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Linguistic Vitality and Tonal Variation in San Juan Tepeuxila Cuicatec

Vitalidad lingüística y variación tonal en el cuicateco de San Juan Tepeuxila

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Abstract

The current study focuses on tonal variation and its link with linguistic vitality from a variationist perspective, in the Cuicatec community of San Juan Tepeuxila, Mexico. Given the high level of endangerment of this language, just as all minority languages in the world, I propose linguistic vitality as a key factor in the study of variation. Elicited data from a representative sample of speakers was analyzed qualitatively and quantitatively to obtain a global perspective of the phenomenon. The results of multivariate analysis in RBRUL show that one of the most significant variables is the speaker as a social factor. At a qualitative level, these results suggest that the high degree of structural and interpersonal tonal variation is due to the low level of linguistic vitality of Cuicatec. Thus, the socio-cultural context of the language and its level of vitality directly influence the type of tonal variation observed. This is also supported by previous studies where results are compared between different Cuicatec communities, revealing again, the powerful link between the language and its speakers.

Keywords: Variationist sociolinguistics, Minority languages, Cuicatec, Tone, Phonology

Resumen

El presente estudio se enfoca en la variación tonal y su vínculo con la vitalidad lingüística, desde una perspectiva variacionista, en la comunidad cuicateca de San Juan Tepeuxila, México. Dado el alto riesgo de desaparición de esta lengua, como todas las lenguas minoritarias del mundo, propongo que la vitalidad lingüística es un factor clave en el estudio de la variación. A partir de la elicitación de información en una muestra representativa de hablantes, los datos fueron analizados cualitativa y cuantitativamente para obtener una visión global del fenómeno. Los resultados del análisis multivariante en RBRUL muestran que una de las variables más significativas es el hablante como factor social. A nivel cualitativo, estos resultados sugieren que el alto grado de variación tonal estructural e interpersonal se debe al bajo nivel de vitalidad de la lengua cuicateca. De este modo, el contexto sociocultural de la lengua y su nivel de vitalidad influyen directamente en el tipo de variación tonal. Esto también es respaldado por estudios previos donde se comparan los resultados entre diferentes comunidades cuicatecas revelando, nuevamente, el estrecho vínculo entre la lengua y sus hablantes.

Palabras clave: sociolingüística variacionista, lenguas minoritarias, cuicateco, tono, fonología

INTRODUCTION

The current study presents a phonological and sociolinguistic account of tonal variation in Cuicatec from a variationist perspective (Labov, 1972, 1994, 2001, 2010; Sankoff, Tagliamonte & Smith, 2005; Tagliamonte, 2006). It specifically examines the variables that influence tonal variation in the San Juan Tepeuxila (SJT) variety of Cuicatec, an endangered Mixtecan language spoken in the Cañada region of Oaxaca, Mexico.

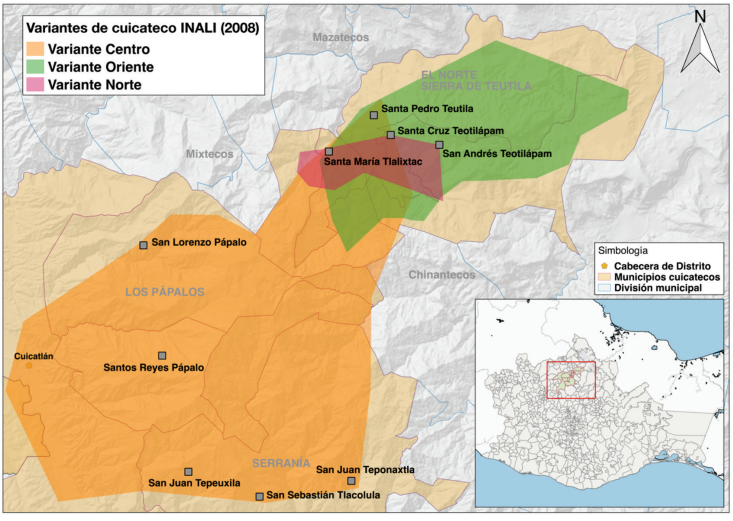
The premise underlying this study is that tonal variation is conditioned by linguistic and socio-cultural factors. Within the linguistic factors, there is a considerable variation in the phonetic realization of tone, which seems to correspond to the relative pitch range within lexical paradigms, conditioned by factors such as stress, syllable, type of phonation, etc. Among the sociolinguistic factors, variation will be primarily determined by the linguistic vitality (Fishman, 1991; UNESCO, 2009; Lewis & Simons, 2010) of the variety of Cuicatec being studied, as well as the speaker's age and gender. These variables also need to be studied qualitatively from an ethnographic point of view.

Cuicatec, also known by its auto denomination *dibaku*, *dbaku* or *dubaku*, is an endangered tonal language of the Mixtecan family, along with Mixtec and Triqui, within the Oto-Manguean macro-family (Suárez, 1983; Kaufman, 1994; Smith-Stark, 1995; Campbell, 1997). This macro-family is one of the most heterogeneous within this region of Mexico and encompasses a great amount of linguistic diversity (Kaufman, 1994; Smith-Stark, 1995), including languages such as Chinantec, Zapotec, Mazatec and others.

Dibaku is spoken in the Cañada region of Oaxaca, and is an endangered language, with few linguistic studies and no variationist studies having been conducted. This language is spoken in 11 municipalities (counties), and in 2015 the National Institute of Statistics and Geography (INEGI) registered 13 318 speakers. The National Institute of Indigenous Languages

(INALI) recognizes three varieties of Dibaku: central, northern, and eastern, as shown on the following map.

Fig. 1. Cuicatec Varieties



Source: INALI (2008). Map by Diego Mendoza.

Ethnologue (Simons & Fennig, 2017) catalogs Cuicatec in two variants: Teutila and Tepeuxila, which are approximately 80% intelligible. Cuicatec is in contact with other indigenous languages such as Mixtec, Mazatec and Chinantec, in addition to Spanish. However, San Juan Tepeuxila, the community under study, does not share borders with any other community that speaks another indigenous language, and their daily interactions in the community are mainly in Spanish.

