Can a bilingual lexicon be sustained by phonotactics alone?

Evidence from Ecuadoran Quichua and Media Lengua

John M. Lipski
The Pennsylvania State University

This study focuses on bilingual speakers of Ecuadoran Quichua and the mixed language known as Media Lengua, which consists of Quichua morphosyntactic frames with all content word roots relexified from Spanish. For all intents and purposes, only the lexicon – more specifically, lexical roots – separate Media Lengua from Quichua, and yet speakers generally manage to keep the two languages apart in production and are able to unequivocally distinguish the languages in perception tasks. Two main questions drive the research effort. The first, given the very close relationships between Quichua and Media Lengua, is whether each language has a distinct lexicon, or a single lexical repository is shared by the two languages. A second and closely related question is the extent to which language-specific phonotactic patterns aid in language identification, possibly even to the extent of constituting the only robust language-tagging mechanism in a joint lexicon. Using lexical-decision and false-memory tasks to probe the Quichua-Media Lengua bilingual lexical repertoire, the results are consistent with a model based on a single lexicon, partially differentiated by subtle phonotactic cues, and bolstered by contemporary participants' knowledge of Spanish as well as Quichua.

Keywords: Quichua, Media Lengua, Spanish, Ecuador, bilingual lexicon, lexical decision, false-memory

There is substantial evidence that for bilinguals, the mental representations of the languages are not entirely independent of one another (Grosjean, 1989). Moreover, there is a large body of research indicating that bilinguals do not completely inhibit the non-target language in production or processing (Hermaans et al., 1998; Kroll, Misra, Bobb, & Guo, 2008; Kroll, Dussias, Bogulski & Valdés Kroft,

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2011; van Heuven, Schriefers, Dijkstra, & Hagoort, 2008). These observations notwithstanding, the natural assumption is that bilinguals know which language they are speaking at a given time, and similarly that they can recognize and distinguish the same languages in processing, but the means by which such acknowledgment and recognition are achieved are not always clear. In many – perhaps most – instances, there are substantive morphosyntactic, lexical, and phonotactic differences between the languages that ensure quick and unambiguous identification. In other cases, e.g. among closely related regional languages, there may be enough overlap in one or more dimensions to create areas of ambiguity, with frequent fluid and not always deliberate shifting between the systems, which engenders debates as to the qualitative nature of language-dialect-register distinctions (e.g. Muysken, 2000, chapter 5).

The present project examines an unusual language contact environment that can offer a unique perspective on the bilingual lexicon and its role in language identification and language mixing. The languages are Ecuadoran Quichua (as the Quechua languages are referred to in Ecuador) and the mixed language known as Media Lengua, which consists of Quichua morphosyntactic frames with all content word roots relexified from Spanish. For all intents and purposes, only the lexicon – more specifically, lexical roots – separate Media Lengua from Quichua, and yet speakers generally manage to keep the two languages apart in production, and are able to unequivocally distinguish the languages in perception tasks. The existence of small speech communities of Quichua-Media Lengua bilinguals provides a typologically unique linguistic environment in which to determine the extent to which lexical differences alone can keep two languages apart. The following sections describe a series of experiments (lexical decision and false-memory) designed to provide a first glimpse into the linguistic feature(s) responsible for speakers' ability to distinguish the languages. Two main questions drive the research effort. The first, given the very close relationships between Quichua and Media Lengua, is whether each language has a distinct lexicon, or a single (language-tagged) lexical repository is shared by the two languages. A second and closely related question is the extent to which language-specific phonotactic patterns aid in language identification (e.g. Altenberg & Cairns, 1983; Ju & Luce, 2004; Lagrou, Hartsuiker, & Duyck, 2011; Weber & Cutler, 2004), possibly even to the extent of constituting the only robust language-tagging mechanism in a joint lexicon.

Preliminary experimental results are consistent with a model based on a single lexicon, partially differentiated by subtle phonotactic cues, and arguably bolstered by contemporary participants' knowledge of Spanish as well as Quichua. When language-specific knowledge is removed from the equation, e.g. when responding to non-words in lexical decision tasks, the role of phonotactic patterns is the only

remaining resource for potential language identification. These tenuous differences may contribute to the apparent instability of Media Lengua, which appears to have survived for no more than a few generations in the communities for which it is documented (Lipski, 2019).

The role of the bilingual lexicon in language identification

A common thread in generative models of bilingual grammars is the proposal that "All differences between languages are ultimately lexical in nature. A particular language results from the specific properties of a particular lexicon and a set of universal linguistic principles" (Muysken, 2000, p. 37). Critical to any model of bilingual production and processing is therefore the nature of the bilingual lexicon(s), centering around two major issues: lexical storage and language tagging, and language recognition. The bilingual lexicon is therefore fundamental in language identification, above and beyond the general complexities of isolating and recognizing spoken words (e.g. Dahan & Magnuson, 2006). Muysken (2000, p. 133) asks "how do we know to which language a given word belongs? This language may be the context in which the word was acquired, but more clearly the morphophonemic patterns of a language play a role as algorithms for assigning a word to a given language. Where the languages are morphophonemically similar, it may not be possible to assign an unambiguous language index." If recognition of a word as belonging to a specific language is tied to the accompanying morphosyntactic frame in which it appears, then if two languages also share morphosyntactic similarities, the task of differentiating the languages extends beyond the level of individual words; the greater the overall similarities, the more cognitive resources need to be harnessed by bilinguals. Extrapolation to the extreme limiting case involves probing for any remaining production and processing mechanisms that could ensure the differentiation of two languages in bilingual contact that share similar phonotactics, identical morphosyntax, but have disjoint lexical repertoires. Taking Quichua-Media Lengua bilingualism as a limiting case for the bilingual lexicon (identical morphosyntax and basic phonotactics, disjoint lexical repertoires; e.g. Muysken, 2000, p. 37), the crux of the matter can be stated as follows: if bilingual lexical access is generally non-selective, and if all syntactic material is projected from the lemma level (and recognition of a word as belonging to a specific language is tied to the accompanying morphosyntactic frame in which it appears), then what mechanism(s) do Quichua-Media Lengua bilinguals use to keep the languages apart? The present project takes a fine-grained look at the bilingual lexicon, unencumbered by typological differences and divergent morphology.

Quichua and Media Lengua in Ecuador

In the Andean highlands of South America Quechua – the language of the former Inca empire – has been in contact with Spanish for some five centuries, and a broad panorama of contact-induced phenomena can be observed. For example, Spanish affixes have been borrowed into many varieties of Quechua (e.g. Muysken 2012a, 2012c) and there are also varying degrees of lexical borrowing, typically nouns, verbs, and some adjectives (e.g. Sánchez, 2012). These Spanish-garnished Quechua varieties are clearly distinguishable from even the most Quechua-influenced Spanish interlanguage phenomena, which are all essentially Spanish-based (Calvo Pérez 2001; Cerrón Palomino 1976; Escobar 2000; Haboud 1998; Lipski 2013, 2014; Merma Molina 2004, 2007; Muysken 1980, 1982, 1985; Sánchez 2003).

In Ecuador, the Quechua dialects are collectively referred to as Quichua (a reflection of the lack of mid-vowel allophones in Ecuadoran varieties). In addition to Spanish-tinged Quichua and Quichua-influenced Spanish, a putative "third language" has been documented for a few indigenous communities in highland Ecuador, referred to as *Media Lengua*, literally 'half-language.' Media Lengua consists of Quichua morphosyntax with nearly complete replacement of Quichua lexical roots by their Spanish counterparts. Media Lengua was first brought to the attention of linguists by Muysken (1979, 1981, 1982, 1988, 1996, 1997, 2012b), who, based on field research conducted in the mid 1970's described the language behavior of speakers in rural communities in the province of Cotopaxi, to the south of Quito. Today this region has shifted to Spanish, and Media Lengua is no longer the basis for daily communication, although a literal handful of speakers still remains (Müller 2011; Shappeck 2011; also verified by the present author during visits in 2018 and 2019).[1]

Although the Media Lengua varieties encountered in the 1970's have all but disappeared, in the northern province of Imbabura, Media Lengua is alive and well in three small communities, and provide the data for the present project. Gómez Rendón (2005, 2008) is the first study of the Media Lengua spoken in the indigenous communities of Angla and Casco Valenzuela, in the *parroquia*

1. Muysken (1979, p. 55) also briefly described another Media Lengua-like variety spoken near Cañar in southern Ecuador, but field work by the present author in 2017 revealed that this speech form was in effect the first efforts of monolingual Quichua speakers to communicate in Spanish and may never have been more than a transitional variety. Muysken additionally mentioned a third mixed variety near Saraguro in Ecuador's southernmost province of Loja, but in 2018 the present author visited the same community in which Muysken had encountered Media Lengua (Oñakapak), and once more found only memories of this way of speaking, although Quichua is still spoken by many older residents and is being taught as a second language to children in the community school.

