sound change is still progressing and probably nearing completion, and show that the palatal system in BAS is losing the (alveolo)palatal nasal.

1 Introduction

The present study explores the production of the (alveolo)palatal nasal, /ɲ/, and the nasal-plus-glide sequence, /nj/,[1] in Buenos Aires Spanish (BAS). Palatal consonants have had a prominent place in the Hispanic Linguistics literature due to their historical development, their distribution in the phonological system of Spanish and their effect on stress placement (Harris 1983, Lloyd 1987, Lipski 1989, Harris & Kaisse 1999, Penny 2002, Guitart 2003, Baker 2004, Zampaulo 2013). The patterns of variation of Spanish palatal consonants have also attracted much research. The palatal series arose through complex sound changes

[1] We start this article with a disclaimer regarding the employed notation. In the instrumental literature analyzing the production of /ɲ/ and the nasal and glide sequence, the latter has been represented as /nj/ or /n + j/ (e.g. Shosted, Hualde & Scarpace 2012). One issue with this notation is that it conflates phonological and phonetic representations: [j] is the prevocalic allophone of /i/. An alternative notation is the one used in work analyzing Spanish vowel sequences, where the notation often used is *iV*, and by extension, /niV/ for the nasal and glide sequence (e.g. Bongiovanni 2016). In this article, I will use /nj/ to refer to the nasal and glide sequence. We are choosing this notation for several reasons. First, it follows previous research that compares the palatal nasal and the alveolar and glide sequence, especially work referencing the merger (e.g. Colantoni & Hualde 2013). Second, /niV/ does not permit differentiating between hiactic and diphthongal sequences (e.g. *manía* /ma.ní.a/ [manía] 'mania' vs. *Alemania* /a.le.má.nia/ [alemánja] 'Germany'). Thus, in order to avoid alternating notations, we will use /nj/ when referencing the category under study here – the nasal plus glide sequence – or transcribing full words, though we recognize that this notation conflates phonetic and phonological representations.

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that originated from non-palatal segments in Latin and have historically exhibited considerable instability. Synchronically, palatals also tend to vary widely. In particular, Buenos Aires Spanish is well known for the sound change that led /ʝ/ to become fronted and articulated as a post-alveolar fricative, [ʒ] or [ʃ] (Fontanella de Weinberg 1978; Wolf & Jiménez 1978; Chang 2008; Rohena-Madrazo 2013, 2015). Another palatal segment that has been claimed to undergo sound change in this dialect is the (alveolo)palatal nasal. Several authors have reported a tendency in BAS to merge /ɲ/ and /nj/, such that minimal pairs like *uranio* /uɾánjo/ 'uranium' and *huraño* /uɾáɲo/ 'unsociable' are neutralized (Malmberg 1950, Kochetov & Colantoni 2011, Colantoni & Hualde 2013).

The reports of neutralization of /ɲ/ and /nj/ in BAS trace back over half a century, to the 1950s. Malmberg (1950) observes an accidental palatalization in fast and relaxed speech, even among educated speakers (*sic*), which disappears in slow or emphatic speech. As a result, *Alemania* /alemánja/ 'Germany' may be realized as [alemáɲa]. More recently, Kochetov & Colantoni (2011) have shown variation in the production of /ɲ/ in a small sample of BAS speakers, with some speakers producing this segment as (alveolo)palatal, and others as an alveolar nasal with a delayed palatal constriction or as a sequence of a nasal and a glide. In light of these findings, some researchers have suggested that /ɲ/ is absent from the phonemic inventory of BAS (Colantoni & Hualde 2013). The current study examines the production of the putative contrast between /ɲ/ and /nj/ in a large sample of BAS speakers, focusing on duration and formant contours.

2 Buenos Aires Spanish and the palatal system

Palatal consonants in Spanish have garnered the attention of much theoretical and experimental work (e.g. Recasens 1990, 2013; Harris & Kaisse 1999; Guitart 2003; Baker 2004; Zampaulo 2013). At the palatal place of articulation, traditional Spanish phonological descriptions include four phonemes: an obstruent (/ʝ/), a lateral (/ʎ/), an affricate (/t͡ʃ/), and a nasal (/ɲ/), which arose through different co-articulatory processes such as fronting, tongue-body raising and assimilation. Most research on Spanish palatals has focused on the palatal obstruent, on account of their regional and contextual variation. In addition to the merger with /ʎ/ in the vast majority of Spanish dialects, the palatal obstruent exhibits a broad range of realizations with varying degrees of constriction, from glide [j] to affricate [ɟ͡ʝ], though allophonic distributions may vary regionally (Hualde 2014: 162). Other dialects present pronunciations that move away from this continuum of constriction degree. Most notably, Argentine Spanish presents a voiced post-alveolar sibilant [ʒ], which underwent devoicing in BAS. Sociolinguistic work uncovered that while women spearheaded the sound change, devoicing of [ʒ] nowadays varies as a function of age, with older speakers resisting sound change more than younger speakers (Fontanella de Weinberg 1978; Wolf & Jiménez 1978; Chang 2008; Rohena-Madrazo 2013, 2015). Variation with the palatal obstruent in BAS may present sociolinguistic parallels with the case at hand, which we will explore in the results and discussion sections.

The (alveolo)palatal nasal presents another example of variation in the palatal system in Spanish. The reported alternative realizations across Spanish dialects include [j̃] (with loss of the coronal constriction), [n] (with loss of the palatal constriction), and [nj] (with maintenance of coronal and palatal gestures; Sala 1974, Lipski 1989, Quilis 1993, Penny 2002).[2] BAS belongs in this last group, thereby prompting the aforementioned reports of merger between /ɲ/ and /nj/.

[2] An anonymous reviewer asked if [jn] was a possible realization. To the best of our knowledge, [jn] has not been reported in the literature.

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Even though the (alveolo)palatal nasal and the nasal-plus-glide sequence are historically related (one of the sources for /ɲ/ in Spanish is precisely /nj/; for an overview see Fradejas Rueda 2000: 102–103), the two categories have been emphatically described as presenting phonetic and phonological differences. Specifically, Martínez Celdrán & Fernández Planas (2007: 126) describe a palatal element in the (alveolo)palatal nasal as 'solidly connected to the nasal segment', but identify it as a 'full glide' in the nasal-plus-glide sequence. One of the assumptions underlying this description relates to the phonological affiliation of this palatal element: part of the onset of the syllable if connected to the nasal consonant, whereas part of the (complex) nucleus of the syllable, if a full glide – arguments for this can be found in Harris (1983: 14–16), Quilis (1993: 178–179), Guitart (2004: 160–163), Colina (2009: 21), Hualde (2014: 64–72), Morales-Front (2018), among others. These phonological differences, according to Martínez Celdrán & Fernández Planas (2007), surface acoustically as differences in duration of the vocalic portions as well as spectral characteristics. By the same token, the articulatory literature has documented the Peninsular Spanish /ɲ/ well (Fernández Planas 2000, 2009; Shosted, Hualde & Scarpace 2012) and provides additional support for the phonetic differences between /ɲ/ and /nj/. For example, the findings in Shosted et al. (2012) indicate that the (alveolo)palatal nasal presents a wide pattern of occlusion in the alveolar and front palatal area. At the moment of maximum constriction, /ɲ/ presents a more posterior constriction than /nj/. See next section for a discussion of articulatory characteristics of [ɲ] and [nj].

Articulatory research on BAS presents a different scenario. Kochetov & Colantoni (2011) found that some Argentine speakers produced /ɲ/, in a word like *pestaña* /pestáɲa/ 'eye lash', as a more typical (alveolo)palatal nasal, with maximum contact at the back of the palate. Other speakers realized /ɲ/ in two distinct constrictions, alveolar/post-alveolar and palatal, and these two constrictions were not necessarily produced quasi-simultaneously. The palatal constriction was delayed with respect to the alveolar constriction, which suggested a sequence of [n] and [j] or a palatalized alveolar nasal [nʲ]. However, the extent to which the realization of /ɲ/ overlapped with that of /nj/ was not examined in particular; this lacuna motivates the present study.

A consequence of /ɲ/ going to [nj], coupled with /ʝ/ going to [ʒ], may be the restructuring and shrinking of the palatal series in this particular dialect (Colantoni & Hualde 2013: 32). Thus, the realization of palatal segments other than the palatal obstruent in BAS, and in particular how the (alveolo)palatal nasal contrasts with /nj/ given the evidence available, deserves a thorough examination. Given what we currently know about sociolinguistic variation in the palatal system of BAS, an examination of the /ɲ/–/nj/ merger cannot shy away from group differences. Our goal with this study is to contribute to the literature on Spanish palatals by examining the acoustic details of /ɲ/ in BAS, how it compares to /nj/, and how it may vary across speaker groups. Insights from these enquiries not only provide experimental evidence to support or reject reports of neutralization of /ɲ/ and /nj/ but also add to our understanding of processes affecting palatal consonants and the ways in which their variation manifests in the phonological system of Spanish.

