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## **Spanish phonology in contact with Catalan**

On implementations of gradience and discreteness in the study of sociolinguistic variation of laterals

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This study investigates sociophonetic variation in the production of the alveolar lateral /l/ in Catalan and Spanish, the velarization of which is considered the hallmark feature of Catalanian Spanish (Arnal, 2011; Casanovas Català, 1995; Hickey, 2012). Using an innovative combination of both gradient and categorical analyses to evaluate lateral production in Spanish and Catalan elicited from Catalan-Spanish bilinguals and Madrid monolinguals stratified by gender and exposure/usage of Catalan, we assess the degree to which lateral velarization pervades this contact setting. In so doing, we demonstrate that lateral velarization and the inventory of lateral categories in these languages are best approached using gradient and relative hierarchies of lateral darkness rather than discrete applications of intrinsically light [l] or dark [ɫ].

**Keywords:** Lateral velarization; Spanish-Catalan contact; Sociophonetics; Dark and light /l/; Bilingualism

## 1. Introduction

The Spanish spoken by Catalan-Spanish bilinguals, despite a well-documented history of language contact as early as the 12<sup>th</sup> century (Vallverdú, 1984, p. 16), has traditionally been the subject of fewer empirical linguistic studies than other (especially non-contact) Spanish varieties, and even Catalan (Galindo-Solé, 2003, p. 18). In order to shed further light on the continued evolution of this contact variety of Spanish, this study presents an empirical analysis of one particularly salient phonological feature of Catalan Contact Spanish (CCS), namely the velarization or darkening of the alveolar (i.e., ‘light’/‘clear’) lateral [l] to a velarized (i.e., ‘dark’) lateral [ɫ]. The Catalan velarized lateral, aptly used by Hickey (2012, p. 5) to exemplify the notion of *linguistic salience*, has been widely characterized as a (if not the) hallmark feature of CCS (Arnal, 2011; Casanovas Català, 1995; Prats, Rafanell, & Rossich, 1990; Sinner, 2002), indeed attested as the object of overt linguistic commentary by Spanish speakers within and outside of Catalan-speaking territories, who refer to it as *la ela/ele catalana* ‘the Catalan l.’

Beyond the many sociolinguistic contributions to be yielded by research on CCS [ɫ]

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production, given its likely status as a linguistic stereotype (Labov, 2001), especially in light of the current political tensions between Catalonia and the Spanish government that continue to bring Catalanian identities and ideologies to the forefront of speakers' daily lives (Woolard, 2016), the exploration of lateral production by Catalan-Spanish bilinguals additionally serves as a unique case study for phonetic variation and analysis. While several studies have explored lateral production in Spanish and/or Catalan as a gradient phenomenon measured on a continuous scale of velarization, others propose discrete, categorical thresholds for second formant values, in hertz (hz), between [l] and [ɫ], echoing a plethora of cross-linguistic research that classifies languages' lateral inventories as either consisting of one light lateral, one dark lateral, or both (see Section 2.3 for references).

We approach this conflict between, on the one hand, an understanding of lateral velarization as inherently gradient, with, on the other hand, an understanding of languages' lateral inventories as discretely light, dark, or both, by applying both gradient and categorical analyses to /l/ production in the Spanish and Catalan of a group of Catalan-Spanish bilinguals. In particular, we address the complexities of answering the question of whether or not a dark lateral indeed exists in CCS as a product of phonetic transfer or imposition (Van Coetsem, 2000) from Catalan, and argue that sociophonetic variation in this contact setting is best accounted for in terms of gradient velarization degrees rather than discrete categories of [l] and [ɫ].

This paper is structured as follows: Section 2 consists of a brief overview of the Catalan-Spanish contact setting, followed by a review of research involving lateral production, with particular emphasis on Spanish and Catalan. Section 3 discusses our research questions and hypotheses with respect to the analysis of lateral production in Barcelonan CCS. Section 4 details the experimental methodology and test instruments. Section 5 discusses data analysis

techniques and results from data collection. Section 6 offers a discussion of the results of the present study. Lastly, we conclude in Section 7 by offering directions for future study.

## **2. Assessments of lateral production in Spanish, Catalan, and other languages**

Though considered a minority language (Huguet, 2006; Strubell, 2001), Catalan shares co-official status with Spanish in Catalonia, and currently boasts an uncharacteristically high degree of societal usage and reported competence, with 2013 linguistic census data for Barcelona, the municipality with the lowest proportion of L1 Catalan speakers in Catalonia (Lleó, Cortés, & Benet, 2008, p. 186), reporting estimates of capacity for understanding, speaking, reading, and writing Catalan at over 94%, 80%, 83%, and 59%, respectively (Institut d'Estadística de Catalunya, 2014).<sup>1</sup> It should come as little surprise that in a situation of centuries-long language contact and modern widespread bilingualism, proclaimed contact innovations are abundant in both Romance languages spanning all grammatical domains (Arnal, 2011; Boix i Fuster & Vila i Moreno, 1998; Seib, 2001; Vann, 2000, 2001; Wesch, 1997).

The phonological variable under study in this investigation, namely lateral production,

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<sup>1</sup> These figures, all of which are notably above the 50% majority threshold, are in stark contrast to those just decades prior. The equivalent figure for capacity for understanding Catalan in Barcelona in 1975 was only 17% (Consorci d'Informació i Documentació de Catalunya, 1978, as cited in Arnal, 2011, p. 14), revealing the astonishing impact of language legislation and community support since the end of the Franco dictatorship (1939-1975), during which Catalan was effectively outlawed from public spheres (Vallverdú, 1984, p. 24).

was selected based on prior accounts of its sociolinguistic status and salience. Sinner (2002) conducted interviews in Barcelona and Madrid, asking speakers to explicitly report linguistic features of Catalans' Spanish of which they were aware. The only phonological feature identified by both Catalan-Spanish bilinguals and Madrid monolinguals was the 'Catalan-like' lateral (Sinner, 2002, p. 163). Madrid speakers additionally commented that the Spanish pronunciation of Catalan speakers was 'country-like,' 'strange,' 'harsh,' 'ugly,' and 'aggressive,' and given that the lateral was in fact the only phonological feature identified at all by the Madrid speakers, it may be inferred that these overt negative connotations are most strongly linked to this speech sound (Sinner, 2002, pp. 163, 165).<sup>2</sup> Additionally, with respect to the Spanish of Palma de Majorca, both Pieras (1999) and Simonet (2010) found that younger females used less Catalan-like laterals than males and than older females, consistent with an account of change from above (Labov, 2001) in which non-standard, more Catalan-like laterals are being avoided in response to an overt social stigma linking them with rurality, lower social class, and older speakers.

### *2.1 Lateral production in (monolingual) Spanish*

The only lateral phoneme shared by all Spanish varieties is the voiced alveolar /l/, which is articulated by moving the tongue tip to create an occlusion in the alveolar region, whilst allowing a non-obstructed stream of air around one or both sides of the tongue (Hualde, 2005, p. 178).

This lateral is often characterized as 'clear' or 'light' (i.e., non-velarized) in all linguistic

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<sup>2</sup> See also Davidson (2019) for a recent empirical confirmation, via matched guise and sociolinguistic interviews, of negative covert and overt attitudes toward the use of *la ela catalana* in Spanish.

contexts (Casanovas Català, 1995, p. 56; Recasens & Espinosa, 2005, p. 3; Schwegler, Kempff, & Ameal-Guerra, 2010, pp. 297-299). Velarized or dark productions of (monolingual) Spanish /l/ as [ɫ] are described as “*totalmente extraña a la lengua española*” ‘totally strange to the Spanish language’ (Schwegler, Kempff, & Ameal-Guerra, 2010, p. 299), echoing the prescriptive call for their avoidance by Navarro Tomás (1918, p. 88): “...[la lengua] *se hace ligeramente cóncava; pero sin llegar en ningún caso a la articulación hueca o velar de la l inglesa o catalana, cuyo uso debe evitarse cuidadosamente en español* ‘...[the tongue] is made slightly concave; but in no instance reaching the velar articulation of the English or Catalan l, whose use should be carefully avoided in Spanish.’ Acoustic characterizations of the prototypical Spanish lateral are most commonly made with respect to F2, inversely correlated with velarization (i.e., higher F2 values with less velarization, lower F2 values with greater velarization). Recasens and Espinosa (2005, p. 3) compiled a list of Spanish F2 values attested in a variety of studies across multiple linguistic contexts, the average of which is 1583 hz (ranging from a low of 1216 hz in the /ala/ context to a high of 2195 hz in the /ili/ context).

