

CONFLICT RESOLUTION IN THE SPANISH L2 ACQUISITION OF YUCATEC EJECTIVES: L1, L2 AND UNIVERSAL CONSTRAINTS

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1. Introduction

Language contact in the Yucatan Peninsula offers the researcher in second language (L2) acquisition the possibility of studying the interaction of two fairly unrelated linguistic systems: Yucatec Maya and Spanish. Our work focuses on the Spanish L2 perceptual¹ acquisition of Yucatec plain-ejective plosive (p-p', t-t', k-k') and affricate (ts-ts', tf-tf') contrasts. The relevance of this learning situation resides in the fact that our Spanish L2 learners need to acquire a feature inactive in their native (L1) grammar, [constricted glottis] ([CG]), in order to perceive the target Yucatec plain-ejective contrasts. It has been claimed (Brown 1997, 1998, 2000) that L2 learners filter incoming perceptual input through their featural system: If a feature is inactive in the L1, it will preclude acquisition of new contrasts. It is shown here, however, that Spanish L2ers are able to accurately perceive target [CG]-based contrasts in Yucatec. Our claim is that successful acquisition of a new L2 contrast is dependent upon 1) the intrinsic perceptual saliency of the contrasting feature, 2) the place/manner specifications of its segmental host, and 3) the syllabic position of this host.

A feature over a segment-based approach is preferred in our analysis because attention to the segmental level can fail to make the right predictions. Best's 2001 study of the successful perception of the Zulu /k^h/-/k'/ contrast in onset position by English native speakers (with [k^h] in their L1), correctly predicts that Spanish native speakers (with /k/ in their L1) will successfully perceive the Yucatec Maya /k/-/k'/ contrast in the same position. However, the same proposal wrongly predicts successful acquisition of the Yucatec maya /t/-/t'/ contrast in onset.

We will further assume here, in line with Clements (2001), that a feature can be considered to be active in a given language if that feature serves a contrastive function. Crucial for our present research purposes, the contrast between plain and ejective plosives and affricates in Yucatec Maya suggests that [CG] is an active feature in this system, as suggested in (1); in contrast, (2) suggests that the glottal gesture is not required by the phonological system of Spanish:

(1) Voiceless stops in Yucatec Maya

p	t	k	ʔ
ts	tʃ		

(2) Spanish consonants

p	t	k
b	d	g

¹ We focus here on *phonemic* perception, i.e., the kind that requires not only to discriminate but also to identify contrastive sounds as belonging to different phonemes.

p'	t'		k'			ʧ	ʤ	
	ts'	ʧ'			f	s		x
					m	n	ɲ	
						l		
						r		
						r		
					w		j	

2. Feature prominence

The concept of relative feature saliency and its interplay with phonological systems is not new (Stevens & Keyser 1989, Flemming 1995, Jun 1995, Brannen 2002). Stevens & Keyser (1989) argue “that not all distinctive features are equally salient from a perceptual point of view. That is, the contrasting acoustic properties associated with the presence or absence of some features provide a stronger auditory response than those associated with other features” (p. 85). They discuss the differential perceptual patterns observed for the pairs /t-s/ (with [continuant] as the contrasting feature) and /t-ʧ/ (with [distributed] as the contrasting feature) in terms of their acoustic/auditory properties. Differences in the presence versus absence of acoustic energy prior to closure release, plus the abruptness of the release itself results in a different acoustic response for [+continuant] versus [-continuant] segmental material; contrasts based on [distributed], on the other hand, lack strong acoustic cues. It is for this reason, the authors argue, that [continuant] is assumed to be *more salient* than [distributed].

Gonzalez’s (2011) review of previous studies on the L2 acquisition of segmental contrasts offers further support to the claim regarding intrinsic feature saliency. He reports interesting cases of successful acquisition of new segmental contrasts based on features *inactive* in L2 learners’ grammar. For example, Larson-Hall (2004) reports an accuracy rate of 82% for advanced Japanese learners of the Russian /l-/r/, a contrast requiring the activation not only of [lateral] but also of [vibrant], a feature inactive in Japanese. Furthermore, Japanese learners of English are successful at identifying the [coronal]-based /l-/ɹ/ contrast in coda position (accuracy rate: 92%; Brown 1997), in spite of the fact that the contrasting features is inactive in the learners L1 grammar, hinting at the fact that syllabic position plays a crucial role in feature saliency. Based on this review, Gonzalez argues that the relative perceptual saliency of a missing contrastive feature plays an important role in SLA: *an L2 contrastive feature is more likely to bypass the L1 filter the more perceptually salient it is*. This assumption will permeate our analysis of the Spanish L2 acquisition of Yucatec Maya ejectives.

3. The experiment

Previous research (Martohardjono & Flynn 1995, Matthews 1999) suggests that evaluation of a learner’s true competence is revealed through perceptual rather than production tasks. It has also been suggested (Brown 1997, Archibald 1998) that the study

of L2 segmental acquisition is best served by looking at the ability of L2ers to identify the target L2 sound when used contrastively in the target system. In accordance with these claims, we will explore here the Spanish L2 acquisition of Yucatec ejectives by testing Spanish NSs' perception of these new L2 sounds in contrast.