3 The phonetics of [ɲ] and [nj]

Recasens (2013) has shown that the (alveolo)palatal nasal is better characterized as (alveol)opalatal rather than palatal-proper. Thus, both /ɲ/ and /nj/ involve alveolar and palatal contact. Comparisons of (Spanish and Catalan) [ɲ] and [nj] reveal differences with regard to the tongue during coronal and palatal constrictions. With [nj], coronal contact is realized with the tongue tip, whereas for [ɲ] with the tongue blade. As for palatal contact, tongue dorsum raising presents a larger degree of contact for [nj] than for [ɲ] (Recasens 1984). Another difference between [nj] and [ɲ] relates to the temporal organization of articulatory gestures. In the production of [ɲ], the peaks of alveolar and palatal contact are achieved

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quasi-simultaneously (Recansens & Romero 1987, Fernández Planas 2009). The production of [nj], on the other hand, shows a longer time span between tongue tip and tongue dorsum gestures. These differences indicate that articulatory differentiation between [ɲ] and [nj] are the result of timing strategies (Recasens 1984: 126), and go hand in hand with the aforementioned observations by Martínez Celdrán and Fernández Planas (2007: 127). In comparison to /ɲ/, the independent segmental status of the glide in the sequence /nj/ would result in a more constricted dorsopalatal realization. These production differences are expected to surface in the acoustics of the speech signal, to which we turn next.

Research on the acoustics of nasal segments has identified acoustic correlates of place of articulation in nasal segments, such as nasal formants, nasal zeros, vowel transitions and their duration (for Spanish, see Massone 1988, Machuca Ayuso 1991, Albalá 1992, García & Rodríguez 1998, Martínez Celdrán & Fernández Planas 2007). However, identifying place of articulation of nasal consonants with acoustic data is notoriously hard; analyses of nasal murmur have yielded inconsistent results (Fujimura 1962). For this reason, the present study examines acoustic differences that surface during the production of the tautosyllabic vocalic portion. 'Tautosyllabic vocalic portion' as used here refers to the period of high-intensity formant structure (following murmur offset). With /ɲ/ this period represents one vowel (i.e. *huraño* /uɾaɲo/ 'anti-social', [o] in the syllable /ɲo/). In the case of /nj/, a palatal glide, which is the prevocalic allophone of /i/, and a following vowel are included in this period (i.e. *uranio* /uɾanjo/ 'uranium', [jo] in the syllable /nio/). Since both /ɲ/ and /nj/ incorporate a palatal 'element' – the former as a part of the nasal consonant, and the latter as part of the vowel nucleus – acoustic differences in the vocalic portion would allow characterizing the difference between /ɲ/ and /nj/. Two acoustic cues are examined in this study: formant contours and duration of the vocalic portion.

The (alveolo)palatal nasal and the nasal-plus-glide sequence are expected to present differences in terms of absolute frequency of F1 and F2, spectral changes, as well as in duration of the vocalic portion. The hypothesized more constricted dorsopalatal realization for the glide element in /nj/ would produce a rise in F2 frequency and a decrease in F1 (Fant 1960: 81, 121). Additionally, because [ɲ] and [nj] have been shown to exhibit gestural timing differences, each category is expected to arrive at their F1 minimum and their F2 maximum frequencies at different times: /ɲ/ should present maximum F2 and minimum F1 readings earlier than /nj/. Furthermore, since [j] is part of a complex nucleus with /nj/, the vocalic portion is expected to be longer with /nj/ than with /ɲ/.

4 Method

4.1 Participants

Participants in the study are 33 native speakers of BAS, 17 females and 16 males, recorded within the dialectal region. Care was taken to ensure that participants were from a similar socio-economic status (middle-class as judged by the researcher, a native of Buenos Aires). Since sound differences affecting palatal obstruents in Argentine Spanish have been shown to previously vary by gender (Fontanella de Weinberg 1978, Wolf & Jiménez 1978) and age (Chang 2008; Rohena-Madrazo 2013, 2015), participants were classified in four age groups: 15–19 years old, 20–29 years, 30–45 years and 45+ years. Table 1 summarizes the demographic information about the participants.[3]

[3] As the reader may notice, demographic information in the second and third age groups is presented as equivalent. College degrees in Argentina are often longer than four years, depending on the degree and the institution (e.g. public vs. private). At the same time, college students may be full-time workers as well as full-time students. As a result, when compared to college-student populations in other parts of the world, college students in Argentina may be older than their counterparts elsewhere around the globe.

Table 1 Demographic information of participants.

Age group (years)	Gender and number of participants	Mean age (years)	Background information
15–19	Females, *n* = 4	16.25	High school students.
	Males, *n* = 5	16.80	
20–29	Females, *n* = 6	25.66	Completed or pursuing a college degree.
	Males, *n* = 4	27.50	
30–45	Females, *n* = 5	35.60	Completed or pursuing a college degree.
	Males, *n* = 4	34.00	
45+	Females, *n* = 2	62.00	Completed graduate school. Established in their profession and/or close to retirement.
	Males, *n* = 3	64.00	

4.2 Stimuli and tasks

All target words include /ɲ/ and /nj/, preceded and followed by /a/, in unstressed and word-final position. The alveolar nasal /n/ was also included for comparison purposes. Example target words are *caña* /káɲa/ 'fishing rod', *Tania* /tánja/ 'personal name' and *rana* /rána/ 'frog'. The experimental design also included these sequences in stressed position, as well as vowel sequences with a front mid-vowel (i.e. /nea/; e.g. *foránea* /foránea/ 'foreigner'), but those sequences are not addressed here (the analysis of /nea/-sequences is reported in Bongiovanni 2016). Table A1 in the appendix includes a complete list of the experimental stimuli under analysis in this study.

In order to examine if and how speakers contrast /ɲ/, /n/ and /nj/, two tasks that created the conditions for hyperarticulation were designed. In this study, hyperarticulation is used as a synonym of 'more emphatic speech'. Hyperarticulation involves pronouncing words more clearly than they are 'normally' produced, and is associated with various acoustic-phonetic features of enhanced speaker effort, such as longer durations and enlarged vowel spaces (Lindblom 1990). As such, the goal of hyperarticulation is to communicate phonemic contrast and thereby to enhance the distinctiveness of the speech output. One way to draw speakers' attention to a form, and induce them to concentrate articulatory effort in that item and enhance phonemic contrast, is by manipulating focus, such that speakers exaggerate linguistically relevant properties (de Jong & Zawaydeh 2002, de Jong 2004). To this end, this study includes two tasks that vary the amount of attention to the phonological target: a first task with no manipulation of focus, and a second one that manipulates focus in three ways.

The first production task was a reading task (henceforth, 'reading condition') that included real words with the target syllables. Three texts were created that elicited three repetitions of the syllables under study. Target words were in statements, phrase medially, and followed by /p/. Participants were presented a page with the three texts to read.

The second production task was a carrier phrase task, with three conditions: neutral focus, lexical focus, and phonological focus. Carrier phrases were presented in Spanish orthography in a PowerPoint presentation on a laptop computer. Neutral focus condition was presented first, followed by the lexical focus condition and, finally, the phonological focus condition. Participants read three repetitions of each carrier phrase.

Under the neutral focus condition, speakers were focused on an item that was not semantically or phonologically related to the target word. Stimuli included real words and nonce words. With real words, the output was ***Ella*** *dijo <u>Alemania</u>, no Pedro* '**She** said <u>Germany</u>, not Pedro' (here and in remaining examples, the target word is underlined and the focus word is in boldface). On the other hand, with nonce words, the output sentence was ***Ella*** *dijo <u>pánia</u>, no Pedro* '**She** said <u>pánia</u>, not Pedro'. In the lexical focus condition, speakers contrasted the target word with a word with no phonological similarity to the targets. The output in this case

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was *Dijo* ***Alemania****, no Francia* 'He said **Germany**, not France.' Finally, in the phonological focus condition, the output sentence was *Dijo* ***pánia****, no páña* 'He said **pánia**, not páña'. There were two foci: on segment and on stress. In the first condition, the minimal pairs contrasted on the nasal segment (*pa*[nj]*a* vs. *pa*[ɲ]*a*). In the second condition, they contrasted on stress placement (*pa*[nj]*a* vs. *pa*[ní]*a* or *pa*[nj]*a* vs. *pa*[nj]*á*). Contrast on segment and contrast on stress conditions were blocked. Nonce words were used for these conditions given that controlling for phonetic context (preceding and following vowel and prosodic location) and stress with real words was not possible.

Regarding procedure, participants first completed an ABX perception task (results are reported in Bongiovanni 2015a). Next, they read the three passages followed by the carrier phrases. Finally, they completed a second perception task. This study analyzes production data from the reading and carrier phrase task. From the data collected in the phonological focus condition, we only analyze the segment focus data, which will be referred to as the phonological condition in the remainder of the paper.

4.3 Instrumental analysis

This study examines duration and formant trajectories in the tautosyllabic vocalic portion. To this end, each production of /n/, /ɲ/ and /nj/ and their tautosyllabic vocalic portions were extracted and analyzed using Praat (Boersma & Weenink 2016). The theoretical ceiling of tokens was 3267, or 99 per speaker (reading condition, $n = 9$; neutral focus condition, $n = 36$; lexical focus condition, $n = 18$; phonological focus condition, $n = 36$). In some cases, however, speakers accidentally repeated or skipped over tokens. In addition, 157 tokens were eliminated from the analysis of duration and 181 tokens from the analysis of formants, as they presented non-target productions, nasal consonants with no identifiable oral constriction, creaky voice, background noise or measurement error (see footnote 5 below).