## 2.2 Lateral production in Catalan

The Catalan alveolar voiced lateral /l/ has been readily characterized as velarized in all linguistic contexts (Casanovas Català, 1995, p. 56; Prieto, 2004, p. 204; Recasens, 2004, p. 594, 2012, p. 371, 2014a, p. 20; Recasens & Espinosa, 2005, p. 3; Recasens, Fontdevila, & Pallarès, 1995, p. 38; Recasens & Pallarès, 2001, pp. 37, 47-48). This velarization is accomplished via an additional velar constriction resultant from tongue dorsum retraction toward the velum (Pieras, 1999, p. 213; Prieto, 2004, p. 204). Though acoustic characterizations of Catalan /l/ vary by

dialect, Recasens and Espinosa (2005, p. 3) compiled a list of Central (i.e., Barcelonan) Catalan F2 values attested in a variety of studies across multiple linguistic contexts, the average of which is 1106 hz (ranging from a low of 850 hz in the /ul/ context to a high of 1450 hz in the /ili/ context).

### *2.3 On the classifications and criteria for distinguishing light and dark laterals*

Both dialectological surveys and experimental studies of alveolar lateral production consistently invoke the notion of darkness with respect to a typology of alveolar lateral inventories in the world's languages, identifying three main types: (a) language varieties with a single light lateral category, such as Spanish, Italian, French, German, Danish, Czech, Hungarian, Swedish, Indian English, and Irish English; (b) language varieties with a single dark lateral category, such as Central Catalan, Majorcan Catalan, Russian, European Portuguese, Welsh, Leeds British English, and Australian English; and (c) language varieties with both a light and a dark lateral category, such as American English, British English Received Pronunciation, and Dutch (Bansal, 1990; Giles & Moll, 1975; Morris, 2017; Oxley, Roussel, & Buckingham, 2007; Recasens, 2004, 2012; Turton, 2014; Van Hofwegan, 2009). In the absence of any attested language that phonemically contrasts light and dark laterals, these language inventories are allophonic in nature. Distinct articulatory targets (i.e., the presence of both lateral categories) are referred to as *extrinsic* allophones of /l/, whereas any contextually conditioned variation in velarization degree (i.e., onset vs. coda position, coarticulation effects, etc.) for languages with a single lateral category or target is understood as *intrinsic* (Ladefoged, 1968, as cited in Recasens, 2012, pp. 369-370).



Thus, the basis for distinction between the categories of dark vs. light is grounded principally in discrete articulatory differences between each lateral, crucially constituting two unique articulatory targets rather than a single articulatory target whose small degree of variability, with respect to velarization degree, is conditioned by phonological context. While many articulatory accounts posit specific parameters for tongue configuration, others posit distinct orders and/or speeds of gestures, summarized below in Table 1 (crucially, note that the following articulatory distinctions are not posited to be mutually exclusive).

**Table 1.** Overview of articulatory accounts distinguishing light and dark laterals.

Basis for Articulatory Distinction	Light [l]	Dark [ɫ]	Relevant Literature
Tongue Dorsum Retraction	Absent	Present	Recasens, 1996, 2004; Stevens, 2000
Tongue Predorsum Height	High (No active lowering)	Low (Active lowering)	Recasens, 2012; Recasens, Fontdevila, and Pallarès, 1995; Recasens and Pallarès, 2001
Shape of Tongue Body; Tongue Tip Contact	Rigid; Present	Bunched; Absent	Bean, 2013; Pieras, 1999
Gestural Ordering	1) Consonantal apical 2) Vocalic dorsal	1) Vocalic dorsal 2) Consonantal apical	Sproat and Fujimora, 1993
Gestural Speed	Fast	Slow	Giles and Moll, 1975

As the acoustic manifestation of lateral velarization is not posited to vary based on which

(combination) of the aforementioned articulatory accounts is most accurate, we are able to unproblematically focus on the acoustic correlates of [l] vs. [ɫ], similarly summarized below in Table 2.

**Table 2.** Overview of acoustic correlates distinguishing light and dark laterals.

Basis for Acoustic Distinction	Light [l]	Dark [ɫ]	Relevant Literature
F2	High (>1500 hz)	Low (<1200 hz)	Martínez Celdrán and Fernández Planas, 2007; Pieras, 1999; Quilis, 1981; Recasens, 1991, 2012
Sensitivity to Syllable Position (Onset vs. Coda F2 Difference)	Strong	Weak	Recasens, 2012, 2014a; Recasens and Espinosa, 2005
Sensitivity to Coarticulation (Front vowel vs. Back vowel F2 Difference)	Strong	Weak	Dalston, 1975; Oxley, Roussel, and Buckingham, 2007; Recasens, 2004, 2012; Recasens and Farnetani, 1990; Recasens and Pallarès, 2004; Recasens, Fontdevila, and Pallarès, 1996

In spite of the above articulatory and acoustic specifications for [l] and [ɫ], the majority of which suggest discrete (or categorical) thresholds between the two laterals, a series of both articulatory and acoustic studies suggest that light and dark laterals exist on a gradient continuum of velarization. Electropalatography data for Central Catalan, Majorcan Catalan, Valencian Catalan,

and German (Recasens, 1996, 2004; Recasens & Espinosa, 2005) suggest that tongue dorsum height, tongue dorsum retraction, and tongue tip contact configurations are gradient and relative rather than strictly absolute. With respect to acoustic (F2) data, there exists a wide degree of variability within the supposed discrete categories of light and dark laterals, such that languages with a proclaimed single light lateral and languages with a proclaimed single dark lateral in fact share overlapping distributions of F2 values; for example, while some Czech laterals (presumably light) show higher F2 values than equivalent (i.e., same phonological context) Majorcan Catalan, European Portuguese, and Central Catalan (presumably dark) laterals, other Czech laterals exhibit lower F2 values than their counterparts in Majorcan Catalan, European Portuguese, and Central Catalan (Recasens, 2012, p. 373). Moreover, within-category variability is also considerable, with the supposedly discretely light laterals of Spanish, German, and French exhibiting a gradient F2 hierarchy (i.e., Spanish > French > German), and the supposedly discretely dark laterals of Central Catalan, Russian, and Majorcan Catalan exhibiting a parallel gradient hierarchy (i.e., Central Catalan > Majorcan Catalan > Russian) (Recasens, 2012, p. 373).

The gradient nature of lateral velarization, alongside the reality of discrete articulatory targets for /l/ in a given language, poses a unique and complex problem for the assessment of any language's lateral inventory, and in particular for the assessment of lateral inventories with respect to language transfer in a setting of language contact. Speakers within and outside of Catalonia expressly acknowledge the difference between a 'Catalan l' and a 'Spanish l,' and while this might intuitively lead one to invoke the labels of 'dark' and 'light,' respectively, it is perfectly possible for both laterals to in fact be intrinsically 'light' or 'dark,' since each articulatory target exhibits within-category variation. Without any segment-intrinsic measures

with which to classify either (or any) lateral as [l] or [ɫ], how can one assess the degree to which a ‘Catalan l’ indeed exists in CCS? And if indeed a ‘Catalan l’ is now present in CCS, has it replaced the prior ‘Spanish l’? Furthermore, might there now exist two laterals in CCS, regardless of if either (or both) is dark or light? In order to address these questions, we shall apply an innovative combination of segment-intrinsic metrics with which to assess the lateral inventories of CCS and Catalan.

#### *2.4 Acoustic metrics for assessing gradient velarization and discrete lateral allophones*

Let us consider the merits of employing a set of five possible metrics for analyzing alveolar lateral production in a given language. In light of the posited F2 thresholds to differentiate light and dark laterals noted previously in Table 2, perhaps the most straightforward metric for assessing a language’s laterals would be to compare F2 values with proposed thresholds, such that average F2 values of less than 1200 hz would indicate a dark lateral, and those above 1500 hz would evidence a light lateral. Notwithstanding the complication that arises if a language’s average F2 value falls within the 300 hz gap between thresholds,<sup>3</sup> this metric is quite problematic. Such a metric would be highly incompatible with sociolinguistic research, as these

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<sup>3</sup> Stricter categorical thresholds (lacking a problematic gap in hz) have been proposed, such as separating light laterals from dark ones at 1200 hz (Fant, 1960, as cited in Proctor, 2009, p. 62) or separating light laterals from dark ones at 1500 hz (Recasens, Fontdevila, & Pallarès, 1995, p. 42). As will be argued, however, these do not alleviate other problems with using raw hz comparisons (not to mention the fact that they immediately conflict with the understanding of velarization as a gradient phenomenon, at least as far as production is concerned).

and other reported light/dark thresholds are not normalized measures, accordingly derived exclusively from adult male speakers and, in effect, disallowing raw comparisons with non-adult-male speakers. Moreover, as discussed in the previous subsection, the distributions of raw hz values across proclaimed single light lateral languages and single dark lateral languages overlap, calling into question the accuracy and cross-linguistic applicability of these kinds of thresholds in the first place. Accordingly, raw F2 comparisons with reported light and dark thresholds in prior dialectological literature cannot be considered a viable and segment-intrinsic method for (socio)phonetic acoustic analysis.