Data were gathered in January 2005 from two experimental groups of monolingual native speakers (NSs) of Spanish: a group of early acquirers (EAs) who had an early, passive exposure to the target language (i.e. from birth up to 10 years of age), and a group of late acquirers (LAs) who were exposed to the L2 late in their lives (i.e. at 16 years of age and up). All subjects were continuing education students at the Centro de Español y Maya (CEM) in the Universidad Autónoma de Campeche, México. Three native speakers of Yucatec Maya constituted the control group; all of them teach Yucatec at the CEM. Age ranged between 26 to 40 years. An AX Discrimination task was administered to both experimental and control groups modeled after Brown (1997). In this task, subjects were required to listen to Yucatec C-C' minimal pairs both in onset (e.g. /ka:n/ 'snake'- /k'a:n/ 'land measure') and coda (e.g. /i:k/ 'hot pepper'- /i:k'/ 'wind') position, and indicate whether the members of the pair were the same or different. A total of 15 experimental pairs in onset position, 12 in coda, and 19 control pairs were presented twice in opposite order, to control for presentation order effects. All stimulus material consisted of monosyllabic Yucatec words as spoken by a male native speaker of the Camino Real dialect of Yucatec Maya. The interstimulus interval was set above 1500 ms to ensure phonemic processing of the Yucatec Maya /k/-/k'/, /t/-/t'/, /p/-/p'/, /tʃ/-/tʃ'/ and /ts/-/ts'/ contrasts.

Given the sample size, a non-parametric Mann-Whitney U statistical analysis of test results was performed, where means of ranks (MR) rather than accuracy scores (AS) are compared. The results of this analysis reveal the perceptual patterns shown in (3), where shaded cells indicates inaccurate performance. For each contrast, MRs are provided in the upper row; to the left; ASs (in %, shown only for illustrative purposes), in the lower row:

(3) Summary of perceptual accuracy among experimental subjects

	Onset					Coda				
	Stop			Affricate		Stop			Affricate	
	k-k'	p-p'	t-t'	tʃ-tʃ'	ts-ts'	p-p'	t-t'	k-k'	tʃ-tʃ'	ts-ts'
LAs	4	7	3.25	3.25	3.5	3.12	3.37	5.12	5.87	5.5
	81.7	91.7	65	62.5	33.3	16.7	12.5	60.8	81.6	68.7
EAs	9.25	8.12	9.37	9.06	8.69	8.56	9	7.31	7.75	7
	97.9	97.9	91.2	91.2	72.9	62.5	75	67.1	87.5	75

Results suggest not only the prominence of [CG] – inactive in Spanish, but also an interaction between syllabic position and the place/manner of articulation of the feature host, particularly among LAs: in general, stops are better feature hosts in onset, affricates in coda. These patterns can be formalized within the OT framework (Prince & Smolensky 2004 [1993]) via a set of perceptually and – in the case of harmonic

alignment – prosodically motivated constraints, introduced in the grammar in the form of both prominence hierarchies (e.g. IDENT[Manner] » IDENT[Place]) and faithfulness-based harmonic scales (Howe & Pulleyblank 2004), such as IDENT[CG]/STOP[Peripheral] » IDENT[CG]/STOP[Coronal]. The interaction of harmonically aligned faithfulness constraints with structural restrictions (e.g. *CG) can account for the attested perceptual patterns among our L2ers. An OT analysis also allows to illustrate the conflict of L1 (v.g. *[t] » *[tʃ]), L2 (v.g. IDENT[CG]/STOP[Peripheral] » IDENT[CG]/STOP[Coronal]) and universal constraints (v.g. *CG/Fricative) in the processing of perceptual L2 input.

4. Constraint grounding: typological and phonetic evidence

4.1 Phonological features: issues on perceptibility differentials

Two main claims will be put forward regarding the likelihood of a feature to be accurately perceived. These are summarized in (4) below:

- (4) Factors determining accurate feature perception
- a) Accurate perception of a feature is in part dependent upon its intrinsic acoustic saliency.
 - b) Accurate perception of a feature is in part dependent upon the manner/place of articulation and the syllabic position of its host.

More specifically, our general claim is that contrasts based on air stream mechanism differences are more salient than contrasts based on manner, which in turn are more salient than place of articulation differences. This hierarchical relationship interacts and is dependent upon the segmental and prosodic traits of a given feature host. In onset position, oral stops are optimal feature hosts; in coda, stridents and liquids better preserve input features. In order to formally capture this interaction, we will elaborate on a proposal due to Howe & Pulleyblank (2004), who claim “that the driving force behind the strength of a faithfulness constraint is perceptibility... [T]hose segments that are more perceptible rank higher on the relevant scale than those segments that are less perceptible,... faithfulness acts like a constraint on inertia: deviations from input are optimal when perceptibly minimal” (2004: 36). The fixed ranking between more and less perceptible segments is captured in their analysis via a harmony-as-faithfulness approach, where the members of two natural scales ($NS_1 = X > Y$; $NS_2 = a > b$, where “>” = more prominent) can be aligned into two corresponding harmony scales ($HS_1 = X/a \succ X/b$; $HS_2 = Y/b \succ Y/a$, where “ \succ ” = more harmonic, and X/a indicates that a occurs in position or context X). Unlike a harmony-as-markedness approach, the linguistic elements that are members of the harmony scales do not violate, but are faithful to corresponding constraints aligned in exactly the same hierarchical relationship as the linguistic elements they refer to, so that if $X/a \succ X/b$, then $X/a \gg X/b$ (where “ \gg ” = dominates).