The onset of the vocalic portion was defined by the visual presence of an abrupt change in formant structure and frequencies, as exhibited by the breaking up of the telltale 'smearing' in the spectrogram and lighter shades of gray of nasal consonants (Ladefoged 2005). The offset of the vocalic portion was identified on the basis of a sudden loss of energy in the waveform and a breaking up of the formant structure in the spectrogram. Figures 1 and 2 illustrate measurement landmarks for a /ɲ/ and a /nj/ token. No attempts were made to indicate boundaries between formant transitions or the glide and the vowel /a/. Therefore,

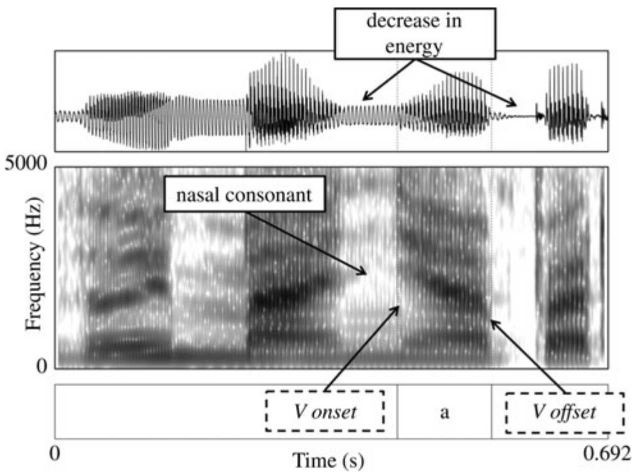

Figure 1 Waveform and spectrogram of the word *maña* 'trick' /maɲa/produced by a Peninsular Spanish speaker during piloting (Bongiovanni 2015b).

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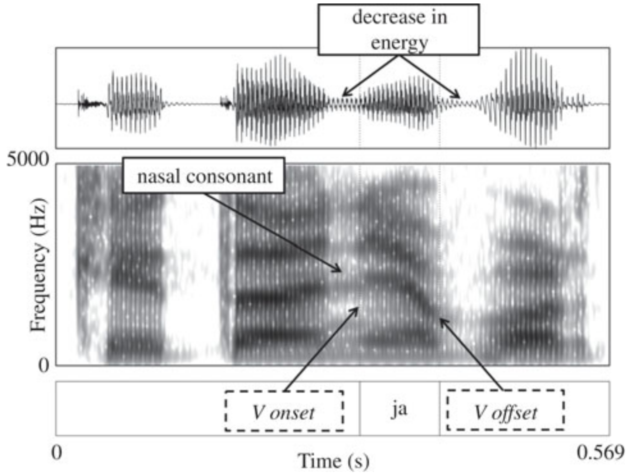

Figure 2 Waveform and spectrogram of the word *Tania* (personal name) /tanja/produced by speaker F12 (female, 15–19 age group).

the duration of the vocalic portion in the case of /ɲ/ and /n/ represents the monophthong /a/ and, in the case of /nj/, the diphthong /ia/.

Once annotation was complete, measures of duration of the vocalic portions were extracted automatically (Lennes 2002). Formant measurements, on the other hand, were extracted semi-automatically, using the Burg LPC-spectra formant estimation function in Praat (McCloy & McGrath 2012). Measurements were taken at twenty temporal points within the vocalic portion, from 5% to 100%, every 5%.[4] Measurements of 2.3% of the data ($n = 74$) were manually corrected, as it was evident that there were tracking errors.[5]

Two types of formant analysis were performed. The first analysis follows recent research that takes into account that formant curves are dynamic elements. Time-varying formant analysis was performed via smoothing-spline analysis of variance (SSANOVA; Davidson 2006, Wassink & Koops 2013). More details of the procedure are presented in the next section. The second approach analyzes static points in the formant structure, in order to confirm the results of the SSANOVAs. To this end, the F1 minimum and F2 maximum ($F1_{min}$ and $F2_{max}$, respectively) were identified during the first half of the vocalic portion and two measurements were taken: (i) formant readings of $F1_{min}$ and $F2_{max}$ and (ii) the temporal lag between the onset of the vocalic portion and the time stamp on $F1_{min}$ and $F2_{max}$. The combination of these two measurements allows for the characterization of differences in formant frequencies as well as timing differences.

4.4 Statistical analysis

For duration of the vocalic portion, a repeated-measures ANOVA was performed in SPSS (IBMCorp 2016). Target syllable (/na/, /nja/ and /ɲa/) and task condition (neutral focus

[4] Non-time normalized measurements were also taken and analyzed. Results of that analysis showed no differences from the results presented here.

[5] The Praat script used for formant measurement extraction prompts the user to either accept the formant measurements or adjust the formant settings and recalculate, or mark the interval as unmeasurable, before proceeding to the next interval or file. This procedure allowed the author to identify tracker errors. Most often, the formant track deviated from the formants seen in the spectrogram for half of the vocalic portion. These tokens were annotated using the comment function in the script before moving on to the next token. Then, formant tracks were hand-corrected where necessary. Where manual extraction still rendered tracker errors, the token was removed from analysis.

condition, lexical focus condition, phonological focus condition, and reading condition) were entered into the model as within-subject variables, and gender (male and female), and age group (15–19, 20–29, 30–45 or 45+) were entered as between-subject. Statistical significance was set at α = .05.

For the analysis of formant contours, formant values were transformed to Bark units, which represent perceived formant frequencies, and two analyses were performed, on static as well as on dynamic measures. Statistical significance for the time-varying formant analysis was established via smoothing-spline SSANOVA, implemented in R (R Core Team 2016). The smoothing spline is a type of natural cubic spline that connects points (knots; Time * Bark coordinates) and finds the best possible balance between fitting the data points and producing a smooth curve. Statistical significance is indicated by non-overlapping confidence intervals. Following research employing SSANOVA (e.g. Simonet, Rohena-Madrazo & Paz 2008, Nance 2014, Kirkham 2017), only the graphical representations of the SSANOVA model fit are reported here.

With regard to static formant measures, only /nj/ and /ɲ/ were examined. Four repeated measures ANOVAs were performed (also in SPSS, IBMCorp 2016), one per dependent variable: $F1_{min}$, $F2_{max}$, temporal lag from onset of the vocalic portion to $F1_{min}$ and to $F2_{max}$. Target syllable (/ɲa/ and /nja/) and task condition (neutral focus, lexical focus, phonological focus, and reading) were entered into the model as within-subject variables, and gender (male and female) and age group (15–19, 20–29, 30–45 or 45+) were entered as between-subject. Statistical significance was also set at α = .05.

5 Results

5.1 Duration of the tautosyllabic vocalic portion

Given that /ɲ/ and /nj/ present different numbers of phonological elements (i.e. CV vs. CVV), /nj/ was expected to be longer than /ɲ/. Figure 3 presents the data for the vocalic portion (descriptive statistics are embedded in the figure). Overall, findings follow the prediction: the duration of the vocalic portion is longer for /nj/ than /ɲ/, which in turn is longer than /n/.

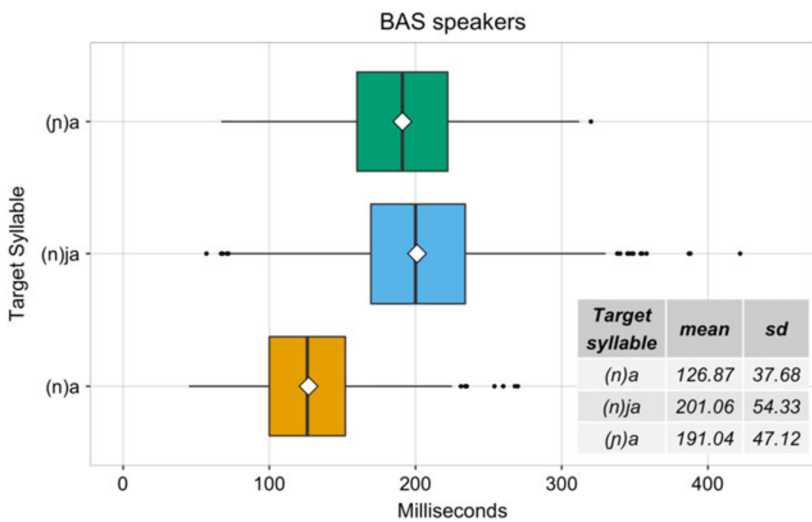

Figure 3 Duration of the vocalic portion in milliseconds per target syllable. Diamonds represent mean values. The values in the table are raw averages and standard deviations (*sd*) that have not been adjusted by the statistical model. For interpretation of the references to color in figure legends, the reader is referred to the web version of this article.

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Table 2 RM ANOVA results with target syllable and task condition as within-subject variables, and gender and age group as between-subject variables, and duration of the vocalic portion as dependent variable. Only statistically significant interactions are included.

Independent variable	*F* statistic	*p*	partial-η^2
Target syllable	$F_{(1.92,48.11)} = 97.14$	*	0.79
Task condition	$F_{(2.01,\ 90010.94)} = 120.46$	*	0.83
Gender	$F_{(1,\ 92392.84)} = 0.91$	n.s	0.03
Age group	$F_{(3,\ 92392.84)} = 5.96$	*	0.42
Interaction term			
Target syllable * Task condition	$F_{(4.26,106.53)} = 8.45$	*	0.25
Task condition* Gender	$F_{(2.01,\ 90010.94)} = 4.93$	*	0.16
Target syllable * Age group	$F_{(5.77,\ 48.11)} = 4.50$	*	0.35
Target syllable * Task condition * Age group	$F_{(12.78,\ 9465.31)} = 1.98$	*	0.19

* = statistically significant; n.s. = not significant.