A second metric relies on the posited classification of lateral inventories in the world's languages. By comparing (normalized) F2 data between the language in question and a language posited to exhibit a single dark or light category, one could claim that a lateral equally or significantly more velarized than that of an established, single dark lateral language would uncontestably be classifiable as dark, and in parallel, an equally or significantly less velarized lateral than that of an established, single light lateral language would uncontestably be light (Fuchs, 2015). This metric too is problematically segment-extrinsic, relying solely on light/dark classifications proposed for other languages. Given the aforementioned hierarchy of velarization degrees (i.e., within-category variation) found for so-called single light lateral and single dark lateral languages, the threshold for light or dark /l/ classification would vary based on the comparison language in question; selecting Russian as the comparison language, for example, would force a lower F2 threshold than selecting Central Catalan. Moreover, such a comparative analysis assumes stability in lateral production for the reference or comparison languages being used, which is not readily compatible with diachronic change. Lateral inventories in the world's languages, like any grammatical feature, are candidates for eventual language change; for

example, Latin is notably argued to have exhibited both light and dark laterals (Allen, 1989, p. 33; Grandgent, 1991, pp. 185-187; Niedermann, 1953, p. 9; Pope, 1973, pp. 74-76, Rasico, 1981, p. 200; Recasens, 2014a, p. 21; Slomanson & Newman, 2004, p. 209), whereas its modern dialects (i.e., Romance offspring) now show either one or the other (refer back to Section 2.3, and recall that in this very study, we are considering the possibility that the lateral inventory of a variety of Spanish may be changing). Accordingly, this metric is unfortunately also ill-suited as a viable and segment-intrinsic method for (socio)phonetic acoustic analysis.

A third metric involves laterals' sensitivity to syllable position, namely the degree to which laterals in onset vs. coda position show distinct degrees of velarization (Recasens, 2012, 2014a; Recasens & Espinosa, 2005). The articulatory account for this differential sensitivity to syllable position effect proposes that consonants with relatively unconstrained articulatory configurations tend to exhibit a degree of articulatory strengthening in onset position and a degree of articulatory weakening in coda position. As the dark lateral requires a more constrained or strict articulatory configuration (e.g., predorsum lowering and postdorsum retraction) than the light lateral, dark laterals are less subject (or ideally, even immune) to velarization differences across these syllable positions than are light laterals, which are expected to be darker in coda position and lighter in onset position (Recasens, 2012, pp. 369, 376-377; Recasens & Espinosa, 2005, p. 6). Thus, if a lateral in a given language is not sensitive to syllable position effects, this is consistent with the expected articulatory profile of a dark lateral. Conversely, if a lateral is sensitive to syllable position effects, then the problematically relative magnitude of effect must somehow be evaluated; that is, how weak of an effect (i.e., how small of a hz difference across syllable positions) evidences a dark lateral, and how strong of an effect (i.e., how large of a hz difference across syllable positions) evidences a light one?

Note that the application of this metric presupposes the presence of precisely one lateral category in a language, effectively a kind of Litmus test for what kind of lateral (i.e., light or dark) a particular single kind of lateral is. With respect to distinguishing languages with one lateral (regardless of type) from languages with both, this same metric is applied somewhat differently. Recasens (2012, pp. 376-377) finds that for languages previously classified as having both laterals (e.g., Dutch, American English, and British English Received Pronunciation), observed (statistically significant) F2 differences across syllable positions are above 400 hz, whereas for languages previously assumed to exhibit one kind of lateral (e.g., Italian, Spanish, Majorcan Catalan, and Russian), observed (and indeed statistically significant) F2 differences across syllable positions are less than 200 hz. Accordingly, a threshold emerges,<sup>4</sup> namely that 400 hz or greater differences across syllable positions are suggestive of languages with a light and dark lateral. Alternatively, if F2 differences across syllable position are less than 200 hz, this suggests intrinsic, within-category variation of a single lateral category, the status of which (i.e., light vs. dark) would be revealed by the former (problematic) application of this metric; that is, assessing if the less than 200 hz difference is ‘so small’ that it merits analysis as a dark lateral as opposed to a light one. Overall, this segment-intrinsic metric has applications for both the assessment of how many laterals a language has, and additionally what kind of laterals they are; however, it still does not resolve these questions fully on its own. Ultimately, the binary classification of any individual lateral is executed using a gradient measure, namely deciding if the observed F2 difference across syllable positions is small enough to warrant one classification

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<sup>4</sup> This reported threshold did not apply across every language examined. Recasens (2012, p. 377) finds cases of syllable position differences that fall between the 200-400 hz threshold, such as Hungarian at 299 hz.

over the other.

A fourth and somewhat similar metric in terms of application to both the assessment of number of laterals in a language, in addition to the classification of any particular one, is that of sensitivity to coarticulation effects (Dalston, 1975; Oxley, Roussel, & Buckingham, 2007; Recasens, 2004, 2012; Recasens & Farnetani, 1990; Recasens, Fontdevila, & Pallarès, 1996). As discussed above, the articulatory configuration for a dark lateral is more constricted than that of a light lateral, and thus a dark lateral is expected to show greater resistance to coarticulatory effects with an adjacent segment, whereas a light lateral is expected to show greater velarization degrees, for example, in contexts of an adjacent back vowel, which shares a similar tongue dorsum shape to a dark lateral (Recasens, 2012, p. 370; Recasens & Espinosa, 2005, p. 7). Therefore, if a lateral (ideally) shows no coarticulation sensitivity, this is consistent with the expected articulatory profile of a dark lateral, serving as another kind of Litmus test for intrinsically identifying a dark lateral. Recasens (2012, p. 379) finds that the average coarticulation differences (adjacent /i/ vs. /u/) for languages with a presumably single light lateral are 517 hz, which is considerably higher than the 148 hz value for languages with a presumably single dark lateral. As both are statistically significant differences, once again we are faced with gradient coarticulation sensitivities (as opposed to the ideal scenario in which one lateral exhibits no difference, best evidencing a dark lateral), leaving one to problematically assess the relative magnitude of coarticulation effect in a given language, and thus decide if a lateral is dark or light by making subjective comparisons with other studies' attested sensitivity differences.<sup>5</sup> Overall,

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<sup>5</sup> Though it would be possible to compute average coarticulation differences (i.e., F2 difference for laterals adjacent to velar/back segments vs. non-velar/front segments) for languages that presumably exhibit both laterals vs. those with presumably only one, in order to potentially



then, the metric of coarticulation sensitivity appears rather parallel to the previous one of syllable position sensitivity, suffering from the same shortcomings of necessitating extrinsic comparisons to reported difference values in other studies (still in un-normalized units from adult male speech) in order to ultimately apply subjective categorizations to inherently gradient data.

Finally, a fifth metric for the analysis of lateral production in a given language concerns the distribution of collected data. Curiously, none of the aforementioned studies has assessed the number of laterals in a given language by examining the distribution of F2 (or normalized unit) values. A unimodal distribution of acoustic data would be consistent with a single articulatory target, or one single lateral of either type, with values on either side of the modal peak (i.e., lighter and darker productions of a single lateral) being the result of within-category, intrinsic variation reflecting linguistic factor effects like syllable position, coarticulation, *et cetera*. A bimodal distribution of F2 (or normalized unit) values, on the other hand, would be consistent with two articulatory targets, with extreme values for each peak once again corresponding to linguistic factor effects like syllable position, coarticulation, etc. While this segment-intrinsic metric directly speaks to the number of lateral categories evidenced in a given language, it nonetheless does not offer insight into what kind of lateral(s), dark or light, is/are attested, since each type of lateral is expected to show a gradient range of velarization.

Having considered five unique means of assessing lateral production in CCS or any given language, with each one not being able to individually fully address, segment-intrinsically, the number of laterals in a language and any particular laterals' light vs. dark classification, we will

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propose a threshold that distinguishes languages with one lateral vs. those with two (akin to what was discussed with the prior metric of syllable position sensitivity), Recasens (2012) neglected to perform this analysis.

apply a combination of these metrics in order to best characterize the lateral inventory of CCS. In particular, we will examine the distribution of lateral productions in CCS, alongside possible differential sensitivities to syllable position and adjacent segment coarticulation, using normalized, gradient F2 data from a group of Barcelonan Catalan-Spanish bilinguals. Moreover, in order to most accurately assess the influence of Catalan on CCS, we additionally will draw comparisons between CCS and Catalan laterals in distinct profiles (i.e., L1 vs. L2) of Catalan-Spanish bilinguals (see Simonet, 2010).

### **3. Research questions and hypotheses concerning CCS lateral production**

In order to assess the nature of the lateral inventory in CCS, particularly with regard to potential influence from Catalan, this study puts forth the following three research questions:

RQ1) How does lateral velarization in CCS compare to lateral velarization in Catalan?