There are relatively few linguistic studies on Cuicatec. Notable works include de Belmar's grammar (1902), Needham and Davis's (1946) and Ariano (2023) studies of phonology, Davis and Walker's (1955) analysis of morphology, and Anderson and Concepción's (1983) Cuicatec–Spanish dictionary. Research on tone includes San Giacomo (2017a, 2017b), San Giacomo and Chávez Peón (2023). Bradley (1991) contributed a study on syntax, while Feist and Palancar (2016) focused on verbal morphology. Additionally, there are several unpublished manuscripts from the Summer Institute of Linguistics available online. A colonial-era confessional text has been the subject of a few studies

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by Doesburg (2013) and Mendoza (2023, 2024). While these publications offer valuable insights into Cuicatec, further research is essential for a comprehensive understanding of the language's grammar. On a segmental level, Cuicatec has the following consonantal inventory:

Table 1. Consonants in SJT Cuicatec

	Bilabial	Alveolar	Palatal	Velar
Nasal	m	n		
stop		t		k k^w
Pre-nasalized		^{n}d		^{ŋ}g $^ŋg^w$
Affricate			tʃ	
Fricative	β	ð s	j	
Lateral		l		
trill		ɾ		

Sourse: Ariano (2023).

As can be seen in the table above, Cuicatec has 15 contrastive consonants: /m/, /n/, /t/, /k/, /kw/, /nd/, /ŋg/, /ŋgw/, /ʧ/, /β/, /ð/, /s/, /j/, /l/ and /ɾ/. As Ariano (in press) affirms, each variety of Cuicatec employs, to some extent, this consonant inventory. The primary differences among the varieties are the presence/absence of the trilled consonant, voiceless velar fricative, and pre-nasalized velar. Besides these consonantal differences, there is also a distinction between oral and nasal vowels in six vowel quality: /i/, /ĩ/, /u/, /ũ/, /e/, /ẽ/, /o/, /õ/, /ɛ/, /ɛ̃/, /a/ and /ã/, as seen in Table 2.

Table 2. Vowel Chart of SJT Cuicatec

	Oral			Nasal		
	Front	**Central**	**Back**	**Front**	**Central**	**Back**
Closed	i		u	ĩ		ũ
Mid	e		o	ẽ		õ
Open	ɛ	a		ɛ̃	ã	

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All of these vowels can be the syllable nucleus and can have one of the phonation types present in the language: modal, breathy voice, creaky voice or glottalized voice, as seen in the examples outlined in (1) (San Giacomo, 2017b, p. 95).

(1) a. [ˈka^{4}ka^{4}] ‘I am going to cut’ Modal
b. [ˈka^{4}ka̤^{4}] ‘I am going to walk’ Breathy
c. [ˈka̰:^{24}] ‘I am going to give’ Creaky
d. [ˈkaʔa^{34}] ‘I am going to go’ Glottalized

It is important to mention that breathy voice has a debatable status given that it tends to appear at the end of the word, which is due to phonetic factors. For a more in-depth explanation of voicing and tones in Cuicatec, see San Giacomo (2016, 2017b). The syllabic structure of Cuicatec allows two consonants in onset position and one in coda position, resulting in the following structures (Ariano, 2023): V, VC, CV, CCV and CVC. As for stress, it is trochaic and falls on the second mora starting at the right boundary of the stem (Mendoza 2024), as shown in the following example.

(2) a. [ðu^{3}ˈtu:^{34}] ‘hill’
b. [ˈni^{4}nũ:^{4}] ‘corn’

In (2), although the words are disyllabic, the stress falls in different places. In (2a), it falls on the last syllable of the word ‘hill’ because the vowel is long and the second mora, counted from the right to the left, is found in this syllable. In (2b), on the other hand, the stress falls on the first syllable since it is the location of the stem’s second mora. In Cuicatec, VSO word order is the most prominent; aspectual flexion is marked on CV prefixes that encode potential, continuous, completive and perfective categories (Mendoza, 2023), aspects that should be further considered in future work.

TONE IN CUICATEC

Cuicatec is a tonal language and has level, contour and complex tones. According to Yip (2002), a language is tonal if a change in pitch causes a contrast in meaning. An example of this is seen in (3) from SJT Cuicatec:

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(3) a. [ˈja:^{1}] ‘a lot, very’
b. [ˈja:^{24}] ‘sour’
c. [ja:^{424}] ‘earth’

As seen in this example, only the tone of each word changes its meaning, with each segment otherwise identical.[1] In (3a), there is a level tone, in (3b) a rising tone, and in (3c), a complex tone. San Giacomo (2017b) presents an instrumental analysis of pitch and proposes the existence of four level tones, five contour tones (three falling and two rising) and three complex tones (two concave and one convex), which make up the tonal inventory.[2] This inventory constitutes the first proposal on the contrastive units and sequences in SJT Cuicatec.

Table 3. Tonal Inventory of SJT Cuicatec

Level	rising	falling	Concave	Convex
4		42	424	
3	34			342
2	24	21	212	
1	12			
				= 12 tonemes

Source: San Giacomo (2017b, p. 109).

Additionally, San Giacomo *et al.* (2023) have confirmed that there are four level tones, which form the basis of the system and, in combination, make up the other tones. They propose distinct levels of analysis, in which the basic tones correspond to the four subjacent level tones: ^{1}, ^{2}, ^{3} and ^{4}. From these four basic or primitive tones, other contrastive patterns are formed at the

1 The numbers in superscript represent the different types of tones that have been found. The level tones correspond to 1. Low, 2. Mid-Low, 3. Mid-High, and 4. High. The contour tones include rising and falling tones and complex tones are either convex or concave. Both types are represented as numbers of the implicated tones for the rise and/or fall in pitch.