Table 2 summarizes statistical main effects and significant interactions (in the interest of space, only statistically significant interaction terms are included). Given that Mauchly's test of sphericity was significant, we use the Greenhouse-Geisser correction for the test of overall main effects and the interactions (all results in Section 5 will be reported using the Greenhouse-Geisser correction as per recommendation in Howell 2012). The main effect for target syllable provides statistical confirmation that the difference between phonological elements surfaces as durational differences. Additionally, statistical main effects for age group and task condition indicate that (i) younger speakers produce the shortest and older speakers the longest segments,[6] and (ii) the longest segments are produced in the phonological focus condition. The remainder of this section explores differences per speaker groups (gender and age) and task conditions in light of significant main effects and interaction terms.

5.1.1 Speaker groups

Gender does not show a significant main effect. It is, however, part of a significant interaction with task condition. In the reading condition, males produce longer segments than females, whereas in the focus condition the reverse trend is found. However, acoustical differences between /ɲ/ and /nj/ are not greater for either group. These findings indicate that men and women responded differently to the task rather than these two groups realizing the contrast differently. Regarding differences across age groups, duration of the vocalic portion is produced longer as age increases. Speakers in the 15–19 age group produced the shortest segments, while 45+ speakers produce the longest.[7] These differences in age groups are explored further in the next section, when the interaction with task condition is addressed.

5.1.2 Task condition

Overall, findings reveal greater differences between vocalic portions in the focus conditions than in the reading condition, and more so when speakers are asked to contrast the target item with a phonologically similar item (i.e. the phonological focus condition). Figure 4

[6] Tukey pairwise comparison revealed that only the younger and the older speaker groups were significantly different from each other ($p < .001$).

[7] As an anonymous reviewer pointed out, duration varies as a function of speech rate. For this reason, each individual's rate of articulation (i.e. number of syllables per speaking time) was calculated using a Praat script that automatically detects syllable nuclei and measures speech rate (de Jong & Wempe 2009). Measurements of articulation rate (rate over uninterrupted speech; that is, excluding pauses) show that the youngest age group speaks the fastest with a mean rate of 4.65 ($sd = 0.68$), whereas means for the other groups are 4.36 ($sd = 0.66$; 20–29 age group), 4.49 ($sd = 0.75$; 30–45 age group) and 3.39 ($sd = 0.62$; 45+ age group).

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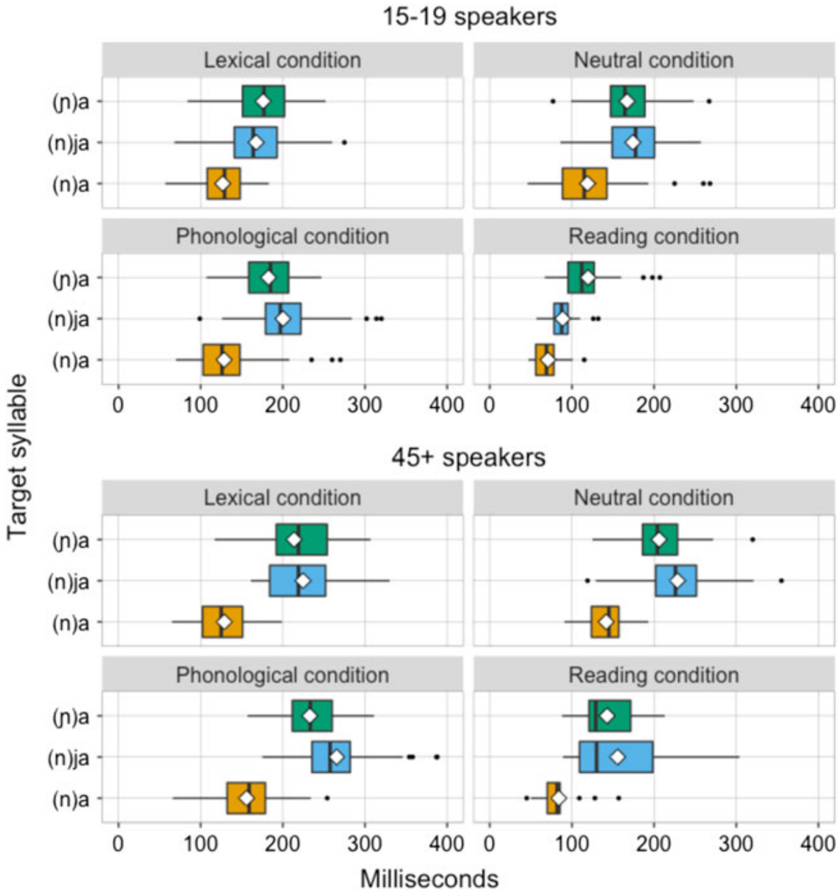

Figure 4 Duration of the vocalic portion in milliseconds broken by target syllable and task for the 15–19 and 45+ age groups. Diamonds represent mean values.

plots production differences across tasks for the two speaker groups that exhibit the largest differences, the youngest and the oldest speakers. For the 15–19 age group, in the reading and lexical conditions, the vocalic portion for /ɲ/ is longer than for /nj/. However, in the neutral and phonological conditions, the reverse trend is found. The oldest age group, on the other hand, presents longer vocalic portions for /nj/ across all task conditions, and it is in the neutral and phonological conditions where differences between /ɲ/ and /nj/ become larger. The neutral and phonological conditions include target nonce words, which may have drawn attention to the phonological target, causing the findings for the neutral condition to pattern with the phonological condition. These results suggest that when attention is drawn to the target (by the use of nonce words or a phonological contrast), acoustic differences are enhanced, especially for older speakers.

5.2 Time-varying formant analysis

This section presents the analysis of formant contours. One way of establishing where and how formant curves differ is by plotting the results of SSANOVA using confidence intervals – statistical significance is indicated by non-overlapping confidence intervals. A first graphical representation showed that the 95% confidence intervals were tight around the smoothing spline, which made visual inspection of the results much more difficult. For this reason,

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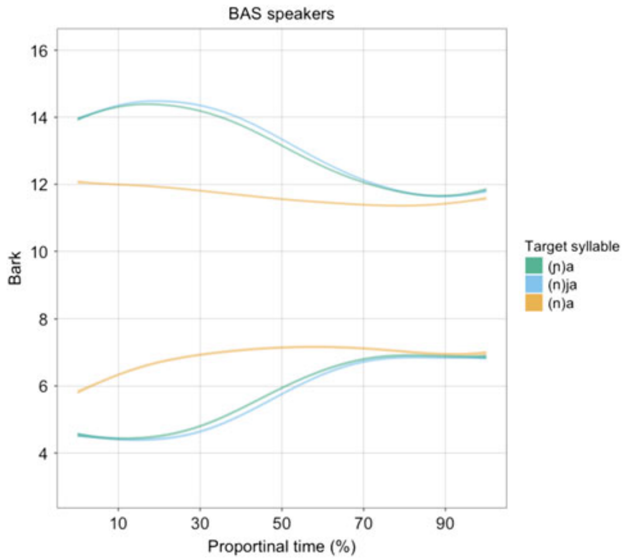

Figure 5 Smoothing Spline ANOVA of formant trajectories in the vocalic portion for all BAS speakers.

figures presented in this section do not include the smoothing splines, but rather only plot the 95% confidence intervals. Width of confidence intervals is represented by the thickness of the lines.

For /ɲ/ and /nj/ to be acoustically different, the F1 'valley' for /ɲ/ is expected to be lower than that for /nj/, and the opposite for F2: a higher F2 'peak' for /ɲ/. Additionally, the temporal lag to these landmarks should be different across /ɲ/ and /nj/. In particular, /ɲ/ should exhibit shorter lags than /nj/ to both F1 and F2. With these predictions in mind, results of the SSANOVA are presented in Figure 5. Between 20% and 60%, trajectories do not overlap, with syllables containing /nj/ presenting a lower F1 and a higher F2. With regard to the temporal structure, the points at which both categories reach highest and lowest formant readings also diverge. When the target syllable is /nj/, highest F1 reading and lowest F2 readings are reached later than with /ɲ/. However, acoustic differences between categories are very small. In contrast, /n/ trajectories are statistically significant from /nj/ and /ɲ/ in all cases. Since the focus of the current study is the contrast between /ɲ/ and /nj/, the /n/ trajectories will not be discussed further. Differences per speaker group and task condition are explored in the next two subsections.

5.2.1 Speaker groups

Figure 6 compares the age groups. Age groups 15–19 and 30–45 (Figures 6a and 6c) present no statistical differences between formant contours of /nj/ and /ɲ/. For the 20–29 age group (Figure 6b), formant trajectories of /nj/ or /ɲ/ present non-overlapping confidence intervals between 10% and 60% of the vocalic portion, in the expected trend (i.e. lower F1 and higher F2 readings for /nj/). Speakers in the oldest age group (45+), on the other hand, produce trajectories that do not overlap throughout 20% and 80% of the duration of the vocalic portion (Figure 6d). One salient difference between these two age groups relates to timing characteristics of formant trajectories. For the older age group, /nj/ reaches the F1 minimum at 20% and the F2 maximum at 30%, while /ɲ/ arrives at those landmarks at 10% (for F1) and 20% (for F2). Additionally, /nj/ presents a plateau-like portion in F1 between 5% and 20% of the vocalic portion. No such plateau is observed for /ɲ/. The 20–29 age group, on the other hand, presents this plateau for both /ɲ/ and /nj/, albeit diverging formant readings.