RQ2) How does lateral velarization in CCS compare to lateral velarization in monolingual (non-contact) Spanish?

RQ3) How many and what kind of laterals comprise the CCS and Catalan lateral inventories?

With respect to the first two research questions, based on the aforementioned impressionistic accounts (Arnal, 2011; Casanovas Català, 1995; Serrano Vázquez, 1996; Sinner, 2002; Vann, 2000, 2001; Wesch, 1997) and empirical research (Pieras, 1999; Simonet, 2010) attesting

increased velarization degrees in CCS, alongside the relative abundance of dialectological and/or experimental studies contrasting Catalan lateral velarization with that (or perhaps better put, with the lack thereof) in monolingual Spanish (Casanovas Català, 1995; Prieto, 2004; Recasens, 1996, 2012, 2014b; Recasens & Espinosa, 2005; Recasens, Fontdevila, & Pallarès, 1995), we hypothesize that velarization degrees will exist in a continuum from greatest in Catalan to lowest in monolingual Spanish, with CCS falling either somewhere in the middle or potentially near Catalan, which would corroborate speakers' explicit judgments of the infamous *ela catalana* indeed being present in CCS (Sinner, 2002). Moreover, hierarchical velarization degrees based on speaker profile (i.e., L1 vs. L2) will further substantiate the role of language contact via L1-transfer in CCS lateral production (Pieras, 1999; Simonet, 2010; see also Flege, 1995, 2007).

With respect to the third research question, previous descriptions of monolingual Spanish and (Central) Catalan claim a single light and dark lateral, respectively (Navarro Tomás, 1918; Prieto, 2004; Quilis, 1981; Recasens, 2012; Recasens & Espinosa, 2005). The strongest segment-intrinsic evidence to support this hypothesis would entail, for Catalan, a unimodal distribution of F2 values and an absence of significant effects of syllable position (i.e., onset vs. coda) and coarticulation (i.e., adjacent front vowel vs. back vowel), alongside, for monolingual Spanish, a unimodal distribution of (higher) F2 values and differential velarization degree based on syllable position and coarticulation effects (i.e., favoring greater velarization degrees in coda position and back vowel adjacency). As for CCS, in light of speakers' explicit judgments about the salient presence of the *ela catalana* in CCS, we predict a unimodal distribution of F2 values alongside a lack of significant effects of coarticulation and syllable position, consistent with the prototypical profile of a dark lateral. Moreover, should the effects of syllable position and coarticulation be mediated by the language dominance of the bilingual speaker (i.e., favoring these effects [which

are suggestive of a prototypically light lateral] in Spanish-dominant speakers), this would strongly confirm the role of language contact in the Catalan-Spanish bilingual setting, with Catalan-dominant speakers acting as the agents of CCS [ɫ]'s emergence in this community (see Hickey, 2012).

## 4. Experimental methodology

### 4.1 Linguistic factors

The present investigation incorporates a set of two linguistic factors, namely syllable position and adjacent segment place of articulation (or coarticulation). With respect to syllable position, two levels are established: onset (e.g., *lógica* 'logic'; *lámina* 'sheet'; *lente* 'lens'; *límite* 'limit') and coda (e.g., *animal* 'animal'; *gandul* 'loafer'; *coronel* 'coronel'; *perfil* 'profile'). With respect to coarticulation, two levels are established: adjacent front vowel (e.g., *líquido* 'liquid'; *lectora* 'reader'; *mil* 'thousand'; *hotel* 'hotel') and adjacent non-front vowel (e.g., *laberinto* 'labyrinth'; *lupa* 'lens'; *sol* 'sun'; *tul* 'tulle'). As discussed in Section 2.4, onset and front-vowel tokens of /l/ (e.g., *lente*, *límite*) are expected to show the lowest velarization degrees, in contrast to coda and non-front-vowel tokens of /l/ (e.g., *sol*, *animal*), and these velarization differences should be greatest (or ideally, exclusively present) for light /l/.

### 4.2 Social factors and subject population

The present investigation incorporates a set of two social factors, namely gender and language dominance, in order to assess lateral production in present-day CCS. Following a variationist sociolinguistic framework (Labov, 2001; Tagliamonte, 2012), gender stratification, wherein female speakers are likely to lead the community-wide adoption of an innovative variant in cases of ongoing change, can reveal insights into the current sociolinguistic landscape of CCS lateral production. Pieras (1999) and Simonet (2010) find that younger female speakers use less velarized laterals more than their older and male counterparts, consistent with a potential community-wide adoption of less velarized laterals in response to overt stigmas associated with darker variants. As evidence of age stratification is necessary in order to substantively comment on potential ongoing change in the present study, we shall limit our interpretations of any observed gender stratification to simply suggest which kind of lateral or direction of velarization degree is more compatible with the possibility of a community-wide change in progress.

With regard to language dominance, as will be further detailed in Section 4.3, participants in the present study are grouped according to profiles of language use rather than by any formal assessment of bilingual competence. Table 3 displays the general distribution of the 36 speakers recruited for this study, from Barcelona and Madrid, according to family language profile (i.e., home language, native language, and parents' native language) and reported weekly usage of Catalan and Spanish with family and friends. Notably, L1-Catalan bilinguals are further separated into two groups based on their residence as a proxy for daily exposure to Catalan, since speakers hailing from the urban center are in closer proximity to L1-Spanish speakers, whereas speakers hailing from smaller, Catalan-prevalent villages on the outskirts of the urban center tend to only come into contact with L1-Spanish speakers after traveling 50 minutes (via public

transportation or otherwise) to arrive at the urban center of Barcelona.<sup>6</sup> All participants were between the ages of 18 and 30 years, permitting interpretations of lateral production data as reflecting contemporary speech.

**Table 3.** Subject population according to language profile group.

Language Profile Group	Speaker Count by Gender (18-30 years old)	Home / Native / Parent Native Language	Weekly Use of Spanish (with Family, Friends, at School/Work, Shopping)
A (Village, L1-Catalan)	10 (5M, 5F)	Catalan / Catalan / Catalan	7% (s.d. = 5.8)
B (Urban, L1-Catalan)	10 (5M, 5F)	Catalan / Catalan / Catalan	10% (s.d. = 6.9)
C (Urban, L1-Spanish)	10 (5M, 5F)	Spanish / Spanish / Spanish	77% (s.d. = 10.8)
D (Madrid, monolingual)	6 (3M, 3F)	Spanish / Spanish / Spanish	100% (s.d. = 0)

#### 4.3 Test instruments

This study utilizes three test instruments. The first is a socio-demographic questionnaire containing 22 questions used to screen participants according to the social criteria outlined in Section 4.2. Its purpose is to gather language histories of participants in order to facilitate their groupings according to the bilingual profile groups that appear in Table 3.

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<sup>6</sup> Village speakers hailed from Sant Miquel de Balenyà and Arenys de Munt.

The second test instrument employed in this investigation is a Spanish elicited production task (recorded list reading). Participants were asked to read aloud, using their best pronunciation, a series of 80 target words with /l/, stratified according to syllable position and coarticulation (20 tokens per cell). These target items alternate with a set of 80 distractor items that do not contain /l/. Beyond the benefit of ensuring an equal number of lateral tokens produced per participant across the aforementioned linguistic factor cells, this task serves to gather more formal or careful speech data. While this is not a perfect reflection of spontaneous speech, given that non-standard variants are typically avoided in more careful speech styles (Moreno Fernández, 2009, p. 101; Tagliamonte, 2012, p. 34), the lateral tokens collected from this task permit a uniquely conservative estimate of the presence of dark laterals and/or high degrees of velarization in CCS, undershooting their presence in spontaneous and more natural everyday speech.

The third test instrument, offered only to the 30 Catalan-Spanish bilinguals, is a Catalan elicited production task (i.e., recorded list reading). Bilingual participants were asked to read aloud, using their best pronunciation, a set of 16 target words with /l/ (adapted from Simonet, 2010, p. 667), stratified according to the same linguistic factors of syllable position and coarticulation (4 tokens per cell).<sup>7</sup> The target items alternate with a set of 16 distractor items that do not contain /l/.

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<sup>7</sup> The discrepancy in stimuli size across Spanish and Catalan elicited production tasks reflects their development as part of a larger-scale study focusing principally on CCS. The Catalan data do, however, meet minimum thresholds of sociolinguistic data to warrant valid statistical inferences regarding the larger population represented by the sample, namely 3-5 tokens per cell, evenly distributed cell counts, and more than 100 total tokens collected (Moreno Fernández, 2009, p. 312; Tagliamonte, 2006, p. 31).