'parish' of San Pablo del Lago in the *cantón* 'county' of Otavalo. In these villages Media Lengua continues to be used (together with Quichua) on a daily basis by most residents, although many of the youngest community members primarily use Spanish. The analysis shows Imbabura Media Lengua to be less Hispanized than the Cotopaxi variety, in effect a nearly complete relexification of Quichua. Media Lengua is also present in the community of Pijal, in the *parroquia* 'parish' of González Suárez (Stewart, 2011, 2013, 2015) near the Pan American Highway and located about an hour's walk downhill from the aforementioned communities. Although according to oral tradition the Media Lengua of Angla and Casco Valenzuela was brought from Pijal, in the latter community only some older adults continue to use Media Lengua, while younger residents speak only Spanish and have only passive knowledge of Media Lengua and Quichua.

Media Lengua is not a cline or continuum of relexification, ranging from mostly Quichua to mostly Spanish lexical roots. Rather, the replacement of Quichua roots by Spanish roots is nearly complete. Muysken (1988, p. 409) notes that "[...] what is peculiar about Media Lengua is not so much that it contains Spanish words (many dialects of Quechua do as well), but that *all* Quichua words, including core vocabulary, have been replaced" and also "All Quechua dialects have borrowed heavily from Spanish, up to roughly 40%, but there are no dialects which borrowed more than 40%. Thus there is an enormous gap between the 40% of hispanized Quechua dialects and the over 90% of Media Lengua" (Bakker & Muysken, 1994, p. 44). The present author's informal estimate for Spanish borrowings in Imbabura Quichua is less than 5% (collected transcriptions such as Díaz Cajas, 2008 suggest even lower numbers), so that the Quichua-Media Lengua contrast is quite pronounced.

An example of Imbabura Media Lengua is given in (1); Spanish-derived roots are in italics and tonic syllables are underlined in this pospositional agglutinative language, in which stress always moves to the penultimate syllable when adding affixes to a root:

(1) *Yu*-ka *bus*-kuna-man *midialingua*-pi *abla*-ngapa-mi *kiri*-ni
I-TOP you-PL-DAT Media.Lengua-LOC speak-DES-AFFIRM want-1SG
'I want to speak to you (pl.) in Media Lengua'

All of the lexical roots are derived from Spanish: *yo* 'I,' *vos* 'you (s.),' *media lengua, hablar* 'to speak,' *querer* 'to wish,' but the 3-vowel system (Spanish /e/ > /i/ and /o/ > /u/), word order and all agglutinative morphemes are entirely Quichua and monolingual Spanish speakers are unable to parse this utterance. The corresponding Quichua sentence would be:

(2) ñuka-ka kan-kuna-man kichwa-pi rima-ngapa-mi muna-ni
I-TOP you-PL-DAT Quichua-LOC speak-DES-AFFIRM want-1SG
'I want to speak to you (pl.) in Quichua'

In order to avoid confusion caused by the stress shift that accompanies the addition of agglutinative morphemes, only bare nouns and verbal infinitives (or invented items that could be construed as such) were employed in the experiments described below.[2] Moreover, no test item was more than three syllables long, or ended in sound configurations that could be mistaken for a morpheme that could attach to a noun or verb.

Previous research conducted with Quichua-Media Lengua bilinguals in Imbabura (Lipski, 2017a, 2017b, 2020; Deibel, 2020) has confirmed speakers' abilities to distinguish the two languages reliably in both production and processing, but the precise means by which this identification is effected in the presence of identical morphosyntax are not clear. When queried explicitly as to how they distinguish Quichua and Media Lengua, speakers typically respond that they "just know," and are unable to offer explicit criteria that might be in play. In everyday life, it is unlikely that the issue of explicit language identification ever arises, since speakers and their interlocutors choose their languages based on pragmatic factors. In the absence of such a context, e.g. when hearing isolated words or short phrases, by process of elimination two possibly overlapping criteria are foremost: knowledge of Spanish as well as Quichua, and language-specific phonotactic cues. The present study represents a first attempt to isolate the role of the lexicon itself in facilitating language identification.

All current speakers of Media Lengua also know Spanish, with proficiency levels ranging from relatively low for older speakers to high among younger residents. Even the least proficient Spanish speakers are familiar with the lexical roots that routinely appear in Media Lengua, so it is not feasible to directly tease out the effects of the Spanish lexicon. However, by presenting participants with a combination of real Quichua and Media Lengua words as well as non-words from each language, the relative contributions of lexical knowledge and phonotactic cues can be examined more closely.

2. All verbs in Quichua and Media Lengua are completely regular, with infinitives ending in *-na* and carrying the usual penultimate stress.

The ecological setting of Media Lengua

Currently, Media Lengua has the greatest vitality in the indigenous communities of Angla and Casco Valenzuela. The two villages are located on opposite slopes of a small valley; by foot they are about twenty minutes apart. Most residents are small farmers and herders, who sometimes need to walk considerable distances to reach their fields or to take animals (sheep and some cows) to pasture. Angla has perhaps one hundred families while Casco Valenzuela has less than half that number. Literacy rates among older adults is quite low, especially among women, since until recently many rural families did not send girls to school. The children of both communities currently attend school in El Topo, another hamlet located in the same valley, about equidistant (a fifteen-minute walk) from both Angla and Casco Valenzuela. Despite the proximity, Media Lengua is not spoken in Topo or other nearby communities, although some children acquire a basic knowledge of Media Lengua from their classmates. Quichua is the dominant language of older speakers in Angla, while younger residents of Angla and most residents of Casco Valenzuela prefer to speak Media Lengua, although they are also fluent in Quichua. In Pijal, on the other hand, only a subset of older residents speaks Media Lengua, and even fewer residents are fluent in both Media Lengua and Quichua. Younger residents speak only Spanish, although they may possess some passive competence in Quichua or Media Lengua.

The communities in which Media Lengua and Quichua are spoken receive few outside visitors, despite their ready accessibility by public and private transportation, but they have welcomed scholars and students who express an interest in their culture and languages. At the same time, conducting field research in this region entails challenges not found in more academically-grounded environments, and among other factors, generally requires a larger number of participants in order to obtain significant results (e.g. Speed, Wnuk, & Ajid, 2018; Whalen & McDonough, 2015). Most potential participants have little or no familiarity with computers or other digital devices (many have never even put on headphones), and have no experience with questionnaires, surveys, or metalinguistic judgments of any kind. Many adults spend the daylight hours tending to their crops and animals, exhausting tasks often carried out at a considerable distance from their dwellings. The logistics of meeting participants in a suitable setting require patience and flexibility, but are fully rewarded by community members' natural intellectual curiosity and willingness to engage in novel activities. The present author has been conducting interactive research in these communities for a decade, in a mutual learning process that has yielded increasingly promising and reliable responses as well as a genuine spirit of collaboration.

Quichua, Media Lengua, and Spanish phonotactics

Upon first hearing Imbabura Quichua and highland Ecuadoran Spanish, the two languages give the impression of sharing the same phonetic structures, but despite some phonetic convergence in bilingual speakers (Lipski, 2015; Stewart, 2011, 2015), there are phonological and phonotactic differences. The phonotactics of Media Lengua roots essentially reflect local vernacular Spanish, with one exception (intervocalic [z]) described below.[3] As a first step in the search for sub-phonemic patterns that may differentiate Quichua and Media Lengua, an Imbabura Quichua corpus was constructed from the traditional narratives transcribed in Díaz Cajas (2008) and Ministerio de Educación (2009), and an Imbabura Media Lengua corpus was constructed from the transcribed narratives in Stewart (2013). Since Quichua and Media Lengua share identical morphological affixes, a Python script was used to strip off all agglutinative morphemes, leaving only the lexical roots.[4] This allowed for the calculation of syllable frequencies and transitions.