Constraints preserving specific featural information in the input segmental material are formalized in OT as a family of identity constraints under the general schema in (5):

(5) IDENT[F]

Let α be a segment in String_1 and β be a correspondent of α in String_2 .

If α is $[\gamma F]$, then β is $[\gamma F]$.

Correspondent segments are identical in feature F (McCarthy & Prince 1999).

We assume that members of String_1 are *input* segments; members of String_2 are *output* segments. In order to capture the fact that input preservation is partly dependent upon its intrinsic acoustic saliency, we will resort to a fixed constraint ranking establishing that $\text{IDENT}[F_\alpha] \gg \text{IDENT}[F_\beta] \gg \text{IDENT}[F_\gamma]$. Furthermore, we will argue that in the case of preferential feature preservation, the insights of a traditional positional faithfulness approach (Beckman 1996) have to be elaborated in order to account for our L2 data: feature preservation is not only a function of the hosting position, but also of the hosting segment in that particular position. Accordingly, we will resort to a harmony-as-faithfulness alignment of two scales, the syllable prominence CODA > ONSET scale (Gouskova 2002, Colina 2009), and the sonority based liquid > nasal > fricative > stop scale (Hooper 1976, Selkirk 1984, Clements 1990, Steriade 1991); based on the perceptual patterns of our data, we will further explode² stops into an affricate > stop subscale. We propose that the constraint hierarchies (C) resulting from this harmonic alignment interact with members of the IDENT[F] constraint hierarchy:

(6) Interaction of 3 prominence-based constraint hierarchies

a) $C_{\text{IDENT}[F]}$ interacting with C_X

$$\begin{aligned} &\{\text{IDENT}[F_\alpha]\text{-X/a} \gg \text{IDENT}[F_\beta]\text{-X/a} \gg \text{IDENT}[F_\gamma]\text{-X/a}\} \\ &\gg \\ &\{\text{IDENT}[F_\alpha]\text{-X/b} \gg \text{IDENT}[F_\beta]\text{-X/b} \gg \text{IDENT}[F_\gamma]\text{-X/b}\} \end{aligned}$$

b) $C_{\text{IDENT}[F]}$ interacting with C_Y

$$\begin{aligned} &\{\text{IDENT}[F_\alpha]\text{-Y/b} \gg \text{IDENT}[F_\beta]\text{-Y/b} \gg \text{IDENT}[F_\gamma]\text{-Y/b}\} \\ &\gg \\ &\{\text{IDENT}[F_\alpha]\text{-Y/a} \gg \text{IDENT}[F_\beta]\text{-Y/a} \gg \text{IDENT}[F_\gamma]\text{-Y/a}\} \end{aligned}$$

Our claim is that the chances of, let us say, $[F_\alpha]$ to be perceptually preserved are increased when its host is a segment of class *a* in the context of *X*; on the other hand, the chances for the same feature to be perceived decrease if its host happens to be a segment of class *b* also in the context of *X*. Furthermore, the chances of $[F_\alpha]$ to survive are higher than the chances of $[F_\beta]$ when hosted by the same segmental class in the same syllabic context.

² This is a term we borrow from Hancin-Bhatt (2008).

4.2 Yucatec ejectives in context: typological facts

4.2.1 Crosslinguistic distribution of ejectives

Typologically, ejectives are more marked than pulmonic stops (Maddieson 1984), a fact that has led some phonologists (Beckman 1998; Howe & Pullwylblank 2001, 2004) to introduce the constraint in (7):

- (7) *[CG]
No constricted glottis

However, this cross-linguistic tendency is mitigated by the phonetic salience of ejectives (Kingston 1985, Ham 2008, inter alios). There are indeed languages (e.g. Berta, Zulu, Tigre) that include ejective segments in their phoneme inventory to the exclusion of the corresponding pulmonic counterparts (Maddieson 1984). Data such as these argue in favor of the faithfulness constraint in (8), after similar proposals found in Beckman (1998), Howe & Pulleyblank, Kim & Pulleyblank (2009)³:

- (8) IDENT[CG]
Correspondent segments in input and output have identical values for [CG]

4.2.2 Yucatec ejectives: issues on their saliency

4.2.2.1 Early perceptual reports

In reference to ejectives, Beltrán's (1859 [1742]) grammar of Yucatec Maya describes this language as we “a bush full of thorns, because of 6 consonants [our 5 ejectives and /ts/] so hard to produce that [most people] have problems with them, even after years of practice, a complete master of the vocabulary and a deep knowledge of grammar rules... [our non-literal translation]”. The six consonants to which the author refers to are the obstruent ejectives and the plain alveolar affricate, alien to the Spanish phonological system. It is important to observe that, according to this author, the only ‘quasi-guttural’ obstruent is the velar ejective, produced “...with an impetuous repercussion originating close to the uvula, and hard to describe because it resembles no [language] sound” [our translation] (p. 3). However, his detailed articulatory descriptions of Yucatec ejectives *systematically* refer to an *impetuous release of the air*, we infer in contrast with the weaker release found in their plain counterparts. Furthermore, it is important to notice Beltrán's description of /tʃ/: ‘it is pronounced ejecting the air with some more impetus than in the pronunciation of /ts/’ (p. 2). We find here an unbiased account of a difference in the strength of the ejective gesture between the 2 Yucatec affricates, which is reflected in the perceptual patterns observed among our L2ers.