#### *4.4 Data collection methods*

Each participant was recorded individually during one experimental session lasting approximately 40 minutes. In order to limit the effects of language mode (Grosjean, 2001), given that bilinguals produced Spanish and Catalan speech during a single interview session, the interview session was strictly divided in two parts, namely a Catalan portion followed by a Spanish portion. The sociodemographic questionnaire was given in Spanish, after the Catalan elicited production task and before the Spanish elicited production task, providing a buffer of approximately 15 minutes between tasks to allow participants to switch from Catalan to Spanish. Participants were recorded using an SE50 Samson head-mounted condenser microphone and an H4n Zoom digital recorder (sampling at 44,100 hz) in an audiometric booth in the phonetics laboratory at the Universitat Autònoma de Barcelona, in an empty classroom at the Universitat de Barcelona or Universitat Pompeu Fabra, or (for monolinguals) in a quiet room in the Centro de Estudios de Posgrado at the Universidad Autónoma de Madrid.

### **5. Data analysis methods and results**

#### *5.1 Acoustic analysis*

Following Simonet (2010, p. 668), F2 values were measured from each /l/ production's midpoint, calculated from hand-marked segment boundaries via transition cues in the waveform



and spectrogram. In order to minimize formant tracking errors, the number of formants and the formant ceiling for each lateral were specified according to linguistic context and speaker gender, adapted by trial and error from those used in Simonet (2010, p. 668). Any gross tracking errors were corrected by hand. Example spectrograms illustrating a lighter and darker realization of /l/ in the token *lectora* ‘reader,’ produced by two different speakers, are shown below in Figures 1 and 2.

**[Please insert Davidson\_Figure 1 about here]**

**Figure 1.** Group A (Catalan-L1, Village) male production of *lectora* (F2 = 961 hz).

**[Please insert Davidson\_Figure 2 about here]**

**Figure 2.** Group C (Spanish-L1, Urban) female production of *lectora* (F2 = 1814 hz).

After midpoint F2 (hertz) values were extracted with a Praat script, they were converted from hz into Bark units and subsequently transformed and normalized using an adaptation of the S-procedure (Fabricius, 2007; Watt & Fabricius, 2002), following Simonet (2010). This normalization procedure expresses individual /l/ tokens as terms of how ‘[u]-like’ (more

velarized) or '[i]-like' (less velarized) they are in relation to each speaker's vowel space. Each speaker's vowel space was calculated (in terms of F2) by measuring the average F2 value (converted to Bark units) for the vowels /u/ and /i/. Once these /u/ and /i/ limits were established for a given speaker, they were averaged together and served as the denominator over which the F2 (in Bark) of that speaker's individual /l/ token was divided, yielding a normalized (henceforth, normed) F2 value with respect to 1 with asymptotes at 0 and 2. Normed F2 values closest to 2 denote more [i]-like (i.e., less velarized) laterals, whereas normed F2 values closest to 0 denote more [u]-like (i.e., more velarized) laterals.

In order to permit direct comparisons between Spanish and Catalan laterals expressed in normed F2 units, it was necessary to confirm that the vowel spaces across the languages did not significantly differ from one another. Accordingly, a linear mixed-effects regression model (with independent variables of *vowel* (i.e., /i/ vs. /u/), *language* (i.e., Catalan vs. Spanish), and the interaction between the two) was run with *F2* (in Bark) as the dependent variable and *speaker* and *token* as random effects. Crucially, neither the main effect of *language* ( $F(1,13.87) = 0.001$ ;  $p = 0.97$ ) nor the interaction between *language* and *vowel* ( $F(1,13.72) = 0.15$ ;  $p = 0.7$ ) was statistically significant, confirming that the vowel spaces for Catalan and Spanish are not distinct, thus warranting the use of the S-procedure across the two languages indiscriminately.

## 5.2 Total counts of collected lateral production data

The Spanish elicited production task yielded a total of 2,880 lateral tokens, while the Catalan

elicited production task yielded a total of 480 lateral tokens.<sup>8</sup> The relatively few tokens with erroneous formant structures and/or notable speaker disfluencies were discarded from analysis, leaving 2,741 Spanish laterals and 464 Catalan laterals available for statistical analysis, which equates to 3,205 laterals analyzed, or roughly 76 Spanish laterals and 16 Catalan laterals per speaker.

### *5.3 Results – overall distribution of lateral production by language and profile group*

In order to examine the distribution of CCS and Catalan laterals, which will reveal each language's overall range of velarization degrees and modal peaks indicative of unique articulatory targets, normed F2 values across the normed F2 scale were graphed using kernel density plots. Figure 3 shows the overall distribution of lateral velarization degrees for CCS and Catalan, while Figures 4 and 5 reveal velarization degrees for each language stratified by language profile group (refer back to Table 3 in Section 4.3 for each group's language exposure and use attributes). Additionally, bimodality coefficients are listed for each lateral distribution, where coefficients greater than  $5/9$  (i.e., recurring .5) indicate a bimodal distribution, and coefficients less than or equal to  $5/9$  indicate a unimodal distribution.<sup>9</sup>

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<sup>8</sup> The discrepancy in token counts between Spanish and Catalan, beyond Group D's (i.e., Madrid monolinguals) exclusively Spanish productions, is due to the Spanish production data forming part of a larger, cross-dialectal project that focused on Spanish.

<sup>9</sup> A test of bimodality was conducted in R using the 'modes' package (Deevi, 2016), specifically calculating, for each lateral distribution, a bimodality coefficient ranging from 0 (i.e., complete unimodality) to 1 (i.e., two completely separated distributions). The coefficient of bimodality,  $b$ ,

**[Please insert Davidson\_Figure 3 about here]**

**Figure 3.** Kernel density plot and bimodality coefficients for normed F2 distributions for bilinguals' laterals in CCS and Catalan.

**[Please insert Davidson\_Figure 4 about here]**

**Figure 4.** Kernel density plot and bimodality coefficients for normed F2 distributions for Spanish laterals by language profile (A: L1-Catalan village; B: L1-Catalan urban; C: L1-Spanish urban; D: Madrid monolingual).

**[Please insert Davidson\_Figure 5 about here]**

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is given by the formula  $(y^2 + 1) / (z + 3)$ , where  $y$  is skewness of the distribution and  $z$  is kurtosis of the distribution (Ellison, 1987, p. 1281).

**Figure 5.** Kernel density plot and bimodality coefficients for normed F2 distributions for Catalan laterals by language profile (A: L1-Catalan village; B: L1-Catalan urban; C: L1-Spanish urban).

While Figure 3 reveals that velarization degrees in Catalan appear generally greater than those produced in CCS, Figures 4 and 5 illustrate a considerable degree of variation in lateral production mediated by language profile group. In particular, following a hierarchy from more to less exposure and use of Catalan (i.e., Groups A > B > C > D), velarization degrees in both Spanish and Catalan laterals appear to decrease. Notably, all bimodality coefficients are indicative of unimodal distributions, consistent with an account of each language overall and each language per profile group, exhibiting a single lateral category rather than two.

#### *5.4 Results – linguistic and social factors conditioning CCS and Catalan lateral velarization.*

As Catalan laterals were not elicited from Madrid monolinguals, a single statistical model comparing linguistic and social factor effects across languages could not be generated.

Accordingly, two models were created. First, for all bilingual data, a mixed-effects linear regression was performed in R using normed *F2* as the dependent variable, testing for fixed effects of three linguistic factors (i.e., *language* (i.e., CCS vs. Catalan), *syllable position* (i.e., onset vs. coda), and *coarticulation* (i.e., front vs. non-front)) and two social factors (i.e., *language profile group* (i.e., A vs. B vs. C vs. D) and *gender* (i.e., male vs. female)). Three-way interaction terms between *language profile group* and *language* with each of all the other independent variables were included in order to assess whether or not any of these effects varied

significantly according to the different bilingual profile groups, by language. *Individual speaker* and *token* were included as random effects. To explore the only remaining comparisons, namely linguistic and social factor effects for CCS and monolingual Spanish, a separate mixed-effect linear regression model for Spanish data was performed in R with the same dependent variable, independent variables (save for language), and random effects.

The results of the bilingual data linear mixed-effects regression and Spanish data linear mixed-effects regression appear in Tables 4 and 5, respectively (only significant effects reported), with negative  $\beta$  coefficients indicating greater velarization degrees compared to the intercept. The ANOVA tables generated from each mixed-effects model returned significant main effects of *syllable position* (for bilingual data,  $F[1,94.22] = 14.65$ ,  $p=.0002$ ; for Spanish data,  $F[1,77.56] = 57.99$ ,  $p<.0001$ ), *coarticulation* (for bilingual data,  $F[1,96.26] = 202.2$ ,  $p<.0001$ ; for Spanish data,  $F[1,77.55] = 284.88$ ,  $p<.0001$ ), *language profile group* (for bilingual data,  $F[2,25.09] = 58.72$ ,  $p<.0001$ ; for Spanish data,  $F[3,27.99] = 109.25$ ,  $p<.0001$ ), *gender* (for bilingual data,  $F[1,24.62] = 23.51$ ,  $p<.0001$ ; for Spanish data,  $F[1,27.99] = 14.72$ ,  $p=.0007$ ), and lastly, for the bilingual data, of *language* ( $F[1,95.93] = 33.14$ ,  $p<.0001$ ). Additionally, for the bilingual data model, one significant interaction effect was found, namely between *language* and *syllable position* ( $F[1,94.22] = 5.26$ ,  $p=.02$ ). For the Spanish data model, two significant interaction effects were found, namely between *language profile group* and each of *syllable position* ( $F[3,2620.83] = 25.71$ ,  $p<.0001$ ) and *gender* ( $F[3,27.99] = 21.14$ ,  $p<.0001$ ). Given the complex nature of these models, we shall elaborate on each of these findings separately, offering additional information (and post-hoc analyses) as necessary for each finding.