- VOWELS. Quichua has three vowel phonemes (a front, generally high /ɪ/, low /a/, and back and generally high /ʊ/), while monolingual Spanish has the usual five-vowel system: /i/, /e/, /a/, /o/, /u/. The Spanish spoken by many Quichua-Spanish bilinguals in Imbabura does not fully differentiate mid and high vowels, although individual vowel tokens occupy a larger acoustic space than the corresponding Quichua vowels (Lipski, 2015). Imbabura Media Lengua vowels tend more toward the three-vowel Quichua system, but with a greater proportion of mid vowel tokens (Stewart, 2011). For the purposes of this study, only the three vowels /i/, /a/, and /u/ were used in both words and non-words.
- CONSONANT INVENTORY. Quichua is often described as lacking phonologically distinct voiced stops, but Imbabura Quichua presents numerous examples of word-initial and intervocalic voiced stops, some in assimilated Spanish borrowings such as *buru* (Sp. *burro*) 'donkey'(Cole, 1982, p.199), and others

3. These overall phonotactic differences may be subject to subtler within-language variation based on syllable frequencies and transition probabilities, and it is possible that recognition of Quichua or Media Lengua lexical items is reinforced by statistical learning of these patterns. Transitional probabilities, biphone and syllable frequencies, and neighborhood densities have been calculated for Spanish (e.g. the BuscaPalabra program of Davis & Perea, 2005), but no similar data exist for either Quichua or Media Lengua. The results of the experiments reported in the present study show no signs of such low-level phonotactic bootstrapping, but a more fine-grained approach may reveal some recurring patterns.

4. I am grateful to Isabel Deibel for her assistance with the implementation of this project.

in patrimonial Quichua words (e.g. *batu* 'coarse,' *dalina* 'to whip,' *pugyu* 'well spring'), so that this cannot be regarded as a robust phonotactic differentiator. Imbabura Quichua obstruents are automatically voiced in post-nasal contexts, e.g. *kan-pak* [kam.ba(k)] 2.S-GEN 'yours' and word-internally before /ɾ/ (e.g. *wagra* 'cow,' *chagra* 'farm,' *rigra* 'arm,' and the immediate future suffix *-gri*, as in *ri-gri-ni* go-FUT-1.S 'I will go'). Spanish has /b/, /d/ and /g/ in phonological opposition to /p/, /t/, /k/, for example *pata* 'paw' vs. *bata* 'robe'; *arte* 'art' vs. *arde* 'burn-3.S'; *coma* 'comma, coma' vs. *goma* 'rubber.' Imbabura Media Lengua partially exhibits a voicing distinction among stops following the Spanish sources (Stewart, 2015): *punina* (Sp. *poner*) 'to put'; *bus* (Sp. *vos*) 'you (s.)'; *tudu* (Sp. *todo*) 'all'; *kirina* (Sp. *querer*) 'to want'; *guta* (Sp. *gota*) 'drop'.. Quichua has the fricative phoneme /ʃ/, absent in Spanish (e.g. *ushi* [u.ʃi] 'daughter,' *shitana* [ʃi.ta.na] 'to throw'), but lacks the intervocalic tap /ɾ/ vs. trill /r/ distinction found in Spanish, e.g. Sp. *caro* [ka.ro] 'dear' vs. *carro* [ka.ro] 'car' (Toapanta, 2012), but only marginally maintained in Media Lengua. In the only language-specific case, Media Lengua – but not Spanish – has several Spanish-derived words with intervocalic [z], possibly reflecting the status of Spanish sibilants until the end of the 16th century: *kazana* < Sp. *casar* 'to marry,' *kuziina* < Sp. *cocinar* 'to cook,' *kaza* < Sp. *casa* 'house,' *azina* < Sp. *hacer* 'to do. make,' etc.[5] Imbabura Quichua does not normally present prevocalic [z], although this sound has occasionally been documented for a few words (Cole, 1982, p. 200), none of which has been observed among Media Lengua speakers (e.g. *zambo* 'squash,' pronounced with initial [s] by all speakers known to the author). Thus the presence of intervocalic [z] is arguably the only reasonably consistent Media Lengua-specific phone, and given the small number of attested Media Lengua words with intervocalic [z], the relative cue strength of this configuration might seem to be low. However given the relatively high text frequency of *kaza* 'house' and forms of *azina* 'to make, do' and *kuzina* 'to cook' in the corpus, out of 560 syllable types, [zi] (268 = 1.9%, rank 14) and [za] (57 = 0.4%, rank 59) are among the more prominent syllable types.[6]

5. Many highland varieties of Ecuadoran Spanish voice word-final /s/ when closely followed by a vowel-initial word, e.g. *los otros* [lo.zo.tros] 'the others' (Bradley, 2005; Chappell, 2011; García, 2015; Lipski, 1989; Robinson, 1979). This is a syntactically-grounded process apparently unrelated to the strictly word-internal intervocalic [z] found in Media Lengua, although Davidson (2019) in an experimental study found higher rates of /s/-voicing among Ecuadoran speakers with greater knowledge of Quichua.

6. In 2020, the author played recorded Quichua sentences to speakers from nearby communities who did not know Media Lengua, and asked them to translate into what they imagined Media Lengua would be like (explained as making all words Spanish-like). Several respondents

– SYLLABLE STRUCTURE. Quichua has very few consonant clusters in the syllable onset, mostly limited to /gɾ-/ as in *rigra* 'arm,' *chagra* 'farm,' and found only word-internally. This distribution suggests that word-initial onset clusters and onset clusters of the type /C + l/ may be uniquely Spanish/Media Lengua. Media Lengua, like Spanish, has all STOP + LIQUID combinations except for /tl-/, /dl-/ and also /fl-/ and /fɾ-/: *prisiu* (Sp. *precio*) 'price'; *brasu* (Sp. *brazo*) 'arm'; *plata* 'silver, money'; *blanku* (Sp. *blanco*) 'white'; *flaku* (Sp. *flaco*) 'skinny'; *fruta* 'fruit'; *utru* (Sp. *otro*) 'other; *madri* (Sp. *madre*) 'mother'; *krus* (Sp. *cruz*) 'cross'; *grandi* (Sp. *grande*) 'big'; *klasi* (Sp. *clase*) 'class'; *ariglana* (Sp. *arreglar*) 'to arrange.. Quichua routinely exhibits both word-internal and word-final coda /-k/ (usually realized as [g], [ɣ], or [x] in Imbabura), as in *yurak* 'white,' *kuklak* 'brooding hen,' *kunkuksi* 'gaudy,' while in Spanish coda /-k/ is relatively uncommon, found only in Latinate words that did not undergo the usual diachronic changes (e.g. *octavo* 'eighth,' *doctor*, etc.). Spanish coda /-g/ is even more uncommon, found predominantly in Greek-derived words such as *dogma, paradigma*, etc. In Quichua, coda /-k/ can appear before onset /ʒ/ (e.g. *pugllana* 'to play'), /ʃ/ (e.g. llugshina 'to leave'), and /ʧ/ (e.g. *agcha* 'hair'), all of which are impossible combinations in Spanish. The sequence of coda /-k,-g/ + /ʃ/, /ʒ/, or /ʧ/ emerges as the most un-Spanish-like Quichua-specific phonotactic combination. In the Quichua corpus, out of 168 different syllable boundary transitions, transitions of coda /-k/ plus a palato-alveolar consonant represented 0.4% of the total, rank approx. 60. Another consistent Quichua-specific combination is coda /-ʃ/ plus /k-/ (e.g. *ishkay* 'two') or /t-/ (e.g. *llushtina* 'to peel').[7] Since intervocalic [ʃ] may be confused with the affricate [ʧ] or the voiced [ʒ] found in Quichua, Media Lengua, and local Spanish, coda /-ʃ/ represents a more propitious environment for determining the effect of language-specific phonotactics on lexical organization. In the Quichua corpus, coda /- ʃ / + consonant combinations represented 1.5% of the total, rank approx. 20. Quichua also has a few words with coda /-t/ followed by /k-/ (e.g. *hutku* 'cave, hole,'*utka* 'rapidly'). This configuration is not found in any patrimonial Spanish word, and in fact Spanish coda /-t/ is largely confined to a pair of exogenous items such as *Atlántico* 'Atlantic' and *atleta* 'athlete.'[8] Thus /-tk-/ potentially represents a low-level Quichua-specific phonotactic cue. In the Imbabura Quichua corpus there was only a single token of /-tk-/out of 23,519 word-internal syllable boundaries.

translated forms of Quichua *rurana* 'to make, do' with *azina* (from Spanish *hacer* [a.seɾ]) and Spanish *casa* [ka.sa] as *kaza*, which suggests that Spanish-derived words with [z] may have been present in these communities for a long time.