Zavala (1896) further supports the description of Yucatec ejectives as acoustically salient sounds, hinting also at another difference observed in the perceptual performance

³ To the exception of Beckman, IDENT[CG] is stated as MAX[CG]. However, we will follow here the standard assumption that feature preservation is formally captured via identity, not maximality, constraints (see McCarthy 2008).

of our L2ers. In a brief mention of the articulation of these sounds, *Zavala refers to the ejection in peripheral articulations as violent and 'dry': although /t/ is described as 'dry', there is no reference to a particularly abrupt release of air.* Within the limits of this early description, we seem to find evidence again in favor of a perceptual advantage for Yucatec /k'/ and /p'/ when compared to the alveolar ejective stop.

Finally, Tozzer (1921) observes that “the occurrence of the velar k (q) [kʰ/] and the glottalized or fortis forms of t [tʰ/], p [pʰ/], and the two dental surds (ɔ [tsʰ/] and tš [tʃʰ/]) give the language a certain harshness when compared with the Nahuatl of the north with its smooth liquid sounds... The fortis forms, called by the early Spanish grammarians “*las letras heridas*,” [...] are common and are characterized by a forcible expelling of the breath with glottal closure” (pp. 17-19, our emphasis).

These early references to the saliency of Yucatec ejectives are supported on acoustic grounds. Ejectives are characterized by the presence of 2 release bursts: the oral release and the glottal release (Johnson 2003), the former normally preceding the latter (Greenberg 1970), which seem to ‘gang up’ to differentiate them from 1-burst-only plain stops, an effect that *partially* explains the use of adjectives such as ‘harsh’, ‘almost-no-language-sound’ quality of these phonemes provided in Beltran and Zavala.

4.2.2.2 L1 acquisition of ejectives

A second argument in favor of the acoustic salience of Yucatec ejectives comes from Straight’s (1976) study of Yucatec L1 acquisition. His cross-sectional data reveals that children acquire ejectives in this language quite early. The database in Straight’s study includes production samples from a total of 21 Yucatec children aged 3 to 14 years. The striking finding in regard to ejectives is that these segments seem to be unmarked even among the youngest children’s production, as evidenced in Straight’s comments concerning Alberto’s data, the youngest of his subjects: “The phonetic differences between plain and ejective consonants are always clear in Alberto’s speech” (p. 85). Furthermore, when substitutions took place in Alberto’s data, the chances of substituting an ejective for a plain stop were as high as the opposite pattern. Based on evidence such as this, Straight assumes that “the feature [glottal constriction] is high in the developmental hierarchy, relative to such lower (later acquired) features as [fricative], [apical], or [fortis]... [t]he single feature of glottal constriction was as salient perceptually as the combined force of all of the other various features which define the place and manner of articulation of consonants (1976: 211). He goes on to further claim that “[g]lottal constriction is an early feature to stabilize in child language when it figures in the definition of consonantal oppositions” (p. 216).

4.2.2.3 Acoustic correlates of Yucatec ejectives

The acoustic saliency of ejectives is well attested in the phonetic literature. Ladefoged & Maddieson (2002) discuss the greater intensity of the release associated with these sounds, due in part to the fact that “[t]he pressure behind the closure in the oral cavity is often increased to about double the normal pulmonic pressure” (2002: 78). We assume

that the intensity differences characteristic of ejectives are related to the use of an air stream mechanism that requires a double occlusion: one conferring the sound its distinctive place of articulation, and another providing the sound its source of energy. The intensity resulting from the release of a double occlusion gives ejectives their perceptual edge. We provide in Figure 1 a waveform and spectrogram taken from the experimental tokens used in our AX task to illustrate our point:

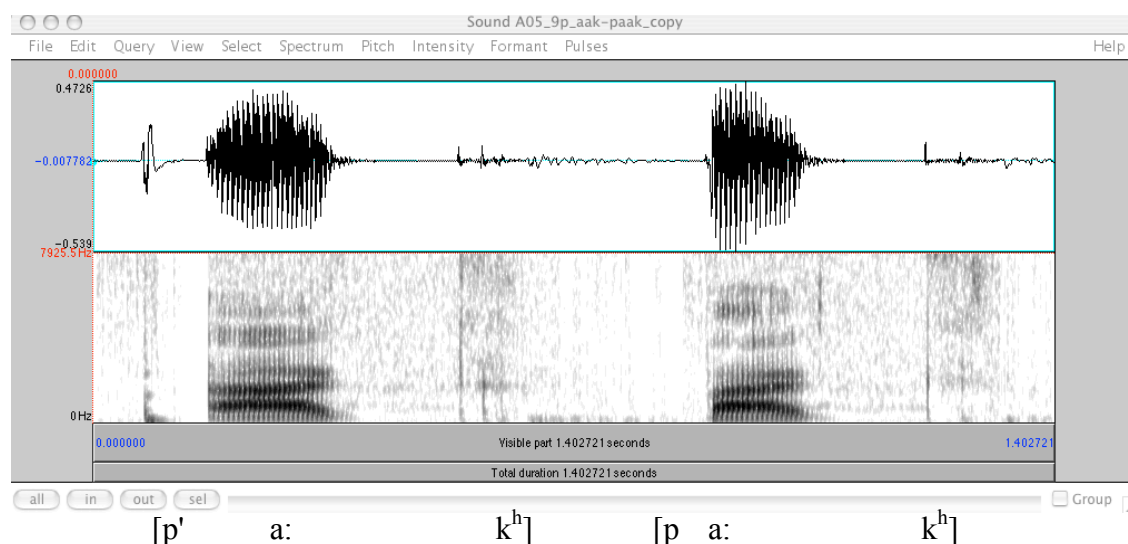


Figure 1: Ejective vs. plain stops in word initial position

In line with Ladefoged & Maddieson's (2002) remarks on clicks, we assume that a difference in terms of intensity constitutes a privileged signal for listeners to notice segmental material.

4.2.3 Relative perceptual salience among ejectives

4.2.3.1 Manner of articulation

Howe & Pulleyblank's (2004) analysis of the preferential preservation of the glottal gesture in stops and the preferential glottalization of sonorants results in their claim that faithfulness between input and output is maximally satisfied when the perceptual salience of the target segment is prime. These differential patterns are explained by positing the existence of a harmonic relationship between glottalised sonorants and obstruents, as illustrated in (9):

- (9) Harmonic scale among ejectives
 CG/STOP \succ CG/SON

Kim & Pulleyblank (2009) argue for a further elaboration of the scale in (9) in order to formalize the crosslinguistic marked status of ejective fricatives. It is also important to

observe that these authors explicitly assume that both ejective stops and affricates “are the least marked category” (2009: 578); however, Maddieson (1984) observes that “ejective affricates occur only in those systems containing glottalic stops (almost exclusively ejectives)” (1984: 109), whereas the reverse pattern is not attested. It is possible, then, to go a step further from Kim & Pulleyblank’s original scale, and elaborate as in (10):

- (10) Harmonic scale among ejectives (Revised version)
CG/STOP > CG/AFFR > CG/SON > CG/FR

Unlike the faithfulness-based interpretation of (9) argued for in Howe & Pulleyblank (2004), Kim & Pulleyblank translate the harmonic relationship between fricative and sonorant ejectives in terms of a markedness hierarchy, as in (11):

- (11) Fricative and sonorant ejectives: Constraint hierarchy
*CG/Fricative >> *CG/Sonorant

Gonzalez (2011) claims that *CG/Fricative plays an important role in predicting the impossibility of perceptually substituting a marked ejective fricative for an unmarked ejective affricate among Yucatec L2ers.

4.2.4 Ejective saliency and syllabic position

Previous research suggests that languages with ejectives favor their presence in onset position (Greenberg 1970), and are more resilient to deglottalization and debuccalization when in the same position (Fallon 2002). Our perceptual study contributes to the charting of a typology of ejective saliency, by providing a piece of evidence suggesting an asymmetrical preference for ejective stops in onsets and for ejective affricates in codas. This is formalized in the hierarchies in (12):

- (12) Context-determined fidelity to input [CG]
a) IDENT[CG]-CODA/AFFR >> IDENT[CG]-CODA/STOP
b) IDENT[CG]-ONS/STOP >> IDENT[CG]-ONS/AFFR

4.2.5 Place preferences among ejectives: universal tendencies versus language-specific choices

Based on Greenber’s (1970) generalizations on glottalic consonants, several studies (Javkin 1978, Fordyce 1980, Maddieson 1984) have confirmed the existence of an implicational relation among ejectives at the 3 main places of articulation:

- (13) Implicational universal for place preferences among ejective stops
[dorsal] < [coronal] < [labial]

The tendency to avoid front articulations is strong among the world languages. For example, Maddieson (1984) reports 11 languages that include both coronal and dorsal,

but not labial ejective stops in their phoneme inventory, and 5 other languages that include only a dorsal ejective stop. No instances of languages with only labial or coronal voiceless ejective stops have been documented. It seems safe to assume that dorsal ejective stops are crosslinguistically less marked than their coronal and labial counterparts. These markedness relations are susceptible to be formalized as in the hierarchy in (14):

- (14) Markedness hierarchy for PA among ejective stops
 $*CG/Stop[lab], *CG/Stop[cor] \gg *CG/Stop[dor]$

However, our L2ers displayed a perceptual advantage for onset /k'/ and /p'/, but not for /t'/. At least two possible explanations can be provided. First, there are diachronic data suggesting an unmarked status for the voiceless labial ejective in Yucatec Maya (Campbell 1973). Unlike other Maya languages, Yucatec Maya and Chol-Tzotzil substituted /p'/ for proto-maya */b/. Under the assumption the labial is the unmarked place of articulation for implosives but the marked place of articulation for ejectives (Greenberg 1970, Javkin 1978, Ladefoged & Maddieson 2002, Maddieson 1984), this historical change would be rather surprising, unless we assume the unmarked status of /p'/ in the phonology of Yucatec Maya. Secondly, we should bear in mind Zavala's (1896) early report on the presence of a more abrupt release of air for peripheral /k'/ y /p'/, but not for coronal /t'/. It seems reasonable, then, to formalize this perceptual advantage by exploding IDENT[CG]-ONSET/STOP into the sub hierarchy in (15):