**Table 4.** Summary of mixed-effects linear regression model fit to bilingual lateral production

data. \*The intercept is Group A (Catalan-L1 village) female speakers producing coda laterals adjacent to front vowels in Catalan.

	<i>B</i>	<i>t</i>	<i>p</i>
(Intercept)*	.8171	18.209	<.0001
Onset	.1536	3.004	.002
Non-Front Vowel	-.1804	-6.364	<.0001
Group B (Urban, L1- Catalan)	.1667	3.158	.0031
Group C (Urban, L2- Catalan)	.3554	6.651	<.0001
Male	-.1226	-2.526	.0176
Spanish	.2003	6.604	<.0001
Spanish: Onset	.2381	4.582	<.0001

**Table 5.** Summary of mixed-effects linear regression model fit to Spanish lateral production data. \*The intercept is Group A (Catalan-L1 village) female speakers producing coda laterals adjacent to front vowels.

	<i>B</i>	<i>t</i>	<i>p</i>
(Intercept)*	.8469	25.698	<.0001
Onset	.046	3.571	.0005
Non-Front Vowel	-.1614	-12.525	<.0001
Group B (Urban, L1- Catalan)	.1568	3.518	.0014
Group C (Urban, L2- Catalan)	.383	8.594	<.0001
Group D (Madrid, monolingual)	.5086	9.885	<.0001
Male	-.1597	-3.62	.0012
Group B: Onset	.0388	4.251	<.0001
Group C: Onset	.0532	5.1	<.0001
Group D: Onset	.08	8.641	<.0001
Group D: Male	.1533	2.129	.0422

With respect to the effect of language profile group, post-hoc analyses (with Bonferroni correction;  $\alpha = 0.0167$  for the bilingual data and .0125 for the Spanish data) reveal that



velarization degrees for /l/ are distinct across each profile group in both Spanish and Catalan, following a hierarchy of language dominance, with greatest velarization degrees for Group A (i.e., L1-Catalan village) speakers, followed by Group B (i.e., L1-Catalan urban) speakers, Group C (i.e., L1-Spanish urban) speakers, and lastly Group D (i.e., Madrid monolingual) speakers (for each comparison in each model,  $p < .0001$ ). These hierarchies reveal important differences in L1 vs. L2 production, in that Catalan laterals are significantly more velarized in the speech of L1-Catalan speakers (i.e., Groups A and B) than in the speech of L2-Catalan speakers (i.e., Group C). In parallel, Spanish laterals are significantly more velarized in the speech of L2-Spanish speakers (i.e., Groups A and B) than in the speech of L1-Spanish speakers (i.e., Group C) and Madrid monolinguals (i.e., Group D). Beyond a notable urban-rural divide, with laterals in both languages being significantly darker in the speech of Catalan-prevalent village communities (i.e., Group A) than the urban center (i.e., Groups B and C), we highlight the fact that all CCS laterals, even those produced by L1-Spanish bilinguals, are significantly more velarized than Madrid Spanish laterals, which is suggestive of the presence of a uniquely darker or more velarized lateral in Catalanian Spanish. Figures 6 and 7 visualize these velarization hierarchies in Spanish and Catalan, respectively.<sup>10</sup>

**[Please insert Davidson\_Figure 6 about here]**

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<sup>10</sup> Note that all subsequent error bars represent 1 standard deviation from the mean.

**Figure 6.** Effect of language profile group on Spanish lateral production (\*\*\*) = significant at 0.001 level).

**[Please insert Davidson\_Figure 7 about here]**

**Figure 7.** Effect of language profile group on Catalan lateral production.

Having examined L1 vs. L2 differences in Spanish and Catalan, we now turn to cross-linguistic differences in lateral production, as revealed by the aforementioned main effect of *language*.

Displayed in Figure 8 below, velarization degrees for Catalan laterals are significantly greater than those of Spanish laterals, independent of (or equally for each) *language profile group*. This indicates that all bilinguals maintain a significant difference in velarization degree across their two languages, suggesting that neither L1 lateral is being fully transferred or imposed (see Van Coetsem, 2000) into speakers' L2.

[Please insert Davidson\_Figure 8 about here]

**Figure 8.** Effect of language on lateral production.

With regard to the aforementioned main effect of *coarticulation*, velarization degrees for laterals adjacent to non-front vowels are significantly greater than those adjacent to front vowels, independent of (or equally for each) *language profile group* and *language*. While the direction of this effect is consistent with prior accounts of lateral velarization degrees, as mediated by adjacent segment place of articulation, prototypically dark laterals are expected to resist this effect more than prototypically light laterals (Dalston, 1975; Oxley, Roussel, & Buckingham, 2007; Recasens, 2004, 2012; Recasens & Farnetani, 1990; Recasens, Fontdevila, & Pallarès, 1996). Accordingly, the lack of differentiated *coarticulation* effect by *language* and/or by *language profile group* precludes the possibility for a motivated consideration of one language's or group's laterals as intrinsically dark vs. light. Figures 9 and 10 display these *coarticulation* effects for Spanish and Catalan laterals, respectively.

[Please insert Davidson\_Figure 9 about here]

**Figure 9.** Effect of adjacent vowel coarticulation on Spanish lateral production.

**[Please insert Davidson\_Figure 10 about here]**

**Figure 10.** Effect of adjacent vowel coarticulation on Catalan lateral production.

With respect to the aforementioned main effect of *syllable position*, velarization degrees for laterals in coda position are significantly greater than those in onset position, a direction of effect consistent with prior accounts of lateral velarization degree, as mediated by increased articulatory strengthening and increased articulatory weakening in onset and coda positions, respectively (Recasens, 2012, 2014a; Recasens & Espinosa, 2005). Post-hoc analyses (with Bonferroni correction) were performed in order to analyze the significant interactions between *language* and *syllable position* for the bilingual data and between *syllable position* and *language profile group* for the Spanish data ( $\alpha = 0.025$  for bilingual data and 0.0125 for Spanish data). Pairwise comparisons for the bilingual data reveal that the effect of *syllable position* (i.e., favoring increased darkness in coda contexts) is significant for CCS laterals ( $p < .0001$ ), but not significant for Catalan laterals ( $p = .403$ ), whereas pairwise comparisons for the Spanish data reveal that while the effect of *syllable position* is significant and in the same direction (i.e., favoring increased darkness in coda contexts) for all *language profile groups* (for all,  $p < .0001$ ), the magnitude of effect is differentiated by bilingualism, exhibiting a stronger sensitivity in

Group D (i.e., Madrid) Spanish laterals than in CCS laterals (i.e., Groups A, B, and C). As a lack of (or minimally, a decreased) sensitivity to syllable position has been suggested to indicate an intrinsically dark lateral (Recasens, 2012, 2014a; Recasens & Espinosa, 2005), these results are consistent with an account of Catalan exhibiting an intrinsically dark lateral, as well as with an account of CCS laterals being intrinsically darker than those of non-contact varieties of Spanish (Pieras, 1999; Recasens, 2012; Simonet, 2010). Figures 11 and 12 illustrate these differential syllable position effects in Spanish and Catalan, respectively.

**[Please insert Davidson\_Figure 11 about here]**

**Figure 11.** Effect of syllable position on Spanish lateral production.

**[Please insert Davidson\_Figure 12 about here]**

**Figure 12.** Effect of syllable position on Catalan lateral production

With regard to the aforementioned main effect of *gender*, velarization degrees for Spanish and Catalan laterals produced by female speakers are significantly lesser than those produced by males, a direction of effect consistent with prior accounts of increased velarization in both Catalan and CCS as non-standard and even overtly stigmatized (Davidson, 2019; Pieras, 1999; Simonet, 2010; Sinner, 2002). Post-hoc analyses (with Bonferroni correction,  $\alpha = 0.0125$ ) were performed in order to analyze the significant interaction between *gender* and *language profile group* for the Spanish data. Pairwise comparisons reveal that the effect of *gender* (i.e., favoring increased darkness in in males' speech) is significant for bilinguals' CCS laterals (for group A,  $p < .0001$ ; for groups B and C,  $p = .001$ ), but fails to reach significance for Madrid Spanish laterals ( $p = .912$ ). Figures 13 and 14 display the gender effect for each of the bilingual profile groups. Given the lesser velarization degrees of lateral velarization found in Madrid Spanish relative to CCS, the lack of gender stratification in Madrid Spanish is consistent with an account of stable, non-socially mediated variation in this variety, precisely outside the contact setting in question. In CCS and Catalan, on the other hand, where velarization degrees are significantly greater, significant gender stratification suggests that a kind of threshold level of lateral darkness exists, and accordingly is strongly socially mediated.