The phonotactic differences between Imbabura Quichua and Imbabura Media Lengua are therefore asymmetrical: while there are many clear Quichua-specific configurations, the existence of Media Lengua-specific cues is less certain. This in turn suggests that Quichua-Media Lengua bilinguals may be more effective at screening out Quichua-like elements when asked to focus only on Media Lengua, while Media Lengua items may behave more like phonotactically ambiguous nonwords when participants are asked to focus only on Quichua.

Experiment #1: Lexical false memory

A lexical false-memory experiment provided a first test of the degree of independence of the Quichua and Media lexicons. The false memory paradigm has been used widely in the study of lexical processing (Brainerd & Reyna, 2005; Deese, 1959; Gallo, 2010; Roediger & McDermott, 1995). The most consistent findings suggest that false memories of words not actually presented in the stimulus sets (critical lures) are more frequent with semantic relatedness than with general category membership (Buchanan et al., 1999; Hutchison & Balota, 2005). The false memory tasks have been used with bilingual speakers, e.g. in terms of relative proficiency in a second language vs. the first language (Anastasi et al., 2005b; Sunderman, 2011). Between-language priming has been limited to the presentation of a study list in one language, combined with recall/recognition in the other language (Cabeza & Lennartson, 2005; Howe, Gagnon, & Thouas, 2008; Graves & Altarriba, 2014; Kawasaki-Miyaji, Inoue, & Hiroshi, 2003; Marmolejo, Diliberto-Macaluso, & Altarriba, 2003, 2009; Sahlin, Harding, & Seamon, 2005; Wakeford, Carlin, & Toglia, 2005).

When participants are instructed to recognize or recall only words in the same language as the studied list, "If word information is represented in language-specific lexicons, little false recognition for critical words should occur when the language changes between study and test. False recognition of critical words should occur only when the language is the same for study and test, and these false recognitions should decrease over trials" (Sahlin et al., 2005, p. 1415). On the other hand, if bilinguals have separate lexical representations for a word in each language, but a common conceptual representation, then "both same-language and different language critical words should produce false memory during the initial trials. Over trials, though, participants should reduce their false

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7. The combination /-ʃp-/ is also found, but predominantly in the subordinating postposition *-shpa*, as well as in a few lexical items such as *kishpichina* 'to forgive.'

8. In popular speech, the Latinate *etcétera* es more frequently pronounced with coda [-k].

memories of critical words because they learn that conceptual relatedness to the studied words is necessary but not sufficient for recognition; a test word must also match a studied word in terms of its lexical representation" Sahlin et al., 2005, p.1415). Since the two languages of bilingual participants tested until now have differed along several morphosyntactic and phonotactic dimensions, the use of mixed lists containing lexical items from both languages is not generally found. The Quichua-Media Lengua dyad is ideally suited to an application of the Deese-Roediger-McDermott (DRM) task, given the absence of morphosyntactic or major phonotactic differences between the two languages, the presence of some shared lexical items (e.g. long-standing Spanish borrowings into Quichua), and the fact that speakers implicitly and explicitly regard Quichua and Media Lengua as separate languages.

Using the DRM paradigm, false memories based on critical lures were probed in within-language trials (Quichua-Quichua, Media Lengua-Media Lengua), and cross-language trials for semantic identity (Quichua-Media Lengua and Media Lengua-Quichua). It was hypothesized that if Quichua and Media Lengua share common conceptual representations linked to different lexical representations, then cross-language (Quichua-Media Lengua) study+trials would produce false memories similar to those exhibited in within-language trials, and at approximately the same rate. At the same time, if separate lexical representations in each language exist (mediated by common conceptual representations), then improvement across mixed trials was expected, as participants pay increasing attention to the lexical traits ("specific traces" in the sense of Schachter et al., 1996) in addition to general conceptual traits or "gist traces").

Participants

A total of sixty-two Quichua-Media Lengua adult bilinguals from the communities of Angla, Casco Valenzuela, and Pijal participated (39female, 23 male; mean age 36.5, SD 6.6). All gave consent prior to performing the tasks and were compensated for their participation.

Materials

Associative word lists do not exist for Quichua or Media Lengua; available lists for Spanish (e.g. Algarabel, 1996; Algarabel et al., 1986; Alonso, Díez, & Beato, 2004; Anastasi et al., 2005a; Pérez-Mata et al., 2002) provided a starting point. In collaboration with two consultants, both Quichua-Media Lengua bilinguals who teach at the bilingual school in the adjacent community of Topo, groups of stimuli were designed. The associative domains were domestic animals found in the Imbabura

indigenous communities, food-preparing and cooking, local food, body parts, kinship relations, and words relating to the mountainous terrain. First, six sets of ten stimulus words each were created; two contained only Quichua words, two contained only Media Lengua words, and two contained five Quichua words and five Media Lengua words each. Then eighteen critical lures were prepared, nine in Quichua and nine in Media Lengua. An additional twelve distractor words (semantically unrelated to the respective associative domain) were prepared, six in Quichua and six in Media Lengua. For each stimulus list, a response list was prepared. For the Quichua-only stimulus lists, the corresponding response lists contained five words from the stimulus list, two words from the semantically unrelated Quichua distractor list, and three Quichua critical lures. A similar distribution was used for the response lists corresponding to the Media Lengua stimulus sets. The response lists corresponding to the mixed language stimulus lists contained two Quichua words and two Media Lengua words from the stimulus set, two Quichua critical lures, two Media Lengua critical lures, one semantically unrelated Quichua distractor, and one unrelated Media Lengua distractor. A female native speaker of Quichua and Media Lengua recorded the words.

Six lexical memory tasks were programmed in the experiment-building platform PEBL (Mueller & Piper, 2014); two all-Quichua, two all-Media Lengua, and two cross-language. A PEBL script allowed participants to listen and respond to all six stimulus sets; the stimuli were individually randomized for each participant. For each of the stimulus sets, participants heard a list of ten words pronounced clearly, with a 500 ms. space between each. The list was immediately followed by a ten-second video clip taken from popular cartoon programs (Spider Man, Flash, Superman, Loony Tunes, etc.), then a ten-second "countdown" such as found at the beginning of old movies. Following the video, the program elicited self-paced responses to the individually randomized words from the corresponding response list.

Procedure

Participants were told that as bilingual speakers, their word-recall skills would be tested in both Quichua and Media Lengua. The instructions (pre-recorded in both Quichua and Media Lengua) indicated that after hearing each list of words, participants would watch a short video clip, and during the following countdown they were to describe the actions carried out in the video in the language of their choice. At the end of the countdown an image of a listening ear appeared, and the target words were presented one by one as participants responded. The participants were instructed to press the right shift key (covered with a green dot) if the presented word had appeared in the previously heard list, and the left shift key

(covered with a red dot) if the presented word did not occur in the previous lists. On-screen icons (thumbs-up and thumbs-down combined with the appropriately colored dots) reinforced the instructions. The image is found in the Appendix. The program recorded responses and reaction times.

After a short practice session, participants performed the six memory tasks in the following order: all-Quichua, all-Media Lengua, mixed, all-Quichua, all-Media Lengua, mixed.

Results and discussion

Table 1 shows the proportion of critical lures falsely identified.