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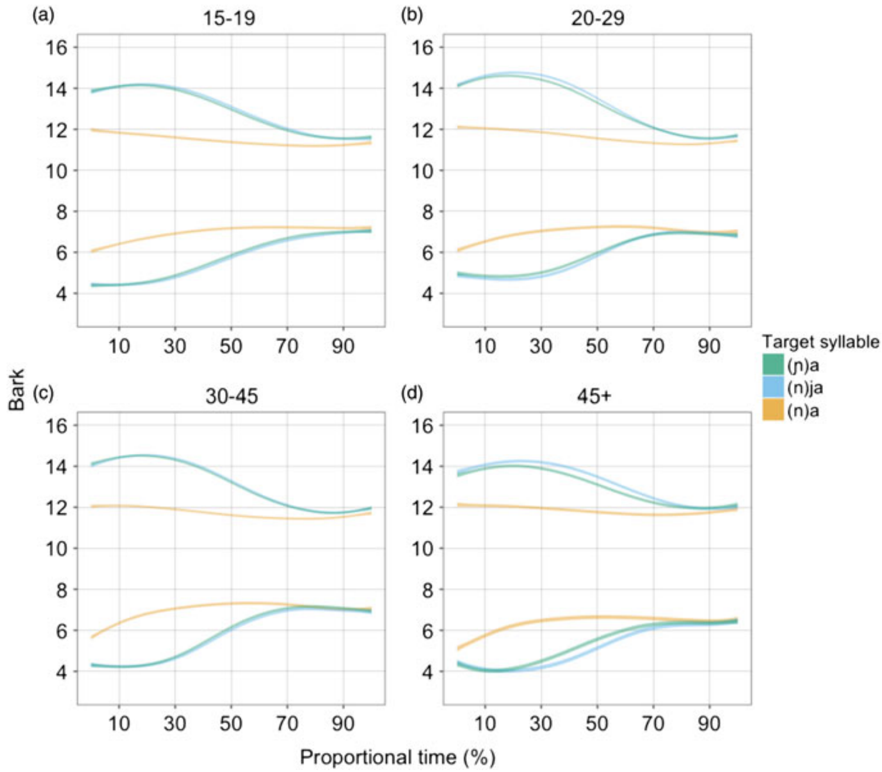

Figure 6 Smoothing Spline ANOVA of formant trajectories in the vocalic portion by age group.

In terms of gender, when all age groups and task conditions are pooled together, no production differences are observed along this acoustic dimension between groups. When males and females within each age group are compared, we find that it is the women in the 20–29 age group and the men in the 45+ group who show more robust differences between /nj/ and /ɲ/ in formant contours. Figure 7 compares men and women in these two age groups. For 45+ women, confidence intervals run adjacent – yet not overlapping – between 30% and 60% of the vocalic portion (Figure 7c). Older males, on the other hand, present much larger acoustic differences (Figure 7d). First, formant readings follow the trend of lower F1 and higher F2 with /nj/, with a difference between trajectories in the order of 0.5 Bark when they are most different. In terms of the time-course of formant contours, F1 raising starts at 10% of the vocalic portion for /ɲ/, but at 20% for /nj/. F2, on the other hand, reaches its maximum reading at approximately 30% of the vocalic portion for /nj/, but earlier for /ɲ/. No such difference is observed among the 45+ females. Men in the 20–29 age group show overlapping formant contours. For women in this age group, differences surface in overall Bark readings (Figure 7a). Similar to the older male group, women in the 20–29 group present a lower F1 and a higher F2 for /nj/ and confidence intervals of formant trajectories do not overlap between 10% and 60% of the vocalic portion. But differences between /nj/ and /ɲ/ in the temporal domain are not stark: both categories reach their F1 minimum and their F2 maximum roughly at the same time.

5.2.2 Task condition

The findings for the effect of task condition indicate that, in the reading condition, /nj/ and /ɲ/ present extensive acoustic overlap. In the focus conditions, findings reveal spectral

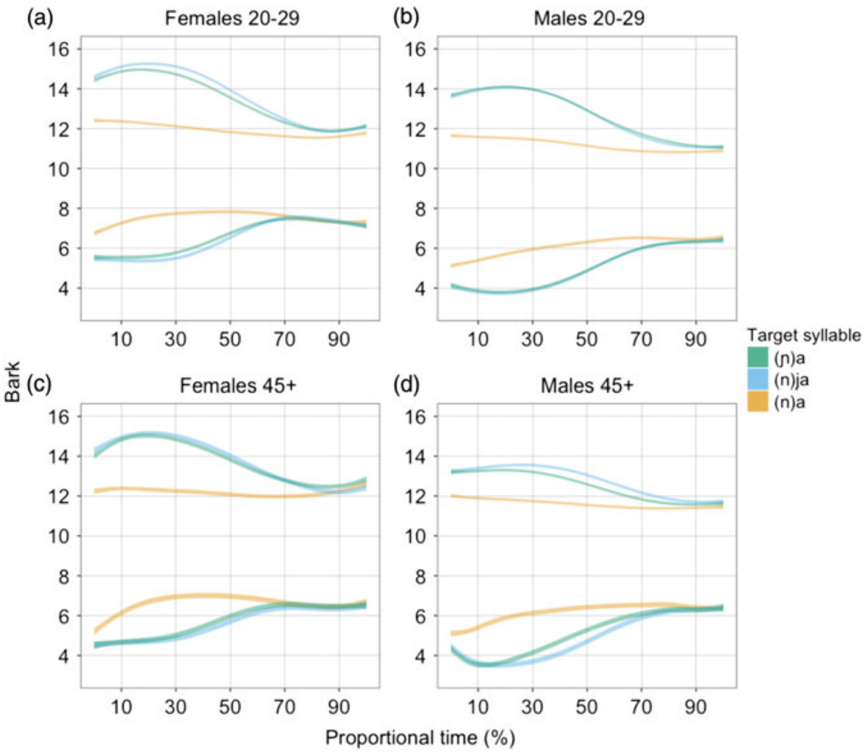

Figure 7 Smoothing Spline ANOVA of female and male speakers' formant trajectories in the vocalic portion in the 20–29 and 45+ age groups.

changes and vowel space expansion, a known result of hyperarticulation, though overall acoustic differences between /ɲ/ and /nj/ are small. The effect of task is explored further for the two speaker groups for whom the contrast between /ɲ/ and /nj/ may be available: the females in the 20–29 age group and males in the 45+ group (see Figure 8). In the reading condition, formant trajectories overlap throughout the duration of the vocalic portion for both participant groups (Figures 8a and 8e). For the women in the 20–29 age group, F1 and F2 show adjacent but non-overlapping confidence intervals in the lexical condition, and acoustical differences between /ɲ/ and /nj/ increase, especially in the F2 domain, in the neutral and phonological conditions. Regarding the older males group, in the focus conditions, the production of /ɲ/ exhibits a much earlier F1 rise and F2 fall; for F1, starting as early as 10% of the vocalic portion, and for F2, at 20%. The difference in timing of formant minimums and maximums is especially visible between 10% and 30% of the vocalic portion in the neutral and the phonological conditions (Figures 8f and 8g). Another key difference between /ɲ/ and /nj/ for this age group is the fact that, in the focus conditions, the F1 trajectory for /nj/ exhibits a plateau-like state between 5% and 30% of the vocalic portion. The (alveolo)palatal nasal, on the other hand, does not exhibit such plateau. Thus, this group of participants establishes a contrast along this acoustic domain, and this contrast is enhanced when they are prompted to focus on the phonological target.

5.3 Static point formant analysis

Finally, in order to confirm the results of the SSANOVAs, an analysis of formant measures at static points was carried out. For this purpose, the minimum reading of F1 ($F1_{min}$) and the maximum reading of F2 ($F2_{max}$) during the first half of the vocalic portion were located, and

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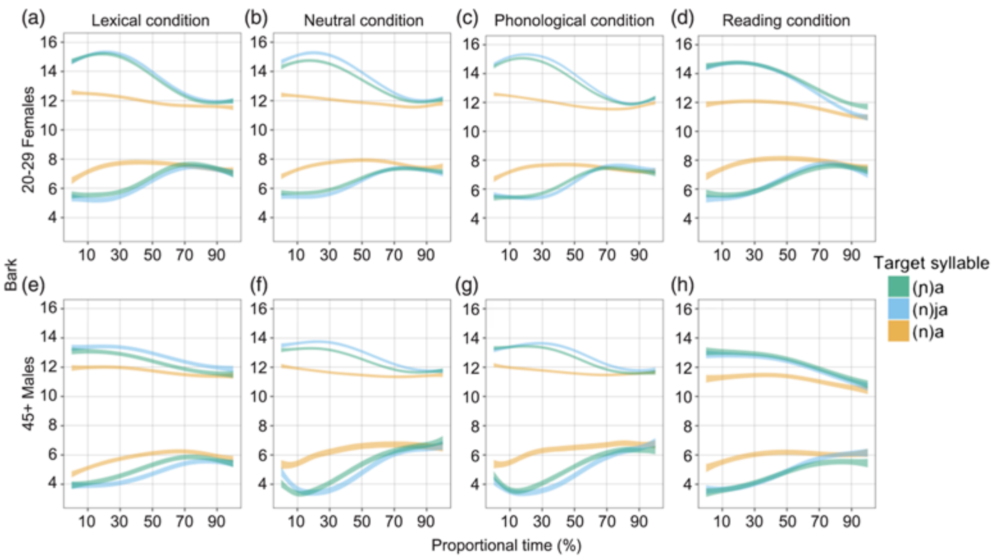

Figure 8 Smoothing Spline ANOVA of formant trajectories in the vocalic portion for females in the 20–29 age group and males in the 45+ age group (rows), by task (columns).

