Sibilant harmony in Santiago Tz'utujil (Mayan)

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Abstract. We analyze sibilant harmony in the Santiago Atitlán dialect of Tz'utujil (Mayan), a phenomenon that was briefly described by Dayley (1985). Novel data show that the obligatory harmony process (i) is asymmetrical (triggered only by [+ant] sibilants), (ii) progressive, and (iii) applies long-distance. Furthermore, we argue that the process is not stem-controlled. In contextualizing the phenomenon within the typology of sibilant harmony (Hansson 2010), we conclude that it is unique. Finally, we suggest that Santiago Tz'utujil sibilant harmony has been stable diachronically because the target segment /ʃ/ is always in the stressed syllable, thus being salient in the input during acquisition.

Keywords. sibilant harmony; consonantal harmony; progressive harmony; phonology; typology; Mayan; Tz'utujil; K'ichean

1. Introduction. Tz'utujil (ISO 639-3) is a K'ichean Mayan language spoken in Guatemala, primarily in several towns on the southern side of Lake Atitlán. The San Juan la Laguna and San Pedro la Laguna dialects share many properties and are the best described of all Tz'utujil dialects (Dayley 1985; Pérez Mendoza & Hernández Mendoza 2001 for San Juan Tz'utujil; García Ixmatá 1997; 1998 for San Pedro Tz'utujil; among others). The variety spoken in Santiago Atitlán (henceforth *STz'*) has only received attention recently in the literature (Levin, Lyskawa & Ranero 2020; Baron, Lyskawa & Ranero 2020; Lyskawa & Ranero 2021a; 2021b) and is the most phonologically innovative of all Tz'utujil dialects (Dayley 1985). Dayley (1985) provides a sketch of STz' phonology and posits a rule of optional sibilant harmony (1). All of Dayley's examples are shown in (2):[1]

(1)   Sibilant harmony in STz' (adapted from Dayley 1985: 36)
        ʃ → s / … s … _   Optional

(2)   Examples of sibilant harmony in STz' (adapted from Dayley 1985: 36)
        a.   /ʃ-Ø-kum-**s**aa-Vʃ-a/   → [ʃkm**s**a**s**a]   'It was killed.'
              COM-B3S-√die-CAUS-PASS-INTR

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[1] We follow the Mayanist convention of labelling ergative/genitive agreement as Set A and absolutive agreement as Set B. Abbreviations are as follows: A = Set A agreement; ADJ = adjective; AP = antipassive; B = Set B agreement; CAUS = causative; CLF = classifier; COM = completive aspect; I = intransitive; INC = incomplete aspect; INCH = inchoative; INTR = intransitive status suffix; ITV = intransitivizer; NMLZ = nominalizer; P = plural; PASS = passive; POS = positional; POT = potential aspect; PROG = progressive auxiliary; RN = relational noun; S = singular; TR = transitive. Note that the B3S agreement morpheme is null. We use < > when transcribing orthographically.

    b.   /ʃ-Ø-χosq'-Vʃ-a/   → [ʃχsɢisa]   'It was cleaned.'
        COM-B3S-√clean-PASS-INTR

    c.   /ʃ-Ø-mis-taχ-Vʃ-a/   → [ʃmstasa]   'It was swept.'[2]
        COM-B3S-√sweep-PASS-PASS-INTR

Sibilant harmony appears to be unique to STz' among Tz'utujil dialects. There is no such process in San Juan or San Pedro Tz'utujil:[3]

(3)   *No sibilant harmony in San Juan Tz'utujil* (Pérez Mendoza & Hernández Mendoza 2001)
    a.   /ʃ-Ø-soχwe-ʃ/   → [ʃsoχweʃ]   'It was floated'
        COM-B3S-√float-PASS   (p. 396; entry for <sojwexik> 'to float')
    b.   /ruu-kam-sa-ʃ-ik/   → [rkamsaaʃiik]   'its killing'
        A3S-√die-CAUS-PASS-NMLZ   (p. 166; entry for <kamsaxik> 'to kill')