2 Because of space limitations, a detailed description of the tones in SJT is not included in the current article.

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underlying level that are associated with lexical morphemes, appearing with different sequences of level tones. In monosyllabic lexical morphemes, all these patterns can be realized at the syllabic level; meaning that level, contour and complex tones are obtained at the phonetic level. In contrast, with disyllabic lexical morphemes, these patterns can have other configurations. For these authors, the Tone Bearing Unit (TBU) of the tone in Cuicatec is the mora not the syllable. This applies to lexical morphemes, especially at the nominal level.

Given the alarming rate of endangerment of the Cuicatec language, it has been necessary to perform linguistic documentation and descriptions to account for its variation. The goal of the previous studies (San Giacomo, 2017b; San Giacomo *et al.*, 2023) was to determine the tonal phonological inventory of SJT Cuicatec and its tonal system, as mentioned above. This article presents the tonal variation found in this variety, as well as the linguistic and socio-cultural factors that condition it.

The present study is theoretically grounded in instrumental phonology (Ohala, 2005, 2008; Kingston, 2007; Herrera & Butragueño, 2008), which provides a suitable framework for the phonetic analysis of Cuicatec and its tonal variation. This analysis is further informed by Autosegmental Theory (Goldsmith, 1976), Moraic Theory (Hyman, 1985), and Usage-Based Theory (Bybee, 2001, 2002, 2010). Both Autosegmental and Moraic theories offer fundamental insights into the study of tone and its formal representation. These theoretical approaches were employed to analyze the tonal system and to establish a comparative framework for identifying tonal variation in SJT Cuicatec.

With respect to the study of socio-cultural factors, this study employs variationist sociolinguistic methodology (Labov, 1972, 1994, 2001, 2010; Sankoff, Tagliamonte & Smith, 2005; Tagliamonte, 2006, 2016; Eckert, 2000, 2012; Martín Butragueño, 2014) complementing it with ethnographic methods that take into account the speech community and its socio-cultural composition to determine significant variables. All the above-mentioned approaches are considered to carry out the multivariate qualitative and quantitative analyses on the influence of the outlined linguistic and socio-cultural factors on tonal variation in Cuicatec.

This perspective is particularly pertinent considering previous research on speech communities and the impact of extralinguistic factors on specific linguistic phenomena, such as loanword adaptation (Poplack, Sankoff &

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Miller, 1988; San Giacomo, 2009, 2011; Friesner, 2009). These studies have demonstrated that speakers' language use is directly influenced by the structure and values of a community. For instance, in communities that prioritize collective identity over individual expression –or vice versa– the role of individual speakers in shaping linguistic phenomena may vary in significance. This suggests that members often align their linguistic behavior with prevailing communal norms.

LINGUISTIC VITALITY AND TONAL VARIATION OF CUICATEC

As it is known, the concept of linguistic vitality has been widely studied. In this article, I identify linguistic vitality through the observable use of language within different socio-cultural community domains, among its interlocutors and through its intergenerational transmission. This allows us to identify the functions it plays in the speech community[3] and its continuity. In this sense, I follow the proposals of Bouchard-Ryan *et al.* (1982), Fishman (1991), UNESCO (2009), Lewis and Simons (2010) and Montaño (2019) who affirm that the more functions a language fulfills for the majority of a speech community, the greater its vitality is and vice versa. Likewise, as these authors mention, linguistic vitality is characterized by its fluctuation in time and space, as well as by its difficult classification and quantification, as is the case for Cuicatec.-

INALI classifies the variant of SJT with "not immediately at risk of extinction" (Embriz & Zamora, 2012, p. 114); however, we have been able to verify that the vast majority of Cuicatec communities have medium to low linguistic vitality, based on the fact that the youngest speakers have an average age of 30 years old in the communities with medium vitality and 60 years old and above for the communities with low vitality. Moreover, the number of speakers is very low and there are very few domains of language use. Fortunately, there are

[3] I understand speech communities as heterogeneous and therefore mixed, not as locations. For example, in SJT there are many more inhabitants than Cuicatec speakers; thus, different speech communities coexist. The degree of language vitality in each community directly influences whether or not it has a high variation.

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also some communities with high language vitality, where Cuicatec is widely spoken, used in all environments, and transmitted among generations. This leads us to consider whether linguistic vitality can really be defined for an entire language, when it is actually used by different linguistic communities with different characteristics. Nor does it seem adequate to define a language's vitality solely through dialect classification. In the case of Cuicatec, INALI's proposal does not reflect the real use of the language, since they report more speakers than there are. Such an official perspective limits the development of appropriate language policies that communities need in order to revitalize the language.

According to my experience, it is more adequate to collect an extensive sample of different communities to further advance in gaining a general understanding of the linguistic vitality of a language as a whole. The present study focuses on the Cuicatec of SJT which corresponds to the central variant. In this municipality the language is in high level of endangerment, since the average age of its youngest speakers is over 60. SJT has around 300 inhabitants, of whom approximately 50 speak Cuicatec.

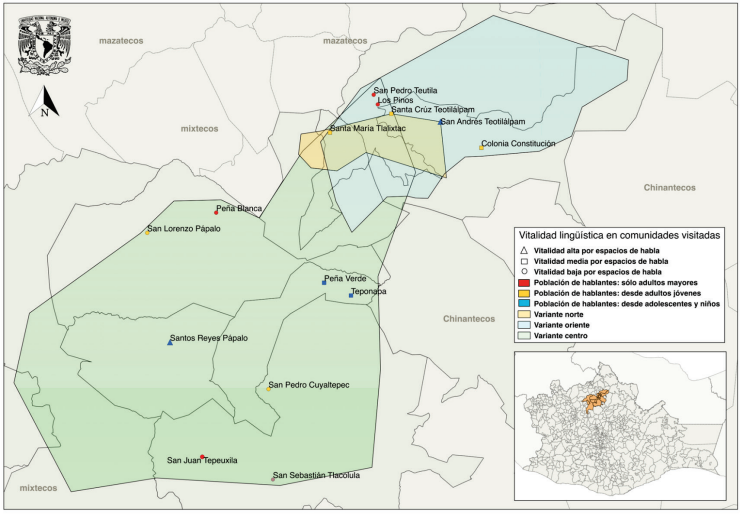
In SJT, there has been an intense migration to Oaxaca City, Mexico City and Los Angeles in the United States. Many of the younger speakers have moved to one of these cities, leaving only older speakers in the community. The inhabitants of SJT are proud and attached to their town and its history. However, the language is disappearing, and its domains of use have been reduced to a minimum due to Spanish language policies implemented by the Mexican federal government since 1930. Nevertheless, it is encouraging to note that there are different levels of linguistic vitality among different Cuicatec communities and in some of them, as mentioned above, their language continues to enjoy great linguistic vitality (author 2023).