- (15) Constraint sub hierarchy for onset ejective stops
 $IDENT[CG]-ONSET/STOP_{[PERIPHERAL]} \gg IDENT[CG]-ONSET/STOP_{[CORONAL]}$

Interestingly, the perceptual patterns observed among our EAs for coda plain-ejective contrasts are asymmetrical with respect to those predicted – and actually attested – by the hierarchy in (15): the coronal contrast was perceived significantly better than both the dorsal and labial dyads. In spite of the fact that we are not claiming the sub hierarchy in (15) to be the result of harmonic alignment *per se*, this perceptual pattern among our EAs can be accounted for if we assume that the hierarchical relationship observed in onset is reversed for ejective stops in coda position. This is illustrated in (16):

- (16) Context-determined faithfulness to input [CG]: coda ejective stops
 $IDENT[CG]-CODA/STOP_{[CORONAL]} \gg IDENT[CG]-CODA/STOP_{[PERIPHERAL]}$

4.2.6 Affricates: issues on relative salience

The perceptual preference for /tʃ'/ over /ts'/ among our L2 learners is, in principle, unexpected: cross-linguistic patterns do not suggest a strong preference for a palatal rather than a purely alveolar articulation among affricate ejectives, as suggested by the UPSID sample (Maddieson 1984): /tʃ'/ is found in 37 languages, /ts'/ in 36. Recall, however, Beltran's observation back in 1742 regarding the fact that the palatoalveolar ejective affricate was characterized by a more abrupt release of air than its alveolar

counterpart; it seems, then, that at least to Spanish ears, a perceptual distinction in favor of /tʃ/ is in place. We will claim here that this pattern is not the result of a direct ban against /ts'/, as suggested by its cross-linguistic distribution, but rather the result of the fixed Spanish ranking illustrated in (17), and its interaction with relevant structural and faithfulness constraints:

- (17) Relative ranking between coronal affricates: Spanish grammar
 *[ts] >> *[tʃ]

The motivation for this ranking is threefold. First, Spanish has [tʃ] but not [ts] in its phonological system: The palatoalveolar affricate is indeed not only a native segment, but it is actually one of the most highly frequent phonemes in Spanish, and one of the first to be acquired (Macken 1996). Secondly, in choosing [tʃ] over [ts], Spanish follows a cross-linguistic tendency in favor of palatoalveolar affricates. Maddieson (1984, p. 38) reports 141 languages with [tʃ], versus 95 languages with either [t͡s] or [ts]. Furthermore, data from the same source reveals that if a language is to have a single coronal affricate, [tʃ] is twice more likely to be chosen than [ts]. The marked status of [ts] has been previously documented in Lombardi's (2003) analysis of Japanese core stratum, where she proposes *[ts] to be a markedness constraint partially responsible for the restricted allophonic substitution of [ts] for [t] before [u]. Likewise, we propose that UG contains *[tʃ], a markedness constraint that accounts for the absence of the palatoalveolar affricate in 41 languages in UPSID. The relative ranking between *[ts] and *[tʃ], accounts for both [ts]-less and [tʃ]-less languages. Finally, differences in terms of the internal structure of both affricates can translate into perceptual differences. In [tʃ], the stop and the fricative gestures contrast in terms of place (dental/alveolar vs. palatoalveolar), whereas in [ts] they don't (both are dental/alveolar). In analogy to the polarization principle (Keating 1984)⁴, we claim that a greater place-of-articulation distance between the members of the palatoalveolar affricate promotes perceptual ease; the lack of a place contrast between members of the alveolar affricate, on the other hand, does not enhance perception.

5. An OT analysis of the gradual L2 acquisition of Yucatec ejectives

We claim here that the L2 acquisition of Yucatec C-C' contrasts is a *gradual* process of accommodating the learners' initial constraint ranking to the perceptual demands of the incoming acoustic signal. Recall (v.s. § 3) that LAs failed to accurately perceive C-C' contrast in onset position other than those involving peripheral stops. This is the result, we propose, of the ranking in (18):

⁴ According to this principle, the actual phonetic implementation of members of a phonological contrast will be driven by perceptual ease: the assumption is that the greater the phonetic distance, the easier the perception of a phonological contrast.

- (18) Early stage of acquisition of onset C-C' contrasts: Only /k'-/ and /p'-/ are perceived accurately

IDENT[CG]/ONSStop_[Periph], *[ts] >> *[CG] >>

IDENT[CG]/ONSStop_[Cor], IDENT[CG]/ONSAffr, *[tʃ]

Ranking IDENT[CG]/ONSStop_[Periph] over *[CG] is crucial to ensure accurate processing of peripherals, as the tableau in (19) shows; candidates differing in place of articulation are discarded since they violate high-ranked IDENT[PLACE]:

- (19) Spanish L2 perception of Yucatec [p'-]

[p'-]	IDENT[CG]/ONSStop _[Periph]	IDENT[PLACE]	*[CG]
☞ a. /p'-/			*
b. /k'-/		*!	*
c. /t'-/		*!	*
d. /p-/	*!		