Table 1. % of Critical lures accepted in lexical false memory task

Trial type	% acceptance
all-Quichua #1	25.5%
all-Quichua #2	66.7%
all-Quichua together	52.9%
mixed #1	75.5%
all-Media Lengua #1	53.9%
all-Media Lengua #2	84.3%
all-ML together	62.7%
mixed #2	40.5%

These aggregate results show that cross-language critical lures were accepted at essentially the same rate as within-language lures. This suggests that translation equivalents from the non-target language were as readily accessible as the test items. As a more formal demonstration, a general linear mixed-effects model with acceptance of critical lures as response variable, language as fixed effect and participant and stimulus as random intercepts, was fitted in R (R Core Team, 2014, version 3.3.1) using the lme4 package (Bates et al. 2014). P-values were approximated with the lmerTest (Kuznetsova et al., 2014) and car (Fox & Weisberg, 2011) packages. There were no significant differences among the all-Quichua, all-Media Lengua, and cross-language tasks; a likelihood comparison with the null model (no fixed effect) showed that adding language did not account for significantly more variance: $\chi^2(2) = 0.762$, $p = .69$.

It is also useful to examine the proportion of critical lures accepted by each participant (in the mixed-effects model, participants were treated as random intercepts, meaning that their contribution was extrapolated from a potentially much larger sample population). As a further test of the ease with which non-target critical

lures were accepted, a repeated-measures ANOVA performed on the arcsine-transformed proportion of acceptance of critical lures for all-Quichua, all-Media Lengua, and cross-language lexical decision tasks did reflect differences in variance ($F(2, 183) = 3.324$, $p < .04$), but a post-hoc Tukey test revealed no significant difference between all-Quichua and cross-language ($p = .999$) or between all-Media lengua and cross-language ($p = .071$). Performance between the two all-Quichua tests and the cross-language task actually got worse, and this decline in performance was responsible for the barely significant ANOVA result: *Welch-t*(121.996) = 4.016, $p < .0002$). There was an overall improvement between the two all-Media Lengua tasks and the cross-language tasks: *Welch-t*(121.589) = −4.066, $p < .0001$.

These data are not consistent with two independently searchable lexicons, but rather suggest a close relationship between individual lemmas and both Quichua and the corresponding Media Lengua lexical items. Since it had been hypothesized that improvement across trials could be reflective of a single lexicon, another general linear mixed effects model with acceptance of critical lures as response variable, task version as fixed effect, and participant and stimulus as random intercepts revealed a main effect (a significant improvement) between the first and the second cross-language memory task: $z = 3.327$; estimate 1.6152; std. error 0.4855; $p < .0009$. A likelihood comparison with the null model showed that including task version accounted for significantly more of the variance: χ^2 (5) = 14.349, $p < .02$. This improvement across mixed-language tasks is therefore consistent with a single set of conceptual representations linked to differing lexical items. As an additional verification, a t-test performed on the arcsine-transformed rate of false identification of critical lures between the first and the second cross-language memory test also revealed a significant improvement: *Welch-t*(121.81) = −5.987, $p < .0001$; this is once more consistent with a single set of conceptual representations linked to differing lexical items.

Experiment #2: Within-language lexical decision

Three sets of lexical decision tasks, conducted a year after the false-memory experiments, provided additional insights into the Quichua and Media Lengua lexicons of bilingual speakers. Lexical decision tasks are normally carried out with written stimuli representing both real words and plausible non-words, and participants' reaction times are calculated. When bilingual participants are involved, individual lexical decision tasks are normally conducted for each language, unless the goal is to simultaneously test lexical access in both both languages. Lexical decision tasks containing items from both languages of bilingual participants can also be used to measure the degree to which the two languages are accessed separately. The first lexical decision tasks were within-language (all-Quichua and all-Media

Lengua), in order to probe for possible phonotactic cues as to language identity. Since Quichua has only recently begun to be widely written, and Media Lengua has no written tradition (combined with the fact that many of the participants had little or no literacy in any language), all of the lexical decision tasks used only auditory stimiuli (cf. Pycha, 2017).

Participants

A total of fifty-seven Quichua-Media Lengua adult bilinguals participated (from Angla, Casco Valenzuela, and Pijal). There were 36 female and 21 male (mean age 37.2, SD 7.1). Twelve of the participants had also performed the false-memory tasks the previous year. All gave informed consent prior to performing the tasks and were compensated for their participation.

Materials

The Quichua lexical decision task included twenty common Quichua words and twenty non-words. There are no word-frequency lists available for any variety of Quichua, but the words used in the present experiments all appear in the first half of the elementary Ecuadoran Quichua textbook by Lema Guanolema (1997). Seven of the non-words had phonotactic patterns peculiar to Quichua: one each with /-kʃ-/ (*pikshina*), /-ktʃ-/ (*akchusa*), /-kʒ/ (*pakllana*), /-ʃk-/ *watushka*), /-ʃt-/ (*upashta*), word-initial /ʃ-/ (*shamina*), and intervocalic /-ʃ-/ (*kashi*). Seven non-words had phonotactic patterns most commonly associated with Spanish and/or Media Lengua: two with intervocalic /z/ (kuraza, mizina), two with voiced word-initial stops (banuba, dipllana), and three with STOP+LIQUID onset clusters not found in Quichua (*yanikla, trupli, chubrina*. The phonotactic patterns of the remaining six words are found in both Quichua and Media Lengua. The Quichua words were evenly divided between uniquely Quichua phonotactic patterns and language-neutral configurations. The reverse distribution was followed in the Media Lengua task: twenty common Media Lengua words and twenty non-words. There are no word-frequency data available for Media Lengua, but the equivalent Spanish roots were all high-frequency as per the SUBTLEX-ESP data base (Cuetos et al., 2011), taken from a forty-one- million-word corpus of recent Spanish language film and television series subtitles, and considered to be the corpus most representative of spontaneous naturalistic speech. All of the Media Lengua lexical items also appear in the stories transcribed by Stewart (2013). The Media Lengua words were equally divided between language-neutral and predominantly Media Lengua/Spanish phonotactics, and the non-words also included seven with Quichua-like phonotactic patterns (one each with /-kʃ-/,

/-ktʃ-/, /-kʒ/, /-ʃk-/, /-ʃt-/, word-initial /ʃ-/, and intervocalic /-ʃ-/), seven with predominantly Media Lengua/Spanish-like phonotactics, and six language-neutral items. A female native speaker of Quichua and Media Lengua recorded the stimulus words on a Marantz PMD-620 digital recorder with an AudioTechnica ATR55 directional microphone.

Procedure

As in the false-memory tasks, the stimuli were incorporated into PEBL scripts, one for each language, and presented on a laptop computer. Participants heard pre-recorded instructions (in Quichua and Media Lengua), and were told that they would hear equal numbers of both real words in the target language and non-words. They were instructed to press the right shift key, covered with a green dot, for real words, and the left shift key, covered with a red dot, for non-words. On-screen icons reinforced the choices. The program randomized the stimuli individually for each participant and recorded responses and reaction times.

Results and discussion

In lexical decision tasks with visually presented stimuli, participants' correct identification scores are usually near ceiling, with reaction time for words vs. non-words providing the relevant experimental data. In the case of oral presentation to Quichua-Media Lengua bilinguals, two departures from these trends emerged. First, for most participants there was a strong "real-word" bias, to such an extent that scores for correct identification of actually occurring words were effectively meaningless, even though reaction times were significantly shorter for real words than for non-words. At the same time, incorrect attribution of "real" status to non-occurring but plausible words was unexpectedly high, possibly because of the skill with which the speaker articulated the test words, lending an air of authenticity that evidently was sufficient to provoke incorrect responses. Given that some participants accepted an abnormally high number of clearly non-word stimuli, d-prime scores were calculated (a formal calculation based on the rate of correct responses or "hits" minus the rate of false positive responses or "false alarms").[9] The rates of correct identification of non-words in the Quichua and Media Lengua lexical decision tasks are given in Table 2, where the figures in parenthesis represent high d-prime participants (responses above chance).

9. In mathematical terms, the d-prime value represents the z-transform of the hit rate minus the z-transform of the false alarm rate. These "z-scores" are thus calculated on the basis of standard deviation from the mean for each participant's responses.