A distribution of Cuicatec communities and their linguistic vitality can be seen in the following figure 2.

Figure 2 illustrates this significant variation in linguistic vitality across Cuicatec communities, even among those with similar population sizes or belonging to different dialectal variants of the language. These disparities can be explained by each community's historical relationship with formal education, as well as the degree to which local authorities complied with or resisted language policies imposed by the Mexican State. In general, communities that were more negatively impacted by these policies tend to show lower levels

of linguistic vitality today. Conversely, those where local authorities adopted more favorable or supportive positions toward the Cuicatec language have generally maintained higher levels of vitality.

Fig. 2. Cuicatec Varieties



Source: INALI (2008), Cuicatec Communities and Linguistic Vitality. Map by Diego Mendoza.

Given the conditions mentioned above, the low level of vitality of the language may be one of the main causes for the high degree of tonal variation. Therefore, if there is no speech community, there is no social conditioning to regulate it. Thus, one of the most significant factors to consider in the analysis must be linguistic vitality because of the lack of a speech community implies the absence of language socialization (Ochs & Schieffelin, 1984, 1995; Ochs & Schieffelin, 2011). In short, speakers cannot give social meaning to linguistic variation or transmit it to the new generations (Eckert & Labov, 2017; Rangel, 2019). This lack of social regulation of Cuicatec leads to high levels of variation in these communities.

In a previous approach studying SJT, an analysis of the tones of this variant was carried out, in which, a total of 12 tone patterns were identified (San Giacomo, 2017b; San Giacomo, *et al.* 2023); however, the pitch range of these tones was found to be highly variable, both within individual speakers

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and across different interlocutors (San Giacomo, 2017a). Phonetic analyses show little systematicity, causing considerable difficulty when interpreting acoustic events phonologically. Tones (as phonemes) within a tonal language are contained within its lexicon; moreover, variation in the height of each tone is delimited by the range of its neighboring tones in each phrase. In other words, if a low tone exceeds its height range, it will be perceived as a mid or high tone; however, in SJT Cuicatec, there are several cases of tonal variation that challenge these statements, as seen below.

Table 4. Tonal Variation in SJT Cuicatec

Gloss	San Juan Tepeuxila Cuicatec
'yellow'	ˈkʷa:^{45}
	ˈkʷã:^{34}
'pumpkin'	ɟu^{3}ˈku:^{14}
	ɟu^{4}.ku:^{13}
'butterfly'	ˈɟɛe^{4}βe:^{21}
	ˈɟɛe^{4}βɛɛ̯^{21}
	ˈɟe^{3}beɛ̯^{21}
	ˈɟe^{4}βe:^{32}
'louse'	ˈʔi^{4}kʊ^{21}
	ʔi^{3}ku^{1}
	ʔi^{4}kˈu:^{13}

As these examples show, the same item may be produced with a wide range of phonetic variation in terms of its tones. This high degree of variation in the production of the same item is remarkable and, superficially, it may seem that there is no tonal contrast in the language. However, if we consider each word independently, a contrastive tonal pattern is present. For instance, in the case of 'yellow' and 'pumpkin', the rising pattern and a high-level tone in the first syllable are maintained. Similarly, in 'louse', the stable pattern is a level tone on the first syllable and a falling tone on the second.

However, in the third instance of 'louse,' there is greater variation than in the previous two items, varying between the falling tone 21 and a rising 13, as seen in the following figures, which show evidence of tonal variation for the same female speaker (age 60+).

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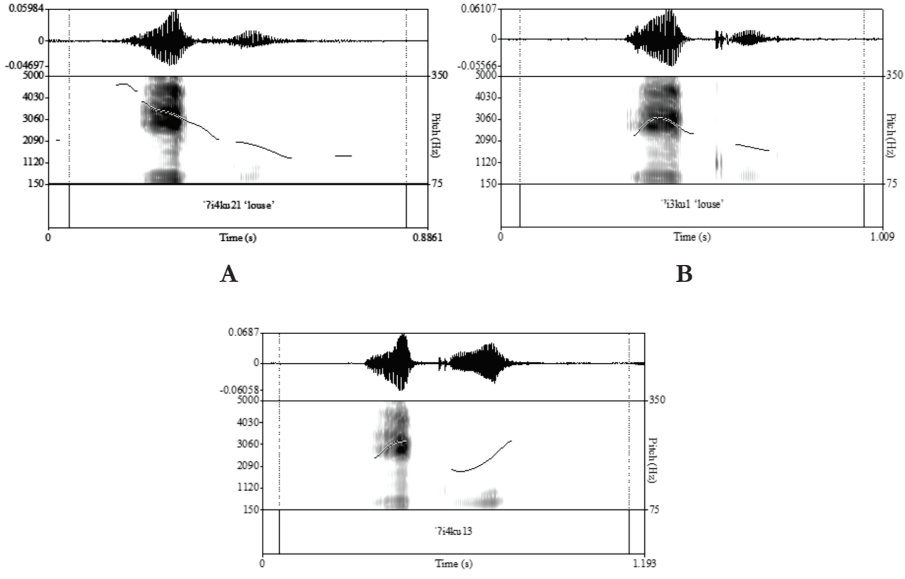
Fig. 3. Tonal Variation in a 60-year-old female Speaker. A. 'louse' with the tone melody [4.21]. B. 'louse' with the tone melody [3.1]. C. 'louse' with the tone melody [4.13]



In the first two examples, (3a) and (3b), the contrast of the high-level tone is maintained in the first syllable, while the contour tone is not present in (3b), although it remains low. However, the tone in (3c) is high for the first syllable, but it has a falling pitch on the second syllable instead of a rising one. These examples provide evidence that indicates that, in general, contrasts between types of tones are maintained, although there is a high variation. The following examples shown in Figure 4, from two male speakers over the age of 80, allow us to infer that the most stable tonal pattern for the element "louse" is 4.21.