**[Please insert Davidson\_Figure 13 about here]**

**Figure 13.** Effect of gender on Spanish lateral production (\*\* = significant at 0.01 level).

[Please insert Davidson\_Figure 14 about here]

**Figure 14.** Effect of gender on Catalan lateral production.

Lastly, in order to quantify the frequency of ‘Catalan-like’ laterals in CCS (and likewise, ‘Spanish-like’ laterals in Catalan), we constructed a categorical means for comparison based on the observed continuum of velarization degrees in each language. As the average normed F2 for Catalan laterals produced by L1-Catalan speakers with the most use and exposure to Catalan (i.e., Group A) speakers was 0.63, we set this as a baseline for ‘Catalan-like’ productions, such that any Spanish lateral produced with a normed F2 of 0.63 or lower could be considered akin to Catalan speech. Likewise, as the average normed F2 for Spanish laterals produced by L1-Spanish speakers with the least use and exposure to Catalan (i.e., Group D) speakers was 1.3, we set this as a baseline for ‘Spanish-like’ productions, such that any Catalan lateral produced with a normed F2 of 1.3 or higher could be considered akin to (monolingual) Spanish speech. Crucially, these normed F2 thresholds do not serve as thresholds to distinguish a light lateral from a dark lateral, but rather simply allow us to examine the frequency with which lateral productions in

each language match or exceed velarization degrees in the other.

One Fisher’s Exact Chi-square test was run on the proportion of Spanish laterals produced with normed F2 velarization degrees of 0.63 or lower across the language profile groups, and a second Fisher’s Exact Chi-Square test was analogously run for the proportion of Catalan laterals produced with normed F2 velarization degrees of 1.3 or higher across the language profile groups. The results of each test, shown for Catalan and Spanish in Tables 6 and 7, respectively, reveal that while the proportion of ‘Spanish-like’ laterals is in fact equally distributed across the language profile groups ( $\chi^2 = 2.958$ ,  $df = 2$ ,  $p = .228$ ), the proportion of ‘Catalan-like’ Spanish laterals is not equally distributed across the groups ( $\chi^2 = 477.565$ ,  $df = 3$ ,  $p < .0001$ ). Post-hoc pairwise comparisons for the Spanish laterals reveal that a significantly greater proportion of ‘Catalan-like’ laterals were produced by Group A, and significantly smaller proportions of ‘Catalan-like’ laterals were produced by speakers of Groups C and D. These count data show, with respect to CCS, that ‘Catalan-like’ laterals are not used as a majority variant by any language profile group, though notably, nearly a third of all CCS productions by Group A speakers are indeed as velarized as the average Catalan production. Additionally, the near categorical absence of Spanish-like laterals in Catalan further supports the aforementioned finding (via gradient data comparisons) of significantly distinct velarization degrees in Catalan and Spanish, thus reinforcing the analysis of CCS velarization degrees (in between those of Catalan and Madrid Spanish) as a hallmark feature of this regional contact variety.

**Table 6.** Counts of ‘Spanish-like’ Catalan laterals by language profile group.

Language Profile Group	# of ‘Spanish-	# of ‘Non-	Total Laterals
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	like' Laterals (%)	Spanish-like' Laterals (%)	Produced
Group A (Village, L1-Catalan)	0 (0%)	167 (100%)	167
Group B (Urban, L1-Catalan)	0 (0%)	147 (100%)	147
Group C (Urban, L1-Spanish)	3 (2%)	147 (92%)	150

**Table 7.** Counts of 'Catalan-like' Spanish laterals by language profile group.

Language Profile Group	# of 'Catalan-like' Laterals (%)	# of 'Non-Catalan-like' Laterals (%)	Total Laterals Produced
Group A (Village, L1-Catalan)	238 (31%)	522 (69%)	760
Group B (Urban, L1-Catalan)	56 (8%)	686 (92%)	742
Group C (Urban, L1-Spanish)	3 (0.4%)	764 (99.6%)	767
Group D (Madrid, monolingual)	0 (0%)	472 (100%)	472

## 6. Discussion

### 6.1 Lateral velarization in CCS, Catalan, and monolingual Spanish

The first and second research questions of this investigation concern comparisons across CCS, Catalan, and monolingual Spanish with respect to the production of alveolar laterals, specifically asking whether or not CCS laterals exhibit velarization degrees similar to those of either Catalan or (non-contact) Madrid Spanish. Acoustic analyses revealed significant, gradient differences in lateral velarization across these varieties, with significantly darker velarization degrees in all bilinguals' Catalan than in their Spanish, which in turn exhibited significantly darker velarization degrees (for all bilinguals) than those of Madrid monolinguals, resulting in the following hierarchy of lateral darkness: Catalan > CCS > Madrid Spanish. Using the average velarization degrees of the lightest laterals (i.e., Madrid monolingual Spanish) and the darkest laterals (i.e., Catalan of L1-Catalan village speakers) as a baseline for 'Spanish-like' and 'Catalan-like' laterals, respectively, it was found that the frequency of 'Spanish-like' laterals in Catalan (across all speakers) was 0.6%, while the frequency of 'Catalan-like' laterals in bilinguals' Spanish was (across all speakers) 13%. Thus, despite speakers' and linguists' characterizations of the *ela catalana* as a hallmark feature of CCS (Arnal, 2011; Casanovas Català, 1995; Hickey, 2012; Prats, Rafanell, & Rossich, 1990; Sinner, 2002), these data suggest that it would be more appropriate to consider increased degrees of darkness as the hallmark of CCS rather than any actual production of truly Catalan laterals in Spanish. Indeed, even though Group A (i.e., L1-Catalan village) speakers produced 'Catalan-like' laterals nearly a third of the time in their Spanish, all bilinguals maintained a significant difference in velarization degree across their languages. Thus, the present findings are wholly inconsistent with the notion of an assimilated or

merged lateral category (Flege, 2002, 2007) across the languages of Catalan-Spanish bilinguals. Instead, rather than direct transfer or imposition (Van Coetsem, 2000) of a Catalan lateral category into CCS, the present data constitute a case wherein Barcelonan bilinguals employ stronger (relative to Madrid speakers) degrees of lateral velarization in Spanish, mediated by language dominance and exposure to/usage of Catalan. These mediating factors speak to contact influence from Catalan, which as we have stated, manifests itself gradiently in degrees of lateral darkness rather than as a categorical transfer of a Catalan lateral category into Spanish.

Social stratification for alveolar lateral production, both in Catalan and CCS, was linked to language profile group (i.e., usage and exposure levels to each language) and gender. The directions of these effects, favoring increased velarization with more exposure and use of Catalan and in male speech, are consistent with prior accounts of increased velarization in CCS and Catalan as non-standard and even overtly stigmatized (Davidson, 2019; Pieras, 1999; Simonet, 2010; Sinner, 2002); in CCS in particular, this is a product of language contact. Still, as velarization degrees for all speakers, including female Group C (i.e., L1-Spanish urban) speakers in particular, were significantly greater than those observed in Madrid Spanish, then we may safely assert that bilingual speakers of CCS actively use lateral darkness (i.e., increased velarization degrees) to differentiate themselves from monolingual Spanish-speaking communities. Features such as lateral velarization distinguish the Spanish of Catalonia as a vitalic, regional variety of Spanish in Spain, characterized by intense contact with Catalan. Indeed, the aforementioned asymmetric difference in frequencies of ‘Catalan-like’ and ‘Spanish-like’ laterals (with the former appearing in CCS over 20 times more often than the latter in Catalan) suggests that regardless of any overt stigma associated with lateral darkness, CCS and Catalan do not show signs of becoming fully ‘Spanish- or monolingual-like’ in terms of lateral

production in the current youth generation.