Table 2. Correct identification of non-words in within-language lexical decision tasks, by phonotactic shape

Trial type	% correct identification
Quichua lexical decision	
ALL DISTRACTORS	48.0% (65.0%)
Quichua-like non-word distractors	31.3% (46.3%)
Spanish/ML-like non-word distractors	56.1% (74.0%)
phonotactically ambiguous distractors	58.4% (76.6%)
Media Lengua lexical decision	
ALL DISTRACTORS	46.5% (67.8%)
Quichua-like non-word distractors	62.1% (94.8%)
Spanish/ML-like non-word distractors	45.6% (60.9%)
phonotactically ambiguous distractors	53.4% (72.7%)

Table 2 reflects a higher error rate in the Quichua within-language lexical-decision task for phonotactically Quichua-like non-words. To demonstrate this, a general linear mixed-effects model with correct identification of distractors as non-words as response variable, language/phonotactic type as fixed effect and participant as random intercept, was fitted. The results are shown in Table 3.

Table 3. Results of the analysis of within-language Quichua lexical decision task; non-word distractors

Phonotactic type	z-score	Estimate	std. error	$p <$
ALL ($N = 57$)				
Q-like ~ S-like	6.271	1.1397	0.1817	.0001 ***
Q-like ~ amb.	7.878	1.2419	0.1576	.0001 ***
S-like ~ amb.	−0.579	−0.1021	0.1763	.57
HIGH D' ($N = 25$)				
Q-like ~ S-like	4.364	1.1948	0.2738	.0001 ***
Q-like ~ amb.	5.693	1.3331	0.2342	.0001 ***
S-like ~ amb.	−0.478	−0.1383	0.2895	.64

With respect to the null model, the model with phonotactic type as fixed effect accounted for significantly more ($p < .0001$) of the variance than the null model: χ^2 (2) = 75.597. Taking only the twenty-five participants with high d-prime scores, the results are similar. With respect to the null model, the model with phonotactic

type as fixed effect accounted for significantly more ($p < .0001$) of the variance of the high d-prime data than the null model: χ^2 (2) = 40.129. The results for the Quichua lexical decision task are consistent with the prediction that distractor words with Quichua-specific phonotactic patterns would be mistakenly identified as real words at a higher rate than Media Lengua-like or phonotactically ambiguous non-words, while the latter two categories were hypothesized to behave in a similar fashion.

Table 2 shows a smaller effect for phonotactically Media Lengua-like non-words in the Media Lengua within-language lexical decision task. A similar model was fitted forand the results are found in Table 4.

Table 4. Results of the analysis of within-language Media Lengua lexical decision task; non-word distractors

Phonotactic type	z-score	Estimate	std. error	$p <$
ALL ($N = 57$)				
Q-like ~ S-like	3.422	−0.8730	0.2551	.0007***
Q-like ~ amb.	−2.720	−0.4651	0.1710	.007**
S-like ~ amb.	−1.731	−0.4079	0.2357	.09
HIGH D' ($N = 23$)				
Q-like ~ S-like	−4.748	−2.4695	0.5202	.0001***
Q-like ~ amb.	3.519	−1.5956	0.4534	.0005***
S-like ~ amb.	−2.505	−0.8740	0.3489	.02*

With respect to the null model, the model with phonotactic type as fixed effect accounted for significantly more ($p < .002$) of the variance than the null model: χ^2 (2) = 13.56. Taking only the twenty-three participants with high d-prime scores, the results are similar. With respect to the null model, the model with phonotactic type as fixed effect also accounted for significantly more ($p < .0001$) of the variance of the high d-prime data than the null model: χ^2 (2) = 29.41. The lack of significant difference across all participants in the responses to Media Lengua-like and phonotactically neutral non-words is also reflective of the minimal cue strength of Media Lengua-specific phonotactic configurations (the minimally significant difference among the high d-prime participants, when set against their participation in the Quichua-only test, may be simply an artifact of the choice of items).

Experiment #3: Cross-language lexical decision

Two additional lexical decision tasks added to the inquiry into Quichua and Media Lengua lexical representation. In this experiment, some of the distractors for a given language (Quichua or Media Lengua) were real words from the other language, as a test of lexical independence (e.g. as per Grainger & Beauvillain, 1987; von Studnitz & Green, 1997). In previous work, for example, Scarborough et al. (1984) found that when bilingual (Spanish-English) participants were instructed to respond positively in a lexical decision task to words of one language, they responded to real words from the non-target language as if they were non-words, reflecting the ability to selectively focus on a single language. If Quichua and Media Lengua truly have distinct lexicons (i.e. are processed as separate languages), it should be possible to replicate this selective attention effect, using within-subject lexical decision tasks in both languages. To this end, two lexical decision tasks were conducted, one in which Quichua was the target language (with some Media Lengua distractors), and one with Media Lengua as target (including Quichua distractors).

Participants

The same fifty-seven Quichua-Media Lengua adult bilinguals who participated in the within-language lexical decision tasks performed the cross-language lexical decision task at a different time.

Materials

The same female native speaker of Quichua and Media Lengua recorded the stimulus words for this experiment. The Quichua-based lexical decision task included twenty common Quichua words and twenty non-Quichua items; among the latter ten were common (Spanish-derived) Media Lengua words not used in local Quichua varieties, five non-words that conformed to Quichua phonotactic patterns, and five phonotactically ambiguous non-words. The reverse distribution was followed in the Media Lengua-based task: twenty common Media Lengua words and twenty non-words, including ten common Quichua words not used in Media Lengua, five non-words with Quichua-specific phonotactic patterns, and five phonotactically ambiguous non-words.

Procedure

As for the within-language tasks, the stimuli were incorporated into PEBL scripts and presented on a laptop computer. Participants were informed that they would hear both real words in the target language and "false" words, but it was not disclosed that some of the latter would be real words in another of the communities' languages.

Results and discussion

The rates of correct identification of non-target items in the Quichua-based and Media Lengua-based cross-language lexical decision tasks are given in Table 5. According to these figures, Media Lengua distractor words with language-specific phonotactic patterns were rejected in the Quichua-based lexical decision task at a higher rate than phonotactically ambiguous or Quichua-like non-words

Table 5. Correct Identification of Non-target Items in Cross-language Lexical Decision Tasks, by Phonotactic Shape. Figures in parenthesis represent high d-prime participants (25 for Quichua, 26 for Media Lengua). Total $N = 57$.

Trial type	% correct identification
Quichua-based lexical decision	
ALL DISTRACTORS	47.9% (68.6%)
Media Lengua (Spanish-like) distractors	59.3%(83.2%)
Quichua-like non-word distractors	34.6%(50.0%)
phonotactically ambiguous non-word distractors	63.6% (90.0%)
Media Lengua-based lexical decision	
ALL DISTRACTORS	49.0% (77.6%)
Quichua (-like) distractors	48.2% (90.4%)
ML/Spanish-like non-word distractors	55.7% (64.4%)
phonotactically ambiguous non-word distractors	39.5% (69.2%)

To place this effect on a firm footing, a general linear mixed-effects model was fitted in R, with correct identification of distractors as non-Quichua items as response variable, language/phonotactic type as fixed effect, and participant as random intercept. The results are shown in Table 6.

With respect to the null model, the model with phonotactic type as fixed effect accounted for significantly more ($p < .0001$) of the variance than the null model: $\chi^2 (2) = 58.12$. Taking only the twenty-five participants with high d-prime scores, the

Table 6. Results of the analysis of cross-language Quichua lexical decision task; distractors

Phonotactic type	z-score	Estimate	std. error	$p <$
ALL ($N = 57$)				
Q-like ~ ML	6.138	1.3015	0.2120	.0001 ***
Q-like ~ amb.	−6.745	−1.5282	0.2266	.0001***
ML ~ amb.	−1.095	−0.2267	0.2071	.28
HIGH D' ($N = 25$)				
Q-like ~ ML	5.077	1.604	.03158	.0001 ***
Q-like ~ amb.	−5.598	−2.2016	0.3933	.0001***
ML ~ amb.	−1.456	−0.5981	0.4106	.15

results are similar. With respect to the null model, the model with phonotactic type as fixed effect accounted for significantly more ($p < .0001$) of the variance than the null model: χ^2 (2) = 48.15. This is a clear demonstration that phonotactic patterns unique to Media Lengua do have an impact on lexical decision, even through their cue strength is lower than Quichua-specific configurations.