Even though we have seen significant variation in the realization of tones in SJT Cuicatec, tonal contrasts remain, that is, tonal melodies maintain distinctive ranges within the analyzed words even though the linguistic vitality of this language is very low. These findings challenge the claim that languages with low vitality tend to lose contrastive features, such as tone. This study is based on the premise that languages disappear primarily due to the lack of domains for use, driven by political and economic factors that lead to the discrimination of their speakers. Nevertheless, their grammatical systems often

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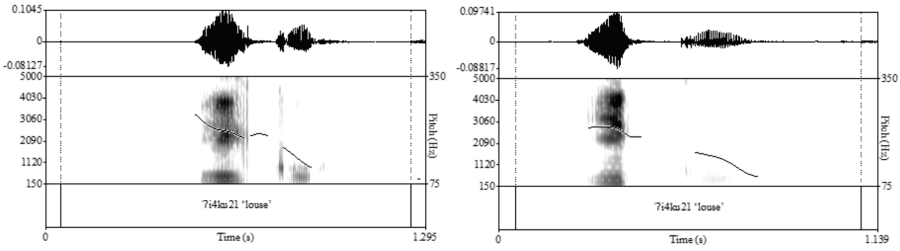
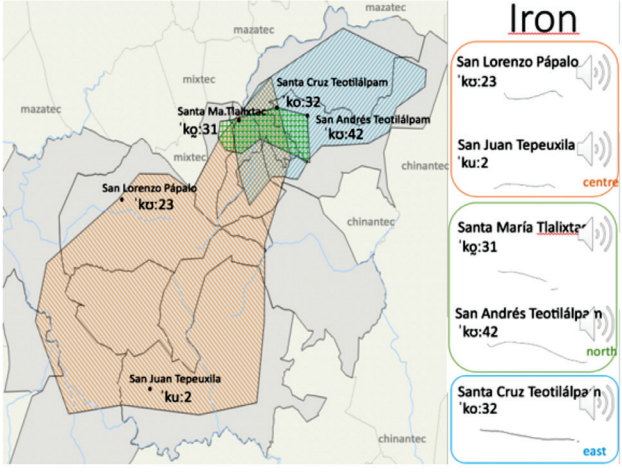
remain, particularly tonal systems, which are structurally significant. This is especially the case in languages such as Cuicatec, where tone plays a central role across all linguistic levels.[4]

Fig. 4. 'louse' with a tone melody of [4.21] (80 year-old male speakers). A. 'louse' with the tone melody [4.21] Juan. B. 'louse' with the tone melody [4.21] Layo.



It is important to mention that variation is also present among different dialects, as exemplified below by the word 'iron' in five Cuicatec communities.

Fig. 5. Tonal Variation of the word 'iron' among Cuicatec communities



Source: Map by Diego Mendoza.

[4] See a more detailed account of this tonal variation by variety and community in San Giacomo (2017a).

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As we can see in the previous figure, the communities present different types of tonal patterns for the word 'iron'. Three of them have falling tones: Santa María Tlalixtac 31, Santa Cruz Teotilalpam 32 and San Andrés Teotilalpam 42; while San Lorenzo Pápalo presents the opposite pattern with a rising tone 23; and SJT a level tone 2. The first three communities belong to the northern and eastern variants, while the last two to the central variant. The above could show a trend by dialect areas, although there is still a wide variation within each one of them.

Although the current study focuses on tonal variation within SJT, it lays the foundation for comparing tonal variation among Cuicatec communities (San Giacomo, 2025), when analyzing the role of linguistic vitality in this variation. In order to do so, I now present data from three communities, apart from SJT, with different degrees of vitality: Peña Verde, San Juan Teponapa and San Francisco Pueblo Nuevo, all belonging to the central variety. The first two have a high vitality since children speak Cuicatec daily, and it is still possible to find monolingual speakers in this variety. The third has a lower vitality than the previous two since its youngest speakers are around 30 years old; nonetheless, they have a higher vitality than SJT.

Qualitative results indicate that, as I proposed in my hypothesis, the type of tonal (and segmental) variation among communities is different according to the linguistic vitality of each one of them.

Table 5. Vitality and linguistic variation by Cuicatec community

	High vitality				Medium vitality	
	Peña Verde		**Teponapa**		**Pueblo nuevo**	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
'Squash'	ni:ʔ^{34}	n̰i:ʔ^{34}	n̰i:ʔ^{12}	n̰i:^{3}	ni:ʔ^{4}	n̰i:ʔ^{4}
'Snake'	ku^{h3}	ku^{h3}	ku^{h1}	ku:^{h3}	ku:^{h3}	ku:^{h32}
'Plate'	kuʔu^{h2}	kṵʔṵ^{21}	kṵʔŭ^{1}	kuʔu^{1}	ˈku2ʔu^{1}	kuʔu^{3}
'Smut'	ø	tũ^{3}	ø	tu:^{3}	tũ:^{2}	tũ:^{4}

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TABLE. 5 (CONT.)

	High vitality				Medium vitality	
	Peña Verde		**Teponapa**		**Pueblo nuevo**	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
'I'	ʔu^{h3}	u3	ʔu͡u^{h3}	ʔu^{h3}	ʔu:^{h3}	ø
'Yes'	ˈti^{4}ka^{1}	ˈti^{4}kạ^{2}	ø	ˈti^{4}ka^{1}	ˈti^{3}kạ^{2}	ˈsi:^{42}

Source: San Giacomo, 2017a, p. 71).

Table 5 above presents a summary of the variation in these three communities. As can be seen, there is variation, but the different tokens of each item produced by the same speaker are very similar. The differences are found between men and women and among communities. This can be contrasted with what was found in SJT (low vitality), as shown below in Table 6 below.