(4)   *No sibilant harmony in San Pedro Tz'utujil* (García Ixmatá 1998)
    a.   /ʃ-Ø-war-isaa-ʃ-i/   → [ʃwarisaʃi]   'It was made to sleep.'
        COM-B3S-√sleep-CAUS-PASS-INTR   (p. 105)
    b.   /ʃ-sir-Vɓaʔ-ʃ-i/   → [ʃsiriɓaʃi]   'A spherical thing was put somewhere.'
        COM-√spherical.POS-CAUS.POS-PASS-INTR   (p. 68)

Novel STz' data in section 3 lead us to modify the rule description in (1) to the following:

(5)   Sibilant harmony in STz'
     ʃ → [+ant] / [+ant, +strid] … _

In section 4, we show that STz' sibilant harmony is typologically unique. Our STz' data come from in-person elicitations from 2017-2019 with four consultants in Guatemala, as well as online video elicitations from 2020-2021. Whenever the syntactic environment is helpful for understanding the data, we provide the target word in its sentential context.

2. Consonantal inventory. In Table 1, we provide the consonantal inventory in Tz'utujil:

	bilabial	alveolar	alveo-affricate	palato-alveolar	velar	postvelar	glottal
simple stop	p	t	**ts**	**tʃ**	k	q	
glottalized stop	ɓ	ɗ	**ts'**	**tʃ'**	k'	q'	ʔ
fricative		**s**		ʃ		χ	
nasal	m	n					
lateral		l					
trill		r					
semivowel	w			j			

Table 1. Consonantal inventory in San Juan Tz'utujil (Dayley 1985); applicable to STz'

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[2] There appear to be two passive suffixes here, the completive passive /-taχ/ (Lyskawa & Ranero 2021a; Dayley 1985: 122; García Ixmatá 1998: 106) and the regular passive /-Vʃ/. Our STz' consultants rejected this example. It is possible that this example involves the verbal root 'to forget' /mest/ and the translation provided is incorrect.

[3] In (3), we provide the underlying forms and gloss of the affixes as given in Dayley (1985) for San Juan Tz'utujil; /-ʃ/ for the passive, /-sa/ for the causative, and /-ik/ for the nominalizer (Dayley uses the term "infinitive"; see p. 105). In (4) we provide the underlying forms and gloss of the affixes as given in García Ixmatá 1998 for San Pedro Tz'utujil: /-ʃ/ for the passive, /-isaa/ for the causative, and /-Vɓaʔ/ for the causative that attaches to positional roots (where the V is a copy of the root vowel).

Sibilants in STz' occur in many roots (mostly of the form CVC) and in the following affixes:

(6)　　List of affixes containing sibilants in STz
　　　　POT: /ʃt-/　　　　　　CAUS: /-saa/
　　　　COM: /ʃ-/　　　　　　PASS: /-Vʃ/
　　　　B2P: /iʃ-/　　　　　　NMLZ: /-ʃik/

The vowel that surfaces in the passive morpheme is not predictable and appears to be lexically idiosyncratic. With this background in mind, we now turn to the description of sibilant harmony in STz'.

3. Empirical description. In this section, we expand on Dayley's (1985) description of sibilant harmony in STz' and arrive at the process described by the SPE-style rule in (7).

(7)　　Sibilant harmony in STz'
　　　　ʃ → [+ant] / [+ant, +strid] … _

We use a descriptive rule format for ease of exposition, making no specific commitment as to the representation of harmony processes in the grammar in general (e.g., via agreement-by-correspondence in OT - Rose & Walker 2004; see Rose 2011 for discussion). The sibilant harmony process in (7) has several properties that we will illustrate and discuss in turn in sections 3.1-3.4 and 4.1:

(8)　　Properties of sibilant harmony in STz'
　　　　a. The only trigger is [+ant, +strid]; [-ant, +strid] is not a trigger.
　　　　b. It is progressive (the trigger precedes the target), not regressive or bi-directional.
　　　　c. It is long-distance; trigger and target need not be in adjacent morphemes.
　　　　d. The target is not morpheme-specific.
　　　　e. It is not stem-controlled.

Sibilant harmony in STz' appears to be obligatory today, in contrast to Dayley 1985's description of data collected almost 50 years ago. The obligatory nature of the process today is shown throughout via examples that were deemed unacceptable by our consultants.