A similar model was fitted for the Media Lengua cross-language lexical decision task; the results are found in Table 7.

Table 7. Results of the analysis of cross-language Media Lengua lexical decision task; distractors

Phonotactic type	z-score	Estimate	std. error	$p <$
ALL ($N = 57$)				
Q ~ ML-like	1.842	0.39413	0.21401	.07
Q ~ amb.	2.175	0.4688	0.2156	.03*
ML-like ~ amb.	3.958	0.8629	0.2180	.0001***
HIGH D' ($N = 26$)				
Q ~ ML-like	−4.216	−1.6469	0.3906	.0001 ***
Q ~ amb.	−3.623	−1.4298	0.3947	.0003***
ML-like ~ amb.	−0.736	−0.2172	0.295	.47

With respect to the null model, the model with phonotactic type as fixed effect accounted for significantly more ($p < .0004$) of the variance than the null model: χ^2 (2) = 15.86. Taking only the twenty-six participants with high d-prime scores, the results are similar. With respect to the null model, the model with phonotactic

type as fixed effect accounted for significantly more ($p < .0001$) of the variance than the null model: χ^2 (2) = 23.452. In this task, low d-prime participants exhibited less certainty with respect to Media Lengua stimuli (a tendency documented in previous research), while the data from the high d-prime participants are consistent with the remaining lexical decision tasks, in demonstrating that Quichua-specific phonotactic patterns enhance recognition of other-language status, while phonotactically ambiguous and putatively Media Lengua-specific items are not differentiated.

Experiment #4: Dual-language lexical decision

As a final test, a dual-language lexical decision task gave participants the opportunity to simultaneously distinguish real words in both Quichua and Media Lengua from non-word distractors. With both languages simultaneously activated, this task provided another measure of the degree of integration of the two lexicons, including the two sets of phonotactic patterns.

Participants

The same fifty-seven Quichua-Media Lengua adult bilinguals who participated in the other lexical decision tasks performed the dual-language lexical decision task.

Materials

The same female native speaker of Quichua and Media Lengua recorded the stimulus words for this experiment. The dual-language lexical decision task included twenty common Quichua words, twenty common Media Lengua words, and and forty non-word distractors; among the latter, fourteen had Quichua-specific phonotactic patterns, thirteen had Media Lengua/Spanish-specific phonotactic structures, and thirteen were phonotactically ambiguous.

Procedure

As in the other tasks, the stimuli were incorporated into PEBL scripts and presented on a laptop computer. The instructions (presented in both Spanish and Quichua) informed participants that they would hear real Quichua and Media Lengua words, as well as an equal number of non-word "traps."

Results and discussion

As with the previously-described lexical decision tasks, participants exhibited a very strong affirmative bias, making only responses to non-words meaningful. Table 8 provides the results.

Table 8. Correct identification of non-target items in dual-language lexical decision task, by phonotactic shape. Figures in parenthesis represent the 25 high d-prime participants. Total $N = 57$

Trial type	% correct identification
ALL DISTRACTORS	57.4% (79.5%)
Media Lengua (Spanish)-like non-word distractors	52.2% (75.0%)
Quichua-like non-word distractors	49.7% (73.5%)
phonotactically ambiguous non-word distractors	61.8% (86.0%)

These figures show that phonotactically ambiguous non-words were correctly rejected at higher rates than non-words whose phonotactic patterns were Quichua-like or Media Lengua-like. This is another indication that non-words with language-specific phonotactic patterns embody a greater risk of mistaken identification as real words than phonotactically neutral non-words The results do not depart qualitatively from the other lexical decision tasks, although the differences among the phonotactic types is not as striking. This may be due to the fact that participants were explicitly searching for both Quichua and Media Lengua lexical items, thereby maintaining both Quichua and Media Lengua phonotactic patterns at a high activation level.

A general linear mixed-effects model was fitted in R, taking correct identification of distractors as non-Quichua items as the reference response variable, language/phonotactic type as fixed effect, and participant as random intercept. The results are shown in Table 9.

This model accounted for significantly more ($p < .0001$) of the variance than the null model: for all participants χ^2 (2) = 38.212; for high d-prime participants χ^2 (2) = 35.244. The difference between either Quichua-like or Media Lengua-like and phonotactically ambiguous words was quite significant, but there were no significant differences in the behavior of Quichua-like vs. Media Lengua-like distractors, which is consistent with the simultaneous activation of both phonotactic systems.

Table 9. Results of the analysis of dual-language lexical decision task; distractors

Phonotactic type	z-score	Estimate	std. error	$p <$
ALL ($N=57$)				
Q-like ~ ML	0.440	0.05589	0.12688	.67
Q-like ~ amb.	−5.713	−0.5945	0.1041	.0001***
ML ~ amb.	−4.319	−0.5386	0.1247	.0001***
HIGH D' ($N=25$)				
Q-like ~ ML	−0.753	−0.10721	0.14229	.46
Q-like ~ amb.	−4.958	−0.58773	0.11854	.0001***
ML ~ amb.	−4.919	−0.69493	0.14128	.0001***

General discussion

The present study has taken as point of departure the unique relationship between Quichua and Media Lengua in Ecuador, namely identical morphosyntactic frames with disjoint sets of lexical roots. Two fundamental research questions emerged from this configuration. The first is whether Quichua and Media Lengua share a single lexicon or exhibit separate lexicons. The second question concerns the role of systematic phonotactic differences between the two languages in online language identification. The results of the experiments conducted with Quichua-Media Lengua bilinguals provide preliminary responses to both questions, as well as laying the groundwork for future inquiries.

One lexicon or two?

The data from the false memory experiment are consistent with a single lexicon, with some type of lexicon-internal language tagging. For cross-language and dual-language lexical decision tasks, it is reasonable to hypothesize that if the latencies for tasks in which both languages are involved are significantly greater than for the single-language task, this would suggest a search of more than one lexical repository. If no mixed vs. pure language effect is observed (in the absence of bottom-up language-specific auditory cues), then a single lexical system is more probable.

In all of the lexical decision tasks carried out by Quichua-Media Lengua bilinguals, there were significant differences in reaction time between words and nonwords, as expected. Taking only reaction times greater than 100 ms. and less than 4000 ms, the results are as follows (high d-prime participants in each test). For the Quichua task, *Welch-t*(38.68) = −6.3448, $p < .0001$; for the Media Lengua task

Welch-t(43.96) = −1.7369, $p < .05$; for the Quichua-based cross-language task *Welch-t*(39.42) = −4.6023, $p < .0001$; for the Media Lengua-based cross-language task *Welch-t*(49.56) = −2.2159, $p < .04$; for the dual-language task, *Welch-t*(277.94) = −6.353, $p < .0001$. There were also consistently longer reaction times for identifying Media Lengua words as opposed to Quichua words in all three experiments. These differences are possibly due to the informally recognized and highly localized nature of Media Lengua (Jarrín Paredes, 2013; Müller, 2011) as opposed to Quichua, a pan-Andean language brought by the Inca empire to northern Ecuador more than five centuries ago, and acknowledged as a national language in the (2008) Ecuadoran constitution.. On the other hand, there were no significant differences in reaction times for either words or non-words among within-language, cross-language, and dual-language tasks; if two separate lexicons were being successively searched, reaction times should be higher for dual-language tasks. Taking reaction time for existent words as an example, for Quichua a Tukey HSD test performed on a repeated-measures ANOVA ($F(2,76) = 1.447$, $p = .24$) revealed no differences between all-Quichua and Quichua-based cross-language lexical decision tasks ($p = .95$), between the all-Quichua task and the Quichua words in the dual-language task ($p = .25$), or between the Quichua-based cross-language task and the Quichua words in the dual-language task ($p = .42$). An ANOVA performed on the Media Lengua reaction time data ($F(2,77) = 2.576$, $p = .09$) revealed for all-Media Lengua vs. Media Lengua-based cross-language $p = .89$; for all-Media Lengua vs. the Media Lengua words in the dual-language task, $p = .10$; for Media Lengua in the cross-language task vs. the Media Lengua words in the dual-language task, $p = .21$.[10] While reaction-time data in themselves do not constitute a foolproof glimpse into the bilingual lexicon, the combined results of the false memory and lexical decision tasks are not offset by any evidence suggesting less tightly bound Quichua and Media Lengua lexical repertoires.