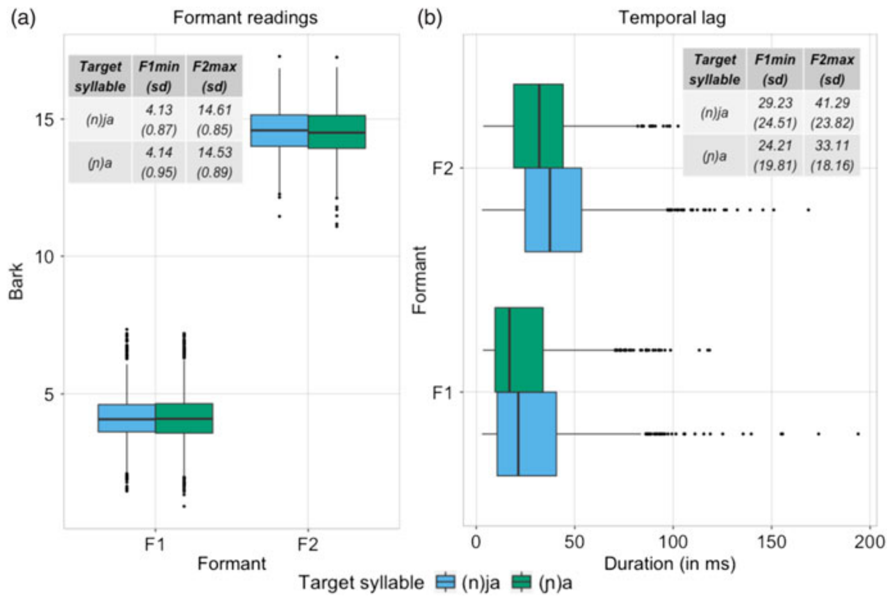

Figure 9 $F1_{min}$ and $F2_{max}$ formant readings (in Bark) and temporal lags (in milliseconds). The values in the table are raw averages and standard deviations (*sd*) that have not been adjusted by the statistical model.

the time stamp on these landmarks was extracted. Next, the temporal lag between onset of the vocalic portion and the moment at which $F1_{min}$ and $F2_{max}$ were reached was calculated. The analysis presented here compares formant readings (in Bark) and temporal lags (in milliseconds). Data is presented in Figure 9 (descriptive statistics are embedded in the figure). Findings for formant readings for temporal lags are divided and presented in the next two subsections.

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5.3.1 $F1_{min}$ and $F2_{max}$

Overall, the findings confirm the analysis of the formant trajectories with SSANOVA. $F1_{min}$ and $F2_{min}$ mean values follow the predicted trend (lower $F1_{min}$ and higher $F2_{max}$ for /ɲ/), but Bark differences between $F1_{min}$ and $F2_{max}$ across categories are negligible, with values falling well below JNDs for formant readings (Just Noticeable Differences; Kewley-Port & Watson 1994, Kewley-Port & Zheng 1999, Kewley-Port 2001).[8] Significant main effects for task conditions and gender indicate that (i) $F1_{min}$ is lower and $F2_{max}$ higher in the focus conditions than in the reading condition, with the phonological focus condition exhibiting the lowest (for $F1_{min}$) and highest (for $F2_{max}$) readings, and (ii) women exhibit higher formant readings, for both $F1_{min}$ and $F2_{max}$ (see Tables A2 and A3 in the appendix for summary statistics for $F1_{min}$ and $F2_{max}$, respectively). These findings indicate that, when attention is drawn to the target, the vowel space is expanded, consistent with descriptions of hyperarticulated speech (Lindblom 1990). In terms of gender, since the vocal tract is expected to be shorter for women than for men, formant readings are higher. Thus, these findings connect with our understanding of more emphatic speech and anatomical differences, but indicate that differences in minimum and maximum formant readings do not index the contrast between /ɲ/ and /nj/.

Statistical interactions show nuanced patterns of variation. A significant interaction between target syllable, task condition and age group for $F1_{min}$ shows that the relationship between /ɲ/ and /nj/ is not consistent across age groups or tasks. For example, the 20–29 and 45+ age groups present higher $F1_{min}$ for /ɲ/, consistent with our predictions, except in the phonological condition (for the 20–29 group) and in the neutral condition (for the 45+ group) where there are no differences between /ɲ/ and /nj/. $F2_{max}$, instead, presented a significant three-way interaction between target syllable, gender and age group, which shows that women in the 20–29 age group and the males in the 45+ group present the least overlapping distributions of $F2_{max}$ between /ɲ/ and /nj/. Taken together, and much like with SSANOVAs, these results indicate that $F1_{min}$ and $F2_{max}$ differences between /ɲ/ and /nj/ surface with some speaker groups. Additionally, these results confirm previous findings that task condition leads to more emphatic speech.

5.3.2 Temporal lag

Concerning temporal lags, the predicted trend also obtains: /ɲ/ presents a shorter lag to $F1_{min}$ and $F2_{max}$ than /nj/. The statistical analysis of the temporal lag to $F1_{min}$ reveals significant main effects for task condition, gender and age group. $F1_{min}$ shows a longer temporal lag (i) in focus conditions, with the phonological focus condition exhibiting the longest lags, (ii) for the women, and (iii) for older speakers (see Table A4 in the appendix for summary statistics). Target syllable does not surface as a statistical main effect, but does as part of a number of significant interactions. The findings reveal that the difference between /ɲ/ and /nj/ is enhanced in the phonological condition, and more so for the 20–29 and 45+ age groups –especially among the men in the latter age group.

With regard to the temporal lag to $F2_{max}$, statistical main effects for target syllable provide statistical confirmation that /nj/ presents longer temporal lags than /ɲ/ (see Table A5 in the appendix for summary statistics). Furthermore, significant results for task condition and age group indicate that (i) focus conditions and (ii) increasing age lead to longer lags, with longest lags being produced in the phonological condition and among oldest speakers. Additionally, the analysis reveals a statistical three-way interaction, between task condition, gender and age group, which indicates that, overall, women produce shorter lags for $F2_{max}$, exceptfor the

[8] JND, or 'just-noticeable difference', represents the amount something, Bark in this case, must change in order for a difference to be noticeable.

15–19 age group. Differences between women and men are greatest in the 45+ age group, but these differences do not pertain to the contrast between /ɲ/ and /nj/. All in all, the findings of the static point formant analysis confirm the results of the SSANOVAs.

6 Discussion

This study was motivated by the reports of merger between /ɲ/ and /nj/ and the lack of studies examining phonetic overlap between the two in particular. The analysis of the speech of 33 BAS native speakers presented here reveals extensive phonetic overlap between /ɲ/ and /nj/, though small (yet statistically significant) acoustic differences are observed. The findings indicate that the vocalic portion for /nj/ is longer than that of /ɲ/. In terms of formant contours, overall, F1 is lower and F2 higher for /nj/, with formant trajectories diverging during a part of the vocalic portion. Additionally, /nj/ presents longer lags to the F1 minimum and F2 maximum. Taken together, these findings are in line with Martínez Celdrán and Fernández Planas' (2007) description of /nj/ presenting a 'full glide'. But the extensive acoustic overlap between /ɲ/ and /nj/ suggests that for most speakers /ɲ/ and /nj/ are merged or near-merged, and that for /ɲ/ they are producing two non-simultaneous gestures, a (probably alveolar) nasal consonant with a delayed palatal constriction, parallel to speakers in Kochetov & Colantoni (2011), who produced the (alveolo)palatal nasal as two non-simultaneous constrictions, alveolar and dorsal.

Small deviations in pronunciation may lead to changes in the sound structure of a language, and in this particular case, a specific dialect. By decomposing the articulatory gestures, the patterns of co-articulation that lead to the emergence of palatal segments are still active in some dialects, to the extent that may bring dephonologization of /ɲ/. In doing so, the patterns uncovered here speak more broadly as to processes that have been known to affect (alveolo)palatal nasals in other Romance languages, such as French and some varieties of Italian where /ɲ/ has also been described as reanalyzed as /nj/ (Simon 1970; Walker 1984: 98; Gess, Lyche & Meisenburg 2012: 5; Ledgeway 2016). In terms of dialectal relevance, the palatal obstruent is not the only palatal phoneme undergoing sound change in BAS. However, the situation is more complex than suggested by the previous reports of merger. Much like the devoicing of /ʒ/, the production of /ɲ/ and /nj/ shows group differences, with older males exhibiting greater acoustic differences. Additionally, drawing attention to the phonological target increased acoustic differences between categories, especially for the speaker groups that contrast /ɲ/ and /nj/ (i.e. women in the 20–29 group and the men in the 45+ group).

6.1 Phonetic facts and the phonemic inventory in BAS

The extensive acoustic overlap between the categories examined herein can be taken as symptom of the underlying reorganization of the phonological system. Speakers produce /ɲ/ and /nj/ with overlapping distributions because they have merged for the majority of speakers. The comparison between speaker groups that produced a contrast between /ɲ/ and /nj/ (i.e. the men in the 45+ age group) and speaker groups that did not (i.e. age groups 15–19 and 30–45; see below for a discussion of differences across speaker groups) suggests that the sound change is /ɲ/ > /nj/ (refuting Malmberg 1950 and confirming Kochetov & Colantoni 2011). In order to address the issue of phonological reorganization, two interconnected issues should be considered, as follows.