TABLE 6. TONAL AND SEGMENTAL VARIATION IN SAN JUAN TEPEUXILA

Low vitality

San Juan Tepeuxila						
	Men			**Women**		
'Squash'	ʔi:^{4}	ni:^{4}	n̰i:^{4}	niʔi^{45}	ni:^{4}	n̰i:^{4}
'Snake'	ˈku:^{2}	ku:^{h4}	ku:^{h4}	ˈku:^{3}	ku^{4}	ku͡u^{h2}
'Plate'	ˈkuʔu^{3}	kuʔu^{4}	ku4ʔu:^{h2}	ˈkuʔu^{2}	kuʔu^{4}	kuu͡u^{h2}
'Smut'	ˈtu^{3}	tũ:^{4}	tũ:^{4}	ˈtu^{3}	tũ͡ũ:^{4}	tũ:^{4}
'I'	ˈu^{2}	ø	ø	ˈu3	ø	ø
'Yes'	ˈũ^{2}	ũ:^{3}	ũ:^{3}	ˈũ^{2}	ˈũ:^{4}	ˈũ:^{4}

Source: (San Giacomo, 2017a, p. 71).

Table 6 shows the notable tonal and segmental variation that the same speaker produces for the same item, which also occurs with different words. In this case, as previously mentioned, I propose that the low vitality of the

language is the main cause for the high tonal variation, since there is no speech community to standardize forms, ranges and variations. The only limitation so far seems to be the 'contrastive word paradigms' in which each tone is involved, that is, the contrast of minimal pairs (or more words). The speech of the few remaining speakers in the community represents a 'unique' example of the language and of what was a speech community. Therefore, in the case of SJT the high level of variation is due to the loss of Cuicatec and not because of a language change in progress.

Methodology

To conduct an acoustic experiment specifically designed to capture the range of tonal variation, data were collected through fieldwork in SJT, which provides tonal contrasts in both monosyllabic and disyllabic words across all vowel qualities of the language. Measurements of pitch, intensity, and duration were taken for each vowel as acoustic correlates of tone and stress. Data were collected both in isolation and within frame phrases across various phonological contexts, essential conditions for analyzing the linguistic variables influencing this variation.

Additionally, a list of core basic vocabulary items in Cuicatec was elicited to identify both lexical and phonological contrasts. For language documentation purposes, a list compiled by the Cuicatec Language Study Group (IIA-UNAM), containing 660 items deemed relevant to Cuicatec, was used to assess phonological and phonetic variation within the language. Finally, an adapted version of this list corresponding to the Cuicatec subset of the Basic List for the Typology of Lexical Loans (Haspelmath & Tadmor, 2009) was employed.

Sociolinguistic data were gathered through fieldwork observations and sociolinguistic interviews and questionnaires, enabling members of the speech community to reflect on their daily language practices and describe the social structure of their community, by articulating their own socio-cultural categories. This approach facilitates a more comprehensive understanding of the key extralinguistic variables relevant to the present analysis. All collected information contributes to both the multivariate analysis and the qualitative interpretation of tonal variation in Cuicatec, along with other factors influencing this phenomenon.

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Once the data were collected, the audio was phonetically transcribed following the International Phonetic Alphabet (IPA) through the acoustic analysis program PRAAT (Boersma & Weenink, 2019). These transcripts make it possible to build a tool database for both linguistic analysis and general language documentation. Through this sociolinguistic database of speakers, an overview of language use and the characteristics of the community was developed, which shows the intersection of linguistic and social factors used in the multivariate analysis.

Thus, data were collected through fieldwork in SJT from a representative sample of the speech community, which is significantly limited due to its low level of linguistic vitality. In this population, the youngest Cuicatec speakers are 60 years old, and they no longer use the language among themselves. Consequently, the vast majority are Spanish–Cuicatec bilinguals who predominantly use Spanish. Nevertheless, for this reduced bilingual population, Cuicatec persists as a language of memory, with no active domains of daily use. For the purposes of quantitative analysis in this study, data were obtained from six speakers (three women and three men), ranging in age from 60 to 85 (specifically, 60, 65, 74, 75, 80, and 85 years old). This sample of speakers represents over than 10% of the total speech community, which, as mentioned before, represents no more than a total of 50 speakers.

The database consists of 625 disyllabic and monomorphemic lexical items (225 words), coded for tonal variation. The disyllabic tokens were selected because they are the most frequent words in the language and, thus, represent its basic prosodic pattern. One of the primary reasons for this decision was based on previous analyses, in which the most significant variable that determined tonal variation was stress, which can only be analyzed in disyllabic words. The distribution of tokens by tone can be found in the table below.

Table 7. Type of Tone by Syllable within the Database

Type of Tone	1st Syllable	2nd Syllable
Level	572	475
Rising	12	86
Falling	41	41

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TABLE. 7 (CONT.)

Type of Tone	1st Syllable	2nd Syllable
Concave	0	21
Convex	0	2

As seen above, the distribution of tone types is relatively similar in both syllables, with the majority being level tones. The main difference centers on the absence of complex tones (concave and convex) in the first syllable as well as more cases of contour tones (rising and falling) in the second syllable.

The variables coded for in the database and considered for the multivariate analysis in RBRUL (Johnson, 2008) include one binary dependent variable, and nine independents linguistic and social variables. The variables included in the multivariate analysis in RBRUL are summarized below:

Dependent Variable:

1. SJT Cuicatec Tonal Variation (binary).

Independent Variables:

1. Stress (unstressed, stressed).
2. Type of tone on the first syllable (level, rising, falling, concave or convex).
3. Type of tone on the second syllable (level, rising, falling, concave or convex).
4. Type of phonation on the first syllable (modal, creaky, glottalized or breathy).
5. Type of phonation on the second syllable (modal, creaky, glottalized or breathy).
6. Word class (noun, verb, adverb, determiner).
7. Speaker (1, 2, 3, 4, 5, 6).
8. Age (60, 65, 74, 75, 80 and 85 years).
9. Gender (Male, Female).