Since *[CG] ranks higher than IDENT[CG]/ONSStop_[Cor] and IDENT[CG]/ONSAffr, inaccurate perception of the alveolar ejective stop and affricates is expected at early stages of acquisition in onset position:

- (20) Spanish L2 perception of Yucatec [t'-] and [tʃ'-]: LAs

[t'-]	IDENT[CG]/ONSStop _[Periph]	IDENT[PL]	*CG	IDENT[CG]/ONSStop _[Cor]
a. /p'-/		*!	!	
b. /k'-/		*!	!	
c. /t'-/			*!	
☞ d. /t-/				*
[tʃ'-]	IDENT[CG]/ONSStop _[Periph]	*CG	IDENT[CG]/ONSAffr	*[tʃ]
a. /tʃ'-/		*!		*
☞ b. /tʃ-/			*	*

Accurate perception of both [t'-] and [tʃ'-] by EAs, however, hints at an intermediate stage in the acquisition of the onset C-C' contrast, in which faithfulness to coronal stops and affricates takes precedence over the structural prohibition against the glottal gesture:

- (21) Intermediate stage in the acquisition of the onset C-C' contrast: [t'-] and [tʃ'-] are now perceived accurately

IDENT[CG]/ONSStop_[Periph], *[ts] >>

IDENT[CG]/ONSStop_[Cor], IDENT[CG]/ONSAffr_[Periph] >> *[CG], *[t]

We assume that *[CG] is demoted simultaneously below the 2 faithfulness constraints given the absence of a significant difference in the L2 perception of [t'-] and [tʰ'-], Successful perception of the coronal ejective stop is modeled in the partial grammar ranking in (22):

(22) Spanish L2 perception of Yucatec [tʰ'-]: EAs

[tʰ'-]	ID/[CG]/ONSStop _[Periph]	ID[PLACE]	ID/[CG]/ONSStop _[Cor]	*CG
a. /p'-/		*!		
b. /k'-/		*!		
c. /t'-/				*
d. /t-/			*!	

The results of our experimental test with EAs show that continued exposure to input [ts], [ts] and [tsʰ] will result in demotion of *[ts] below IDENT[CG]/ONSAffr, the ranking required in order to accurately perceive both members of the contrasting ts-/tsʰ- dyad. We assume that this is the last reranking in the learners' path to convergence with the target grammar, given the presence of a significant difference in the perception of ts-/tsʰ- when compared to all other onset C-C' contrasts. The relevant ranking is provided in (23):

(23) Last stage in the acquisition of the onset C-C' contrast: /tsʰ-/ is now perceived accurately

IDENT[CG]/ONSStop_[Periph] >> IDENT[CG]/ONSStop_[Cor], IDENT[CG]/ONSAffr
>> *[CG], *[ts]

Accurate perception of Yucatec /tsʰ-/ by EAs is modeled in the tableau in (24):

(24) Spanish L2 perception of Yucatec /tsʰ-/: EAs

[tsʰ'-]	IDENT[CG]/ONSAffr	*[CG]	*[ts]
a. /tsʰ'-/		*	*
b. /tsʰ'-/	*!		*

Since accurate perception of -ts-/tsʰ and -tʃ-/tʃʰ was attested in both LAs and EAs, we assume that the ranking provided in (25) accounts for processing of the relevant input material by the experimental groups:

(25) Rankings predicting accurate perception of [-tʃ] and [-tsʰ]: EAs

IDENT[CG]/CODAAffr >> *[ts] >> *CG >> *[tʃ], *CODA/Affr:

All coda affricates are perceived faithfully.

Acquisition of ejective coda stops, on the other hand, was a gradual process summarized in (26), where figures in parenthesis indicate the number of subjects with perceptual patterns corresponding to a specific stage:

(26) Predicted acquisition stages for Yucatec ejective coda stops:

Stage 1: No ejective coda stop is perceived accurately (2 LAs, 1 EA)

(1) *CG/Stop[lab], *CG/Stop[cor] >> *CG/Stop[dor] >>
IDENT[CG]/CODAStop_[cor] >> IDENT[CG]/CODAStop_[periph]

Stage 2. Three attested possibilities:

→ [-kʰ] will be perceived accurately before [-tʰ] and [-pʰ] (2 LAs, 1 EA)

(2a) *CG/Stop[lab], *CG/Stop[cor] >> IDENT[CG]/CODAStop_[cor] >>
IDENT[CG]/CODAStop_[periph] >> *CG/Stop[dor]

→ Both [-kʰ] and [-tʰ] have a chance to be perceived accurately (1 EA)

(2b) *CG/Stop[lab] >> IDENT[CG]/CODAStop_[cor] >> *CG/Stop[cor] >>
IDENT[CG]/CODAStop_[periph] >> *CG/Stop[dor]

→ Both [-kʰ] and [-pʰ] have a chance to be perceived accurately (1 EA)

(2c) *CG/Stop[cor] >> IDENT[CG]/CODAStop_[cor] >>
IDENT[CG]/CODAStop_[periph] >> *CG/Stop[dor], *CG/Stop[lab]

Stage 3: All ejective coda stops are perceived accurately (3 EAs)

(3) IDENT[CG]/CODAStop_[cor] >> *CG/Stop[cor] >>
IDENT[CG]/CODAStop_[periph] >> *CG/Stop[dor], *CG/Stop[lab]