The first relates to how phonetic facts connect to change in syllable structure. While this study has not examined articulatory data, the findings of the acoustic analysis provide evidence that for some speakers /ɲ/ is produced in two non-(quasi)simultaneous gestures. The decomposition of /ɲ/ constitutes a language-internal mechanism, caused by structural aspect of the language, in this case the reorganization of the articulatory gestures involved. Our interpretation of these facts is that the majority of the speakers surveyed have assigned independent status to the [j]-element at the release of the (alveolo)palatal [ɲ]. As a result, /ɲ/ has invaded the acoustic space of /nj/, and not the opposite. Speakers reinterpreted syllable structure: the CV (i.e. /ɲa/) is now CV_1V_2(/nja/), where V_1 is realized as a ('full') glide, [j]. Thus, [j], which was originally part of the onset consonant, is now interpreted as a full segment and part of the nucleus of the syllable and is produced as such. For these speakers, it may be more appropriate to talk about /nj/ than /ɲ/ for the phonemic inventory (see Colantoni & Hualde 2013: 32).

The second issue to consider is how this merger may impact the contrast with /n/. In the case of speakers decoupling the gestures into [n] and [j] in their realization of the (alveolo) palatal nasal, the contrast between minimal pairs such as *moño* /móɲo/ 'bow of ribbon' and *mono* /móno/ 'monkey' would still obtain. Speakers would produce the first lexical item as [mónjo] and the second one as [móno], and contrast would not be lost. Since there are no minimal triplets that contrast /ɲ/, /n/ and /nj/ (*moño* vs. *mono* vs. **monio*),[9] contrast between the (alveolo)palatal nasal and the alveolar nasal still obtains. Concerning other phonological contexts, there is the potential for loss of contrast with /n/, particularly with minimal pairs of the form /ɲi/–/ni/ (e.g. *cañita* 'little sugar cane' vs. *canita* 'little fishing rod'). With high-front vowels, the (alveolo)palatal nasal cannot merge with /nj/. If the (alveolo)palatal nasal decomposes into an alveolar nasal and a glide, the result would be */nji/ (with the two vocoids in the same syllable), which has been judged inadmissible by Spanish phonologists (Hualde 2014: 64–72). Thus, in some areas of the lexicon, the (alveolo)palatal nasal may have merged with the alveolar nasal and, in other areas, the distinction is maintained. While this study presents evidence that /ɲ/ is missing from the phonemic inventory of speakers of BAS, there is yet much to learn about how the whole system may have been reorganized. This is a question for future research.

6.2 Group differences

One of the key findings of this study is that acoustic differences between /ɲ/ and /nj/ surface when differences among groups are examined. Different parallels with the social distribution of devoicing of /ʒ/ can be drawn. At first blush, the fact that gender was not a statistical main effect, while age group was, suggests that variation in the production of /ɲ/ and /nj/ mirrors the current sociolinguistic patterns of devoicing of /ʒ/, where production varies as a function of age (and not gender; Chang 2008; Rohena-Madrazo 2013, 2015). However, gender becomes significant when considering the interactions: gender does play a role for /ɲ/ > /nj/, but only for the older age group. These findings indicate that the merger between /ɲ/ and /nj/ is more advanced for women than for men. Thus, these patterns are reminiscent, not of current sociolinguistic distributions of devoicing of /ʒ/, but the earlier ones. Both Fontanella de Weinberg (1978) and Wolf & Jiménez (1978) found that females devoiced /ʒ/ with greater frequency than males, and more so among younger generations. Thus, a plausible interpretation is that /ɲ/ > /nj/ is following the path of /ʒ/ > [ʃ].

But a grain of caution in necessary when comparing ɲ/> /nj/ and /ʒ/ > [ʃ]. Decoupled productions of /ɲ/ invade the space of /nj/ and, potentially that of /n/. For devoicing of /ʒ/, on the other hand, change in place of articulation (from palatal to postalveolar) has

[9] The only exception is *caña* 'fishing rod' vs. *cana* 'white hair' vs. *cania* 'nettle'. Nevertheless, *cania* is a word with extremely low frequency (*ortiga* is more commonly the translation to English used for 'nettle'). Anecdotally, the author, a native speaker of Spanish, learned of the existence of the triplet only recently, while writing the research report presented here.

been completed for generations, and later productions of /ʒ/ as [ʃ] did not invade the phonetic space of other phonemes. As such, the focus of this sociolinguistic work has been variation among allophonic forms, and not between phonological categories as is the case of /ɲ/ > /nj/. Taken together, /ɲ/ > /nj/ and /ʒ/ > [ʃ] suggest that it is not only how the nasal system may have reorganized in this particular dialect, an examination of the palatal system more broadly merits examination. Additionally, the nuanced patterns of group differences uncovered in this study point to the need of additional sociolinguistic work.

We will now comment on the one female group that produced acoustical differences between /ɲ/ and /nj/: the women in the 20–29 age group. While their SSANOVAs present non-overlapping trajectories, the duration of the vocalic portion and temporal lag to formant landmarks show no such differences between /ɲ/ and /nj/. These findings question the extent to which the acoustical differences index a contrast between /ɲ/ and /nj/. The mismatch between spectral and durational findings (unlike the men in the 45+ age group) suggests that 20–29 women are hyperarticulating (e.g. they exhibit enlarged vowel space), but these production pressures do not necessarily implement differences between /ɲ/ and /nj/.

One issue that the present study was unable to examine relates to the evaluation of the phonological variable. In Section 6.1, we argued that the merger between /ɲ/ and /nj/ is driven by a language-internal mechanism and, as such, could be interpreted as 'change from below'. In this type of sound change females tend to lead and the variable is not overtly prescribed, as attention to form is unlikely to induce a style shift (Labov 2001). The findings of this study offer evidence that women do in fact lead sound change in the merger of /ɲ/ and /nj/ in BAS, but whether it is prescribed or not is yet to be determined. Presently, there is no evidence in previous research that the decoupled /ɲ/ carries social marking, whether positive or negative. At the same time, there have been instances in Argentine pop media that have drawn attention to the decoupled realizations. For example, Figure 10 presents screen captures from a regular sketch in the comedy show, *Todo por dos pesos* 'Everything for $2', broadcast during the 1990s. In this sketch, the comedian in the suit would correct the speech of the comedian in the white T-shirt, who was meant to represent the Argentine accent. In Figure 10, the speech feature under fire is the contrast examined here. The show uses Spanish orthography to represent the decoupled (alveolo)palatal nasal as <nia> and the (alveolo)palatal nasal proper as <ñ> in the word *mañana* 'morning'.

While the present study has not been designed to examine the underlying mechanisms of sound change, the findings offer partial evidence that it is a case of change from below and lay out ways to examine the merger with acoustic data from other speaker populations in the community. More broadly, given that decoupling of /ɲ/ is not exclusive to Spanish (Simon 1970, Walker 1984, Gess et al. 2012, Ledgeway 2016), and it has also been described in other dialects (e.g. Yucatán Spanish, by Alvar López 1969; Judeo-Spanish, by Sala 1974; northern Morocco Spanish, by Scipione & Sayahi 2005), the research reported here can be extended by examining group differences in these dialectal regions as well.

Figure 10 Screen captures from TV show *Todo por dos pesos* highlighting possible realizations of the word *mañana* 'morning'.

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6.3 Task condition

One last but important aspect of the project examined differences in the production of /ɲ/ and /nj/ according to task condition. When more attention is drawn to the target, acoustic distance can be enhanced. If the two phonological categories are contrastive, variation across task conditions would highlight the relevant acoustic differences. Differences according to task condition reveal that as attention is drawn to the target word, speakers are more emphatic and hyperarticulate. Had focus not been manipulated, these differences would have not been uncovered.

One of the observed patterns is that speakers produce longer segments, with greater spectral differences, in the neutral, lexical and phonological conditions than in the reading condition. As focus to form increases, participants articulate more slowly (and carefully); they speak more emphatically. However, for most speaker groups, these differences surface as longer durations and enlarged vowel spaces. That is, acoustic differences between /ɲ/ and /nj/ do not necessarily increase with this hyperarticulation. Categories still present overlapping distributions both in duration of the vocalic portion and in formant trajectories. This is especially true for the comparison of the production of men and women. Gender was not a significant main effect, but the interaction with task revealed that men and women were behaving differently across tasks, and not necessarily with regard to the realization of the contrast between /ɲ/ and /nj/. When more careful speech was elicited, as is the case with the focus conditions, the female speakers exhibited more emphatic production, which suggests that women were more sensitive to the effect of task. The comparison of age groups, however, shows that some speaker groups can enhance the acoustic differences between /ɲ/ and /nj/ when the conditions for hypearticulation are created: the females in the 20–29 age group and the males in the 45+ age group. One crucial difference between these two groups is that the men in the 45+, in addition to producing spectral differences, also produce greater temporal differences.

Task differences also provide some evidence for our position that the merger between /ɲ/ and /nj/ constitutes ‘change from below’. Differences across task conditions can be interpreted as differences across speech styles, or style shift. In situations of sound changes driven by language-internal mechanisms, speakers often do not exhibit production differences according to speech style, since variation is operating below the level of awareness. Differences according to task condition, for most speakers, do not enhance acoustic differences between /ɲ/ and /nj/, evidence that also points in the direction of a sound change coming from within the linguistic system and not overtly prescribed.