The possible role of phonotactic patterns

Taken together, the results of the lexical decision tasks converge on the conclusion that language-specific phonotactic configurations play a role in language-tagging, even between Quichua and Media Lengua, which share an entire morphosyntactic scaffolding and considerable phonotactic overlap. The fact that Quichua-

10. For non-words, between all-Quichua and the Quichua-based cross-language task, *Welch-t*(48) = 1.649, $p = 0.11$; between all-Media Lengua and Media Lengua-based cross-language lexical decision tasks, *Welch-t*(45.29) = 0.0153, $p = .99$. It is not feasible to directly compare these results with non-words in the dual-language task, since they potentially covered the spectrum from Quichua-like to Media Lengua-like configurations.

specific phonotactic cues are more numerous and apparently more robust than Media Lengua-specific cues may contribute to the observed asymmetry in several experimental tasks, in which Quichua was correctly identified to a greater extent than Media Lengua. Taking the high d-prime participants as the most trustworthy sources of data, Figure 1 illustrates the rate of correct identification of non-target language words in the within-language and cross-language lexical decision tasks.

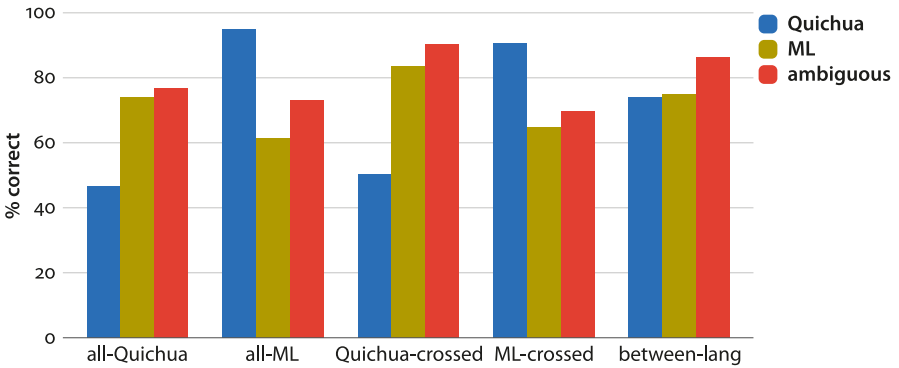

Figure 1. Rate of correct identification of non-target language words/non-words in lexical decision tasks; high d-prime participants

The contrast between Quichua-specific phonotactics on the one hand and both Media Lengua-specific and phonotactically ambiguous stimuli on the other hand holds across all five lexical decision tasks. The high cue strength of Quichua-specific patterns is immediately observable, while the low cue strength of Media Lengua-/Spanish-specfic phonotactic patterns is also apparent. When to this disparity is added the fact that Quichua is a universally acknowledged language while Media Lengua is a highly localized phenomenon referred to humorously as a "half" language, the comparatively longer reaction times and lowered identification rates for Media Lengua stimuli find a ready explanation.

Contributions to the mixed-language debate

As an additional dividend, the Quichua-Media Lengua lexical data contribute to the issue of the long-term stability of mixed languages. Among the small number of documented mixed languages resulting from relexification, Media Lengua is unique in currently being spoken in bilingual contact with the language that provided the morphosyntactic basis (Quichua) and also the lexifier language (Spanish). This is different than, e.g, the Cree-French mixed language Michif (Bakker, 1996; Bakker & Papen, 1997), spoken in several small communities on

either side of the U. S.-Canadoam border, and whose current speakers know neither French nor Cree, or of the Tanzanian language Ma'a (Thomason, 1983; Mous, 2003), combining Cushitic lexical roots and Bantu grammar, whose speakers know no Cushitic language, but who do shift between Ma'a and a Bantu language with essentially the same system morphemes. The fact that Quichua and Media Lengua differ only in their lexical roots leads to the question of whether such minimally differentiated systems represent a stable configuration. Thomason (2003, pp. 23–24), citing personal communication from the Andean linguist Rodolfo Cerrón Palomino, who regards Media Lengua as an ephemeral and unstable phenomenon, declares that "[…] the only uncontroversially stable bilingual mixed languages are those that are now spoken outside the bilingual context in which they arose." Comparative research by Lipski (2019) has shown that Quichua and Media Lengua are most consistently differentiated in Angla and Casco Valenzuela, where Media Lengua has been commonly used only for the past two generations. In Pijal, whence Media Lengua was carried to Angla and Casco, psycholinguistic research has shown that speakers do not reliably distinguish Quichua and Media Lengua, which suggests that Media Lengua in its "pure" form has a limited life expectancy when spoken together with both Spanish and Quichua. When Media Lengua first arose in Pijal around the turn of the 20th century, few members of the community spoke Spanish, creating a stable linguistic boundary between Media Lengua and Quichua, but as Spanish became the dominant language of younger generations, Quichua and Media Lengua became less differentiated. The increasing familiarity with Spanish, together with the minimal Media Lengua-specific phonotactic cues, have eroded the perceptual threshold separating Quichua and Media Lengua. The Ecuadoran data are consistent with the asserted instability of a mixed language in contact with both of its source languages. In response to a query by an anonymous reviewer, it is possible that with greater phonotactic distance a more stable configuration could be achieved, but given the scarcity of true mixed languages, this is difficult to ascertain. For example, Michif has separate phonological systems for the Cree-derived and French-derived items (Bakker, 1997, pp. 80–86), a fact in itself remarkable, and there are phonological differences with the respective lexifier languages (Cree and Canadian French). However, although Michif morphosyntax is closer to Cree than to French (Bakker, 1997, p. 87), it is distinguishable from both, and when this is combined with the fact that most Michif speakers know neither French nor Cree, no possible confusion can result.The other widely-acknowledged mixed language, Ma'a, shares most of its phonology with neighboring Bantu and Cushitic languages (Thomason, 1983, pp. 201–205; Bakker, 2003, chapter 4), although there are some subtle differences. The grammar of Ma'a is essentially that of the Bantu language Pare/Chasu, also used by Ma'a speakers

(known to them as Mbugu), with only the Cushitic lexical roots distinguishing them. As noted by Mous (2003, p.1), "these two languages share one grammar and [...] the vocabulary is parallel." Once more, the Ma'a situation differs from Quichua-Media Lengua bilingualism in several key aspects. Foremost is the fact that the Ma'a lexicon has not been completely replaced by Cushitic roots, and individual speakers' proportion of Bantu and Cushitic roots varies along a cline (Mous, 2003, p.7), although "speakers know to which of the sets a particular form belongs and consequently also when to use which form" (Mous, 2003, p.10). There are also several apparently deliberate phonological modifications that convert Mbugu words to Ma'a words, thus rendering them phonotactically identifiable (Mous, 2003, p.13). Finally, Mous (2003) has shown that the non-Mbugu lexicon has several source languages, none of which are spoken by Ma'a-Mbugu bilinguals. Thus for the moment, the Quichua-Media Lengua configuration may be without parallel among contemporary language contact environments.

Conclusions

The Quichua-Media Lengua bilingual interface provides a unique opportunity to probe for the minimum linguistic factors that permit two languages to be kept separate. Sharing identical morphosyntactic frameworks, Quichua and Media Lengua can only be differentiated by their lexical roots, a large proportion of which are phonotactically compatible with either language. The experiments reported in the previous sections represent a first attempt at a fine-grained examination of this bilingual lexicon, by stripping away all language-specific factors except for phonotactic patterns. The results suggest a subtle but real effect of phonotactic patterns, the differences among which may not be robust enough to ensure the continued separation of Quichua and Media Lengua, especially given the increasing presence of Spanish in the communities in which the data were collected. This research also demonstrates that the inclusion of little-studied and typologically diverse speech communities can significantly complement large-scale paradigms based on the world's most prominent languages.

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Appendix

On-screen image for false-memory and lexical-decision tasks

Address for correspondence

John M. Lipski
Department of Spanish, Italian and Portuguese
442 Burrowes Building
Penn State University
University Park, PA 16802
U.S.A.
jlipski@psu.edu