5. Conclusions

The study of the Spanish L2 acquisition of Yucatec ejectives has strengthened the claim that L2ers filter incoming perceptual input through their featural system. Furthermore, it constitutes an apologia to harmony-as-faithfulness: differences in the perceptual acquisition of L2 contrasts were formalized within OT via a set of perceptually and prosodically motivated constraints, introduced in the grammar in the form of both prominence hierarchies, and faithfulness-based harmonic scales. The interaction of harmonically aligned faithfulness constraints with structural restrictions accounted for the attested perceptual patterns among our L2ers. An OT analysis also allows to illustrate the conflict of L1, L2 and universal constraints in the processing of perceptual L2 input, and allows to formalize the gradual nature of the L2 acquisition process. More importantly, the analysis of the Spanish L1-Yucatec L2 learning situation constitutes a first within the field of studies in SLA. By providing new L1-L2 data, our research significantly contributes to a theory that greatly relies on cross-linguistic surveys in order to test the validity of hypotheses about UG.

References

- Archibald, John. 1998. *Second Language Phonology*. Philadelphia, PA: John Benjamins.
- Beltran, Pedro. 1859. *Arte del idioma maya reducido a sucintas reglas, y semilexicon yucateco (2a ed.)*. Mérida, Yucatán: Imprenta de J.D. Espinosa.
- Brown, Cynthia A. 1997. *Acquisition of segmental structure: Consequences for speech perception and Second Language Acquisition*. Doctoral dissertation. McGill University.
- Campbell, Lyle. 1973. On Glottalic Consonants. *International Journal of American Linguistics*, 39(1): 44-46.
- Clements, G.N. 1990. The role of the sonority cycle in core syllabification. In *Papers in Laboratory Phonology 1: Between the Grammar and Physics of Speech*, eds. John Kingston & Mary E. Beckman, 283-333. New York: CUP.
- Clements, G.N. 2001. Representational economy in constraint-based phonology. In *Studies in Distinctive Feature Theory*, eds. Hall, Tracy A. and Ursula Kleinhanz, 71-146. Berlin: Mouton de Gruyter.
- Colina, Sonia. 2009. *Spanish Phonology: A syllabic perspective*. Washington DC: Georgetown University Press.
- Fallon, Paul Dennis. 2002. *The Synchronic and Diachronic Phonology of Ejectives*. UK: Routledge.
- González Poot, Antonio Arcenio. 2011. *Conflict resolution in the Spanish SLA of Yucatec ejectives: L1, L2 and universal constraints*. Doctoral dissertation. University of Calgary.
- Gouskova, Maria. 2002. Relational hierarchies in OT. In *WCCFL 21 Proceeding*, eds. Mikkelsen, L. and C. Potts. Somerville, MA: Cascadilla Press.
- Greenberg, Joseph H. 1970. Some Generalizations concerning Glottalic Consonants, Especially Implosives. *International Journal of American Linguistics* 36(2): 123-145.
- Hancin-Bhatt, Barbara. 2008. Second language phonology in optimality theory. In *Phonology and Second Language Acquisition*, eds. Zampini, M., and J. Hansen. UK: Cambridge University Press.
- Howe, Darin and Douglas Pulleyblank. 2004. Harmonic Scales as faithfulness. *Canadian Journal of Linguistics* 49: 1-49.
- Kim, Eun-Sook & Douglas Pulleyblank. 2009. Glottalization and Lenition in Nuu-chah-nulth. *Language Inquiry* 40(4): 567-617.
- Larson-Hall, Jenifer. 2004. Predicting perceptual success with segments: a test of Japanese speakers of Russian. *Second Language Research* 20(1): 33-76.
- Ladefoged, Peter & Ian Maddieson. 2002. *The Sounds of the World's Languages*. Malden, MA: Blackwell Publishing.
- Maddieson, Ian. 1984. *Patterns of sounds*. Cambridge: CUP.
- Matthews, John. 1997. The influence of pronunciation training on the perception of second language contrasts. In *New Sounds 97*, eds. Leather, Jonathan and Allen James, 223-229.
- McCarthy, John J. and Alan Prince. 1999. Faithfulness and identity in Prosodic Morphology. In *The Prosody-Morphology Interface*, eds. Kager, René, Harry van der Hulst, and Wim Zonneveld, 218-309. Cambridge: CUP.
- Prince, A. & P. Smolensky. 2004. *Optimality Theory: Constraint Interaction in Generative Grammar*. Malden, MA: Blackwell.
- Selkirk, E. O. 1984. On the major class features and syllable theory. In *Language Sound Structures*, eds. Aronoff, Mark and R. T. Oehrle, 107-136, Cambridge, MA: MIT Press.
- Stevens, Kenneth N. and Samuel Jay Keyser. 1989. Primary features and their enhancement in consonants. *Language* 65(1): 81-106.
- Straight, H. Stephen. 1976. *The Acquisition of Maya Phonology. Variation in Yucatec Child Language*. New York: Garland Publishing.
- Tozzer, Alfred. 1921. *A Maya Grammar: With Bibliography And Appraisalment Of The Works Noted*. Reprint by Kessinger Publishing.
- Zavala, M. 1898. *Gramática maya*. Mérida, Yucatán: Imprenta de la Ermita.