The fact that in the phonological and the neutral conditions differences between /ɲ/ and /nj/ were more robust in the analysis of formant trajectories deserves comment. The appendix includes figures with duration (Figure A1) and formant contours (Figure A2) per target syllable according to lexical status of the word (real vs. nonce). Recall that in the neutral condition participants focused on an item that was not semantically or phonologically related to the target word. However, the researcher noticed that with the carrier phrase *Ella dijo* [target word]*, no él* ‘She said [target word], not him’, participants often paused before the target word, which made them focus on this item in addition to the intended focus in the sentence (*ella* ‘she’). This may be due to several reasons. One possibility is that in the phonological and neutral conditions participants had nonce words, as opposed to the real words offered in the lexical condition and the reading task. Additionally, in order to make stress patterns explicit, in some cases the orthography used did not follow Spanish orthographic rules with regard to placement of diacritical marks. Thus, it is possible that because the stimuli were not real words and infringed orthographic rules, they might have drawn the attention of the participant. As a result, participants may have focused on the target word, even though the carrier phrase was aimed at producing the opposite effect. Thus, the enhanced contrast between /ɲ/ and /nj/ may be a consequence of the lexical status of the stimuli, given that the nasal and neutral conditions included tokens that were not real words.

Another possibility is that this effect is a consequence of the procedure. Before producing target words in the focus conditions, participants had completed the reading task, in which they were not required to focus on any targets. The neutral condition was the first participants received in the carrier phrase task. As a result, this might have made participants more aware of the target and more inclined to focus on it. Alternatively, it may also be due to the repetitive nature of the procedure. As participants repeated carrier phrases, they may have ceased to focus on the whole utterance and focused instead on the target item. All in all, these results suggest that when the task condition drew attention to the target item (by the use of nonce words or a phonological contrast), the contrast between /ɲ/ and /nj/ was enhanced, and more so among the speakers who produced greater differences between the categories – i.e. older male speakers.

7 Final remarks

The study presented here examined the production of /ɲ/ and /nj/ by 33 native speakers of Buenos Aires Spanish following reports of merger. The analysis of the duration and the formant contours in the vocalic portion tautosyllabic with the nasal consonant suggests that, for the majority of speakers in the corpus, the palatal constriction in /ɲ/ was delayed, and as a result its production overlapped with that of /nj/. However, for the men in the 45+ age group, drawing attention to the phonological target by manipulating focus enhanced the acoustic differences between the categories. On a descriptive level, this study provides details of the phonetic underpinnings of variation in the realization of a palatal consonant other than the palatal obstruent. The analysis presented here more fully describes the merger between /ɲ/ and /nj/ and the implications for the phonemic inventory of BAS, and offers a view of how the data speak to broader issues of variation and sound change, suggesting that this particular merger is a language-internal mechanism.

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Appendix. Additional material

Table A1 Experimental items.

Target syllable	Real words	Nonce words
/ɲa/	*maña* 'skill'	páña
	caña 'fishing rod'	fáña
/nja/	*Alemania* 'Germany'	pánia
	Tania personal name	fánia
/na/	*semana* 'week'	pána
	rana 'frog'	fána

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Table A2 RM ANOVA results with target syllable and task condition as within-subject variables, and gender and age group as between-subject variables, and $F1_{min}$ as dependent variable.

Independent variable	*F* statistic	*p*	partial-η^2
Target syllable	$F_{(1,\ 2.26)} = 0.16$	n.s.	0.01
Task condition	$F_{(2.12,\ 11.82)} = 15.35$	*	0.38
Gender	$F_{(1,\ 71.58)} = 21.04$	*	0.46
Age group	$F_{(3,\ 71.58)} = 0.81$	n.s.	0.09
Interaction term			
Task condition * Target syllable * Age group	$F_{(5.16,\ 6.97)} = 2.71$	*	0.25

* = statistically significant; n.s. = not significant.

Table A3 RM ANOVA results with target syllable and task condition as within-subject variables, and gender and age group as between-subject variables, and $F2_{max}$ as dependent variable.

Independent variable	*F* statistic	*p*	partial-η^2
Target syllable	$F_{(1,\ 1.77)} = 0.015$	n.s.	0
Task condition	$F_{(2.53,\ 10.9)} = 22.77$	*	0.48
Gender	$F_{(1,\ 33.69)} = 68.78$	*	0.73
Age group	$F_{(3,\ 33.69)} = 1.22$	n.s.	0.13
Interaction term			
Target syllable * Gender * Age group	$F_{(3,\ 1.77)} = 3.83$	*	0.31

* = statistically significant; n.s. = not significant.

Table A4 RM ANOVA results with target syllable and task condition as within-subject variables, and gender and age group as between-subject variables, and temporal lag to $F1_{min}$ as dependent variable.

Independent variable	*F* statistic	*p*	partial-η^2
Target syllable	$F_{(1,\ 7393.21)} = 3.20$	n.s.	0.11
Task condition	$F_{(2.62,\ 46572.70)} = 10.33$	*	0.29
Gender	$F_{(1,\ 68166.85)} = 6.41$	*	0.20
Age group	$F_{(3,\ 68166.85)} = 3.63$	*	0.30
Interaction term			
Task condition * Gender	$F_{(2.62,\ 46572.70)} = 5.09$	*	0.17
Task condition * Target syllable	$F_{(2.36,\ 24799.70)} = 6.7$	*	0.21
Task condition * Target syllable * Age group	$F_{(7.08,\ 24799.70)} = 3.15$	*	0.27
Task condition * Target syllable * Gender * Age group	$F_{(7.08,\ 24799.70)} = 4.15$	*	0.33

* = statistically significant; n.s. = not significant.

Table A5 RM ANOVA results with target syllable and task condition as within-subject variables, and gender and age group as between-subject variables, and temporal lag to $F2_{max}$ as dependent variable.

Independent variable	*F* statistic	*p*	partial-η^2
Target syllable	$F_{(1,\ 12,732.73)} = 6.15$	*	0.20
Task condition	$F_{(2.65,\ 84,742.26)} = 7.19$	*	0.22
Gender	$F_{(1,\ 35,235.24)} = 0.43$	n.s.	0.02
Age group	$F_{(3,\ 35,235.24)} = 5.72$	*	0.41
Interaction term			
Task condition * Gender * Age group	$F_{(7.95,84,742.26)} = 2.51$	*	0.23

* = statistically significant; n.s. = not significant.

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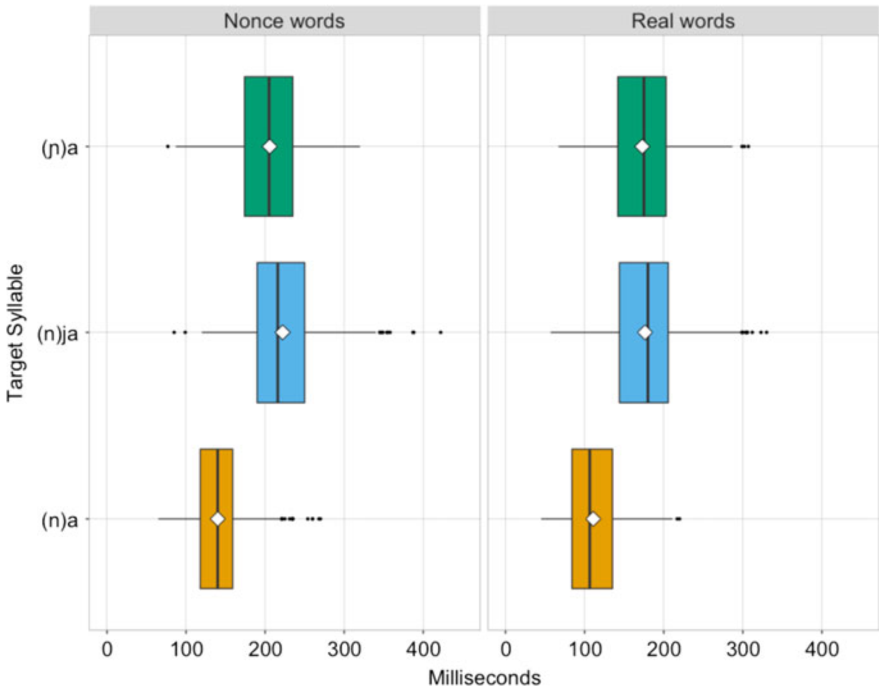

Figure A1 Duration of the vocalic portion by lexical status of the target word (nonce vs. real). Diamonds represent the mean.

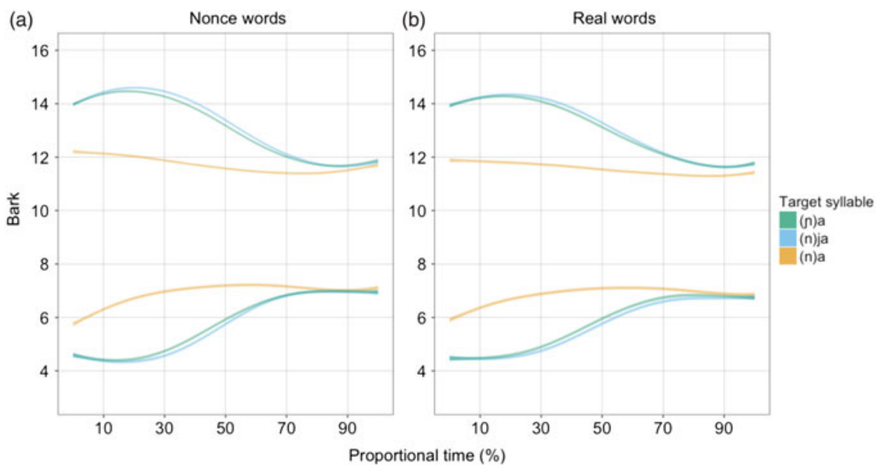

Figure A2 Smoothing Spline ANOVA of formant trajectories in the vocalic portion by lexical status of the target word (real vs. nonce words).

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