The empirical demonstration of the relative vitality of CCS, evidenced in the finding of Spanish lateral velarization as a distinguishing feature of this contact variety, present across rural and urban contexts as well as across configurations of language dominance in Barcelonan youth speakers, underscores the significant advances in linguistic vitality that Catalan has experienced since Franco's death in the late 20<sup>th</sup> century. Despite its status as a minority language in Spain, within Catalonia, its widespread use and considerable social status as a co-official, prestigious language favor its continued influence on Spanish, a testable prediction which we believe will come to fruition in the form of additional CCS innovations, sourced from Catalan, that gain systematic, widespread use and join /l/ production as hallmark features of this regional variety of Spanish. Still, the need for continued, empirical investigations of both Catalan and Spanish with respect to contact influence is especially important given the history of Catalan's subjugation to Spanish. Assertions about Catalan's linguistic decadence after the Franco regime are all too prevalent:

“...the typical phonetic characteristics heard in Catalans speaking Spanish have disappeared in the youngest generations and it is now normal to find people who speak Catalan with a Spanish accent, whereas fifty years ago the opposite was true. [...] ...in the current situation of generalized bilingualism in Catalonia, the change caused by contact does not affect Spanish, but rather only affects Catalan, which is a language that no longer has any monolingual speakers (Prats, Rafanell, & Rossich, 1990, pp. 36-37, as cited in Arnal, 2011, pp. 16, 22).

These kinds of impressionistic claims, which arguably are better taken as a linguistic ‘call to arms’ to preserve Catalan rather than as empirical facts, can only be tested by meticulously studying concrete language production in Catalan and Spanish. Inasmuch as lateral velarization is concerned, the present findings make it clear that while Spanish and Catalan maintain discretely separate lateral categories, youth speakers, regardless of language dominance, velarize in Spanish as part of a uniquely Catalan-speaking community, and in so doing they suggest that claims of Catalan’s weakened or otherwise precarious standing, in relation to Spanish, are at the very least exaggerated, if not simply unwarranted.

### *6.2 Lateral inventories and considerations for the classification of light and dark laterals*

We now return to the third research question, concerning the lateral inventories of CCS, Catalan, and monolingual Spanish as exhibiting either one or two lateral categories. Sensitivity to effects of coarticulation and syllable position were explored as possible metrics for classifying laterals as light or dark, and the overall distribution of velarization degrees was additionally examined as a metric of establishing how many lateral categories are present in a given language. These three metrics were selected over other possible ones, such as direct comparisons with previously proposed F2 hz thresholds for [l] and [ɫ], because they can be unproblematically applied to sociolinguistic data (i.e., data that is not exclusively obtained from adult male speakers), and additionally they are segment intrinsic measures (i.e., they can be applied independently of the existence of other datasets). Notably, unimodal distributions of lateral velarization were found for both Spanish and Catalan, independent of language profile group, consistent with an account of a single articulatory target (i.e., lateral category) for each of Spanish and Catalan. With respect

to coarticulation and syllable position effects, the former were found (favoring increased velarization in non-front vowel contexts) across both languages and across language profile groups, whereas the latter were found exclusively for Spanish (favoring increased velarization in coda contexts) and were significantly weaker in CCS than in Madrid Spanish.

In an idealized scenario, if one language's lateral were wholly insensitive to effects of syllable position and coarticulation, this would be the most transparent evidence in favor of a classification of an intrinsically dark [ɫ], whereas if another language's lateral were strongly sensitive to these same effects, this would be consistent with the articulatory profile of an intrinsically light [l] (Dalston, 1975; Oxley, Roussel, & Buckingham, 2007; Recasens, 2004, 2012; Recasens & Farnetani, 1990; Recasens, Fontdevila, & Pallarès, 1996). As the notion of 'strongly sensitive' is relative, however, the objective classification of a lateral as dark, via a non-relative, categorical absence of syllable position and coarticulation sensitivities, appears to be unduly favored or partial through the application of these metrics; in other words, the results of the present investigation with respect to the classification of either language's lateral as [l] or [ɫ] necessarily apply more transparently for potential cases of [ɫ] than [l]. Regarding the classification of a dark [ɫ], the Catalan lateral evidenced in this study only partially satisfies the aforementioned criterion, meeting it with respect to syllable position (i.e., a lack of significant sensitivity) and failing to meet it with respect to coarticulation (i.e., a significant sensitivity). Regarding the classification of a light [l], since the sensitivity to syllable position in CCS was of a lesser magnitude than that of Madrid Spanish, this is consistent with Madrid Spanish laterals as perhaps meeting the syllable position criterion for being 'strongly' sensitive relative to the CCS or Catalan laterals, but the equal sensitivity to coarticulation found across languages and language profile groups stands in conflict with these differential and categorical classifications of

lateral by language, implying a common category of lateral across them. Ultimately, with respect to the Spanish data, we are left with the choice of either assigning two lateral categories, [l] and [ɫ], to onset and coda contexts respectively, or assigning a single lateral category (either [l] or [ɫ]) to each of CCS and Madrid Spanish, and ascribing positional allophones to within-category or intrinsic variation (Ladefoged, 1968, as cited in Recasens, 2012, pp. 369-370).

Given the inherently relative nature of assessing the strength of sensitivities to coarticulation and syllable position for a language's lateral(s), and indeed the gradient articulatory and acoustic properties of light and dark laterals in the first place, we assert that the goal of linguistic inquiry simply cannot entail a discrete and cross-linguistic differentiation between [l] and [ɫ], as these articulatory targets exist in perpetual relativity to one another. To ask if a particular language has [ɫ] necessarily invokes a relative opposition with [l], and ultimately leads to the placement of subjective thresholds on gradient velarization degrees and/or linguistic factor sensitivities. Likewise, while the cross-linguistic comparison of magnitudes of syllable position effect (see Recasens, 2012) may be suggestive of a binary grouping of languages with a 'strong' positional effect versus languages with a 'weak' positional effect, these groupings are nevertheless inherently relative, and thus cannot be used to intrinsically differentiate [l] from [ɫ]. Accordingly, for the present investigation, we conclude that Catalan, based on the lack of syllable position effect and a unimodal distribution of velarization degrees, exhibits a single lateral that is darker in comparison with those of CCS and Madrid Spanish. Though CCS and Madrid Spanish show differentiated velarization degrees by syllable position, we interpret the unimodal distribution of these values in each language (and across profile groups) to evidence a single lateral category for each variety, thus yielding the attested hierarchy of velarization: Catalan (i.e., darkest), CCS (i.e., darker), and Madrid Spanish (i.e., lightest).

By conceding the opposition between [l] and [ɫ] as inherently relative and eschewing the possibility for claiming either using exclusively and strictly segment-intrinsic means, we are left only to characterize lateral production in a relative hierarchy of degrees of darkness. Consequently, the construal of a strict typology of the world's languages based on alveolar lateral inventory (as in Section 2.3.) is futile. On the basis of segment-intrinsic metrics, laterals in the world's languages are best understood as neither light nor dark, but instead lighter or darker than others. Typological oppositions between, for example, Spanish and Catalan as respectively a light /l/ language vs. a dark /ɫ/ language, are unsupportable by inherently gradient phonetic and articulatory analysis. Furthermore, for languages that show evidence of two distinct lateral categories (e.g., a bimodal distribution of acoustic or articulatory measures), the presumption that one is intrinsically light while the other is intrinsically dark is similarly unwarranted. Instead, by approaching the typology of alveolar laterals as a relative hierarchy of degrees of darkness for each lateral category in a language, we may more accurately assess lateral production across the world's languages both synchronically and diachronically.

## **7. Conclusion**

The present study sought to examine CCS lateral production as a source of contact-induced variation from Catalan, comparing the effects of linguistic and social factors on velarization degrees in each of these languages. Variation in lateral production was assessed using both continuous (i.e., normed F2) and categorical (i.e., discrete 'Spanish-like' and 'Catalan-like' baselines) measures, permitting a more nuanced quantification and interpretation of usage



patterns by different profiles of speaker in each language. Catalan laterals were found to be significantly darker than CCS laterals, which in turn were significantly darker than those of Madrid monolinguals, evidencing a hierarchy of lateral velarization indicative of CCS as a regional contact variety of Spanish that features laterals with increased velarization rather than a discretely merged or transferred lateral from Catalan. Complexities involving the classification of [l] and [ɫ] were addressed using a combination of segment-intrinsic metrics, including coarticulation and syllable position effects, as well as modal distributions of velarization degrees. The analysis of modal distributions suggested a single lateral category in each of Catalan and Spanish, but differential effects of syllable position and coarticulation by language did not support the classification of either language's lateral as inherently light or dark. Consequently, these discrete classifications were rejected in favor of more objective contrasts between lighter and darker laterals in each language, and a new typology of alveolar laterals was proposed in the form of a relative hierarchy of gradient lateral darkness.

In future work, these analyses can be incorporated into an apparent-time study that assesses possible change with respect to constraint hierarchies in different generations of Catalan-Spanish bilinguals, combining potential change in velarization degrees with linguistic factor constraints as a means of diachronically modeling the lateral inventory in Catalan and CCS. Perhaps more crucially, however, is the need for additional incorporations of normalized acoustic measures in the study of lateral production in other languages as a sociolinguistic variable, since a considerable number of prior studies on lateral production in the world's languages employ raw hz values from adult males, which makes cross-linguistic and sociophonetic comparisons extremely challenging.

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