As we can see in Table 8, the independent variable for the multivariate analysis in RBRUL (Johnson, 2008) was SJT tonal variation. The independent

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linguistic variables were stress, the tone type of the first and second syllables, the phonation type of the first and second syllables and word class. The socio-cultural variables were the individual speaker, age and gender; finally, linguistic vitality was measured both qualitatively and quantitatively.

The binary dependent variable encodes tonal variation or its lack and follows the Principle of Accountability (Labov, 1972). The independent linguistic variables included stress, within which tonal variation in the unstressed syllable and in the stressed syllable were analyzed. The tone type of the first and second syllables were also included to measure the influence of concave, convex, rising, falling and level tones. Besides these, phonation type of the first and second syllables were also included to account for the role of breathy, glottalized, creaky and modal productions. Finally, word class –verb, adverb, noun or determiner– was considered since previous studies have shown different tonal patterns for each word class (Snider, 2018). The socio-cultural variables included were the individual speaker, age and gender; as I mention, linguistic vitality was measured as well from a qualitative perspective through field work and ethnographic methods.

ANALYSIS AND RESULTS

As mentioned previously, 9 variables were incorporated into the multivariate analysis 6 linguistic and 3 socio-cultural. The general results show that 66% (N= 412) of the tokens contained tonal variation while 34% (N= 213) did not. The multivariate analysis in RBRUL (Johnson, 2008), considering these N= 625 items from the database, presented a log-likelihood of -209.764 and a prediction of variation (R2) of 75%, as seen in Table 8 below.

Table 8. RBRUL Multivariate Analysis of Tonal Variation in SJT

Tonal Variation in San Juan Tepeuxila Cuicatec
Log-Likelihood: -209.764
Input: 1
AIC: 465.527
Proportion: 0.659

TABLE. 8 (CONT.)

Degrees of Freedom: 23				
Total R2: 0.75				
N Total: 625				
	Log odds	**Factor Weight**	**N**	**%**
(1) Stress p-value: 8.02e-18				
Unstressed	1.087	0.74	294	88
Stressed	- 1.087	0.25	331	45
(2) Type of Tone on the Second Syllable p-value: 6.15e-06				
Convex	11.254	>0.99	2	100
Falling	- 1.006	0.26	41	97
Concave	- 2.133	0.10	21	88
Rising	- 3.792	0.02	86	79
Level	- 4.323	0.01	475	59
(3) Type of Tone of the First Syllable p-value: 0.00216				
Rising	11.108	>0.99	12	100
Level	- 5.542	0.04	572	64
Falling	- 5.567	0.04	41	82
(4) Word class p-value: 0.0248				
Verb	0.841	0.69	88	72
Noun	- 0.197	0.45	450	65
Adverb	- 0.220	0.44	19	68
Determiner	- 0.424	0.39	68	57
(5) Speaker p-value: 0.0443				
1	0.826	0.69	131	71
3	0.487	0.62	90	55
6	0.391	0.59	184	65
4	0.332	0.58	94	73

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TABLE. 8 (CONT.)

5	0.085	0.52	65	52
2	- 2.122	0.10	61	10
Non-Significant Variables				
(6) Type of Phonation of the First Syllable p-value: 0.22				
(7) Type of Phonation of the Second Syllable p-value: 0.51				
(8) Gender p-value: 1				
(9) Age p-value: 1				

The table above presents the five factors that were statistically significant in the analysis of tonal variation. The columns show the variants associated to each variable, and their log odds, factor weight, number of data points per variant and corresponding percentages. The significance for the regression analysis is also presented beside each factor, and the variables are placed in a hierarchy of lowest to highest p-value. Thus, five variables were significant: Stress (p-value: 8.02e-18), Type of Tone of the Second Syllable (p-value: 6.15e-06), Type of Tone of the First Syllable (p-value: 0.00216), Word class (p-value: 0.0248) and Speaker (p-value: 0.0443). The results of this analysis reveal, in order of significance, that tonal variation has a higher likelihood of realization:

1. **in an unstressed syllable** (**1.087**), which shows the greatest amount of variation (within the factor Stress p-value: 8.02e-18). This supports the notion that phonological contrasts are found in the stressed syllable and, thus, variation is present primarily in the unstressed syllable. The fact that this factor ranks first in the hierarchy of significant variables highlights its importance in the phonology of Cuicatec.
2. **in tokens with a convex tone in the second syllable** (**11.254**), (variable Type of Tone in the Second Syllable p-value: 6.15e-06). These results correspond to two crucial elements: the position of the tone in the second syllable, which usually coincides with the unstressed syllable, and the fact that convex tones are the most marked due to their low frequency in the language. Therefore, convex tones relate to the scale of tonal marking on a typological level. In other words, if a language has complex tones, this implies the existence of contour tones and these, in turn, imply the existence of level tones.

3. **in tokens with a rising tone in the first syllable (11.108, variable Type of Tone in the First Syllable p-value: 0.00216)**. The rising tones significantly condition the tonal variation because of their low frequency in the first syllable. Out of the 82 surface rising tones, only 10 of them occur in the first syllable, whereas 72 in the second. Another fact to be considered is the marked status of rising tones compared to falling ones within the typology of tone (Zhang 2001), that is, the existence of falling tones implies that of rising ones. Besides, falling tones may pattern better with the trochaic rhythm of the Cuicatec language.
4. **in verbs (0.841)**, within the factor Word Class (p-value: 0.0248), which shows a possible influence of the morphological effects on this variation. Within the verbs, we find the aspectual flexion of the language with the first-person singular tone being a high-level tone (Martínez in prep.). Thus, it may have a grammatical value in addition to the phonic focus of the current study. At this point, it will be necessary to extend this analysis to items in frame sentences to allow us to examine the relationship between tones and the grammatical categories involved.
5. **in 5 speakers (out of 6)**, within the factor Speaker p-value: 0.0443. The interesting thing for this result is that the only speaker who does not condition tonal variation significantly is a senior adult woman (85 years old), who is also the only speaker in the sample who interacts in Cuicatec daily (everyone else hardly uses the language anymore). She has interacted with her husband in Cuicatec quotidianly for the last 40 years. Furthermore, she and her husband transmitted the language to their children who are known for speaking Cuicatec fluently. Importantly, the fact that this speaker has somebody to interact with, makes us presume that this creates a space of language use that stabilized its variation. In this sense, the use of the language between two people or in a nuclear family can function like a speech community, where the process of socialization itself contributes to stabilizing linguistic variation. Therefore, it is relevant to ponder the question of how many people are necessary to create a speech community.

The following factors were not found to be significant:

6. **Type of Phonation of the First Syllable (p-value: 0.22)**, (7) **Type of Phonation of the Second Syllable** (p-value: 0.51), (8) Gender (p-value: 1) and (9) Age (p-value: 1).

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These findings do not imply that these factors are irrelevant to the study of this language or its variation, even if they are not significant at a statistical level. In the predictive model, their significance does not disprove the null hypothesis, nor does it suggest that probability of their significance is not greater than chance. Therefore, to consider individual speakers, a mixed effects model was carried out (Johnson, 2008); however, the result was similar to that of the previous model. The only difference was that the total R2 increases the prediction of the variation from 75% to 77% in the analysis of mixed effects, taking the speaker as a random effect.

Thus, it is important to consider the two levels –both qualitative and quantitative– that are considered within the variationist analyses since they can explain why four of the linguistic variables were found to be significant, while only one extralinguistic variable resulted significant. In this case, given the characteristics of SJT, sociocultural factors can be explained at a qualitative level. In general, linguistic vitality defines the conditions of use of a language and its possibilities of socialization in each speech community. As mentioned above, the vitality of SJT Cuicatec is very low, and since there are no spaces for using the language within the community, the speakers are seniors (50 years and above).

They do not have interlocutors to allow the appropriation and conditioning of variation, which means that each speaker represents a unique sample of the language, and for these reasons, the variable 'Speaker' was the only significative socio-cultural factor. In this case, one of the most significant variables was only possible to be identified through research methods associated with sociolinguistics and anthropological linguistics such as field work, participant observation, and ethnography, through close interaction with the speakers in the community.

This confirms the finding that, in SJT, given the low level of linguistic vitality, individual speakers significantly influence linguistic variation. Since the language has virtually no active domains of use, there is no speech community through which socialization can take place or through which linguistic variation can acquire social meaning. As a result, such variation is not socially conditioned. Moreover, this variation lacks a new generation of speakers to whom it can be transmitted (Rangel, 2019), preventing it from being socially shaped and, ultimately, from contributing to processes of linguistic change.

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This situation highlights the impact that language shift can have on both the linguistic system and the socio-cultural dynamics of endangered languages.

These findings support the hypothesis that the nature of tonal variation –and its varying degrees of stability– depends on the presence of a speech community capable of supporting linguistic socialization. Moreover, they demonstrate that a high level of variation does not necessarily imply either linguistic vitality or linguistic change.

CONCLUSIONS

This study focused on tonal variation in Cuicatec from a variationist perspective by applying multivariate analysis in RBRUL (Johnson, 2008) to obtain a statistical model of probabilistic prediction of tonal variation in Cuicatec, a Mixtecan language of Mexico.

Along with this study, a qualitative analysis was carried out to identify the significative influence of linguistic vitality in the range of tonal variation in Cuicatec. The statistical results show that the variables that condition this variation are Stress, Type of Tone of the Second Syllable, Type of Tone of the First Syllable, Word class and Speaker at individual level. The multivariate model shows a capacity for describing a total variation of 75% (and 77% for mixed effects analysis).

The social variables such as gender and age did not result significant due to low linguistic vitality, caused by the absence of a robust speech community. Therefore, we affirm that linguistic vitality is a key factor in the study of variation, which represents a significant contribution to the theory of variation and linguistic change. The high level of variation in SJT Cuicatec appears to be related to its low linguistic vitality. These results will be an essential pathway for further exploration, including comparison with results from other Cuicatec communities with different levels of linguistic vitality.[5] It also supports the

[5] A previous study was carried out to compare the tonal variation between two Cuicatec communities with different linguistic vitalities and its results verified the hypothesis presented in this article. The community with the lowest vitality had a higher percentage of variation than the other, which showed a more stable variation (San Giacomo, 2025).

proposal that the definition of vitality should stem from the study of specific speech communities and their sociocultural factors.

The value of the existence of a speech community for the socialization of the language reinforces the idea that it is necessary to retake tools and concepts of sociolinguistics and anthropological linguistics. This allows us to identify the effect that language shift has at the linguistic and socio-cultural level of endangered languages, such as indigenous languages throughout the world.

Given this overwhelming reality, it is necessary to include new variables, concepts and ways of approaching the study of minority and indigenous languages in order to respond to their own linguistic and sociocultural rules.

These results have been obtained through a variationist approach in an indigenous language of Mexico, which is vastly different from the dominant languages in which this model has been traditionally applied. This type of procedure constitutes a valuable methodological tool for the analysis and description of languages exhibiting high levels of variation, a characteristic of many of the world's minority languages, the majority of which remain underdocumented or entirely undescribed.

As mentioned above, there are very few variationist studies on indigenous languages (Yang *et al.,* 2019; Chirkova *et al.,* 2018; Stanford, 2016, 2008; Stanford and Preston, 2009), in part because researchers must rely on an established linguistic description. If this description does not already exist, it must be created by the researcher, as is the case with the current study; this perspective implies both a linguistic and sociocultural approach, complemented by the qualitative and quantitative analysis of variation.

This study contributes to the investigation of understudied aspects of indigenous languages through a combined variationist and qualitative approach. It seeks to determine the impact of linguistic vitality and language endangerment on tonal variation, as well as their implications for theories of linguistic change. Such a combined methodological approach has not been previously applied in this context. UNESCO has declared 2022-2032 the International Decade of Indigenous Languages reminding us that there is still much work to be done.

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