3.1. THE ONLY TRIGGER IS [+ANT, +STRID]. Dayley (1985) shows that /s/ is a trigger for harmony in STz' (2). Novel data in (10) show that all [+ant] sibilants /s, t͡s, t͡s'/ are triggers. First consider the baseline data below:

(9)　　/nk-at-kon-Vʃ-a/　　　　　→ [nkatkonoʃa]　　　　　　　'You are being looked for.'
　　　　INC-B2S-√look.for-PASS-INTR

Now observe the behavior of the [-ant] sibilant /ʃ/ in the passive morpheme /-Vʃ/ when there is a [+ant] sibilant in the root:

(10)　General [+ant, +strid] trigger in the root
　　　　a. /ʃ-Ø-qas-Vʃ-a/　　　　　→ [ʃqasasa] / *[ʃqasaʃa]　　　　　　　　'It was cut.'
　　　　　　COM-B3S-√cut-PASS-INTR
　　　　b. /ʃ-ee-t͡siχ-Vʃ-a/　　　　→ [ʃit͡siχosa] / *[ʃit͡siχoʃa]　　　　'They were spoken ill of.'
　　　　　　COM-B3P-√speak.ill-PASS-INTR
　　　　c. /ʃ-Ø-t͡s'aχ-Vʃ-a/　　　　→ [ʃt͡s'aχeesa] / *[ʃt͡s'aχeeʃa]　　　　'It was smashed.'
　　　　　　COM-B3S-√smash-PASS-INTR

(15) STz' sibilant harmony is not regressive; /ʃ/ in the prefixal field
    a. /k-iʃ-in-sik'-Vχ/ → [kiʃinsik'iiχ] / *[kisinsik'iiχ] 'I am calling you all.'
      INC-B2P-A1S-√call-TR
    b. /ʃt-Ø-a-sik'-Vχ teχlal/ → [ʃtasik'iiχ teχlal̥] /*[stasik'iiχ] 'Hopefully you call him.'
      POT-B3S-A2S-√call-TR hopefully *Spanish*: 'Ojalá lo llamés.'
    c. /ʃ-ee-ruu-t͡si-χ-Vχ/ → [ʃirt͡siχuoχ] / *[sirt͡siχuoχ] 'She spoke ill of them.'
      COM-B3P-A3S-√speak.ill-TR
    d. /ʃ-iʃ-nuu-t͡s'et/ → [ʃiʃnut͡s'et] / *[ʃisnut͡s'et] / *[sisnut͡s'et] / *[siʃnut͡s'et]
      COM-B2P-A1S-√see 'I saw you all.'

The data below show that [-ant] sibilants in the root also fail to undergo assimilation with a [+ant] sibilant on their right:

(16) STz' sibilant harmony is not regressive; /ʃ, t͡ʃ, t͡ʃ '/ in the root
    a. /ʃ-in-a-ʃχow-saa-Vχ/ → [ʃnaʃχowsaaχ] / *[ʃnasχowsaaχ] 'You made me dance.'
      COM-B1S-A2S-√dance-CAUS-TR
    b. /ʃ-Ø-in-reʃ-Vr-saa-Vχ/ → [ʃinreʃersaaχ] / *[ʃinresersaaχ] 'I made it green.'
      COM-B3S-A1S-√green-INCH-CAUS-TR
    c. /ʃ-in-a-t͡ʃVq-Vr-saa-Vχ/ → [ʃnat͡ʃqirsaaχ] / *[ʃnat͡sqirsaaχ] 'You got me dry.'
      COM-B1S-A2S-√dry-INCH-CAUS-TR
    d. /ʃ-Ø-in-t͡ʃ 'aχ-Vr-saa-Vχ/ → [ʃint͡ʃ 'χorsaaχ] / *[ʃint͡s'χorsaaχ] 'I cleaned it.'
      COM-B3S-A1S-√clean-INCH-CAUS-TR

The following examples illustrate most clearly the progressive nature of the harmony process: only [-ant] sibilants following a [+ant] sibilant trigger undergo assimilation, whereas root-internal [-ant] sibilants preceding it do not:

(17) Sibilant harmony is progressive, not regressive
    a. /ʃ-in-ʃχow-saa-Vʃ-a/ → [ʃinʃχowsaasa] / *[ʃinʃχowsaaʃa] / *[ʃinsχowsaasa]
      COM-B1S-√dance-CAUS-PASS-INTR 'I was made to dance.'
    b. /ʃ-Ø-reʃ-Vr-saa-Vʃ-a/ → [ʃreʃersaasa] / *[ʃreʃersaaʃa] / *[ʃresersaasa]
      COM-B3S-√green-INCH-CAUS-PASS-INTR 'It was turned green.'
    c. /ʃ-in-t͡ʃVq-Vr-saa-Vʃ-a/ → [ʃint͡ʃqirsaasa] / *[ʃint͡ʃqirsaaʃa] / *[ʃint͡sqirsaasa]
      COM-B1S-√dry-INCH-CAUS-PASS-INTR 'I was dried.'
    d. /ʃ-Ø-t͡ʃ 'aχ-Vr-saa-Vʃ-a/ → [ʃt͡ʃ 'χorsaasa] / *[ʃt͡ʃ 'χorsaaʃa] / *[ʃt͡s'χorsaasa]
      COM-B3S-√clean-INCH-CAUS-PASS-INTR 'It was cleaned.'

We conclude that sibilant harmony in STz' is exclusively *progressive*.[5]

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[5] No prefixes in STz' contain a [+ant] sibilant. It is therefore impossible to assess whether sibilant harmony is triggered from the prefixal field. It was suggested to us that compounds may serve as an empirical testing ground to assess the directionality of STz' sibilant harmony. While an in-depth exploration of STz' compounds and their prosodic properties is pending (see Dayley 1985: 55 for San Juan Tz'utujil compounds) harmony does not seem to apply here:

(i) a. /nuu-t͡ʃii/→ [nuut͡ʃii] b. /ruu-smal nuu-wa'/→ [rsmal̥ nwa'] c. /nuu-smal-t͡ʃii/ → [nsmat͡ʃii] / *[nsmat͡sii]
    A1S-mouth   A3S-hair A1S-head   A1S-hair-mouth
    'my mouth'   'my hair'   'my beard'
  d. /at͡ʃa/ → [at͡ʃa]   e. /suot͡s'/ → [suot͡s']   f. /at͡ʃa suot͡s'/ → [at͡ʃa suot͡s'] / *[at͡sa suot͡s']
    man   bat   man bat
    'man'   'bat'   'Batman'

3.3. THE HARMONY IS LONG-DISTANCE. All examples assessed so far have shown that [-ant] sibilants assimilate to a [+ant] sibilant that is part of an immediately preceding morpheme. In this section, we show that the process is long-distance: the trigger and the target need not be in adjacent morphemes. This fact, and our discussion in 3.4 below, argue against an analysis that would take the STz' phenomenon to involve a phonologically-conditioned morphological alternation.[6] The crucial examples involve *positional* roots that are derived into transitive verbal stems. These stems can be passivized with /-Vʃ/, whose /ʃ/ segment is a target. Positional roots are a distinct category of roots in Mayan languages that are distinguished morphosyntactically and semantically from other root classes, like nominal and verbal roots (Henderson 2019; Polian 2017). Take for example the positional root /χer/, which surfaces in stems that are derived via suffixes that combine exclusively with positional roots:

(18) Positional roots and derivations
       a. /χer-Cik/   → [χerχik]   'laid down (on the ground)'
          √lay.down.POS-ADJ.POS
       b. /ʃ-in-χer-VʔA-a/   → [ʃinχreʔa]   'I laid down (on the ground).'
          COM-B1S-√lay.down.POS-ITV.POS-INTR
       c. /ʃ-at-in-χer-ɓaa/   → [ʃatinχerɓaa][7]   'I laid you down (on the ground).'
          COM-B2S-A1S-√lay.down.POS-CAUS.POS
       d. /ʃ-at-χer-ɓaa-Vʃ-a/   → [ʃatχerɓaaʃa]   'You were laid down (on the ground).'
          COM-B2S-√lay.down.POS-CAUS.POS-PASS-INTR

Below, we use positional roots that include a [+ant] sibilant to show the long-distance nature of the harmony process. Observe that assimilation occurs, even though the causative morpheme /-ɓaa/ separates the trigger and target:

(19) STz' sibilant harmony is long distance
       a. /ʃ-at-in-sin-ɓaa/   → [ʃatinsinɓaa]   'I undressed you.'
          COM-B2S-A1S-√undressed.POS-CAUS.POS
       b. /ʃ-in-sin-ɓaa-Vʃ-a/   → [ʃinsinɓaasa] / *[ʃinsinɓaaʃa]   'I was undressed.'
          COM-B1S-√undressed.POS-CAUS.POS-PASS-INTR
       c. /ʃ-at-in-t͡sel-ɓaa/   → [ʃatint͡selɓaa]   'I twisted you.'
          COM-B2S-A1S-√twisted.POS-CAUS.POS
       d. /ʃ-in-t͡sel-ɓaa-Vʃ-a/   → /ʃint͡selɓaasa/ *[ʃint͡selɓaaʃa]   'I was twisted.'
          COM-B1S-√twisted.POS-CAUS.POS-PASS-INTR
       e. /ʃ-at-in-t͡s'uʔ-ɓaa/   → [ʃatint͡s'uʔɓaa]   'I sat you down.'
          COM-B2S-A1S-√seated.POS-CAUS.POS
       f. /ʃ-in-t͡s'uʔ-ɓaa-Vʃ-a/   → [ʃint͡s'uʔɓaasa] /*[ʃint͡s'uʔɓaaʃa]   'I was sat down.'
          COM-B1S-√seated.POS-CAUS.POS-PASS-INTR

We conclude that sibilant harmony in STz' applies long-distance.

This is consistent with the observation that sibilant harmony rarely applies across a compound boundary (see Hansson 2020).

[6] See Paster (2014) for the criteria that distinguish whether an alternation arises due to phonological processes or from morphological subcategorization.

[7] Two of our four consultants use an additional transitive suffix in this example type:

(i) /ʃ-at-in-χer-ɓaa-Vχ/   →   [ʃatinχerɓaaχ]   (*two consultants*)
    COM-B2S-A1S-√lay.down.POS-CAUS.POS-TR

3.4. THE TARGET IS NOT MORPHEME SPECIFIC. In all examples shown so far, the target has been the /ʃ/ segment in the passive morpheme /-Vʃ/. However, this is not the only morpheme in which the harmony process materializes. The /ʃ/ segment in the nominalizer /-ʃik/ is also a target for the harmony process. This suffix attaches to a transitive stem and the resulting nominalization can be the complement of an auxiliary verb that is used in the progressive construction (Levin, Lyskawa & Ranero 2020), as illustrated below:

(20) a. /ʃ-Ø-in-loq'   χun ak'/   → [ʃinloq' χun ak']   'I bought a chicken.'
         COM-B3S-A1S-√buy one   chicken

      b. /ruu-mχuon ki-loq'-**ʃik**   i-k'ij   ak'/→ [rumχuon kloq'**ʃ**ik ik'ij ak'] / *[kloq'**s**ik]
         A3S-PROG   A3P-√buy-**NMLZ** P-many chicken
         'He is buying many chickens.'

A /ʃ/ segment in the nominalizer assimilates to a [+ant] sibilant in the root:

(21) Target in nominalizer suffix
      a. /ruu-**sik'**-ʃik/   → [r**s**ik'**s**ik] / *[r**s**ik'ʃik]   'his calling'
         A3S-√call-PASS-NMLZ
      b. /ruu-**t͡s**aj-ʃik/   → [r**t͡s**aj**s**ik] / *[r**t͡s**ajʃik]   'its seasoning'
         A3S-√season-NMLZ
      c. /ruu-**t͡s'**uχ-ʃik/   → [r**t͡s'**uχ**s**ik] / *[r**t͡s'**uχʃik]   'his mocking'
         A3S-√mock-NMLZ

An alternative interpretation of the data just described would posit that /-ʃik/ is decomposable into two affixes – the passive /-Vʃ/ and a nominalizer /-ik/.[8] In other words, this approach would require that nominalizations be derived from passivized stems. For example, Imanishi (2014) proposes this analysis for nominalizations in closely-related Kaqchikel (cf. Can Pixabaj 2015: 114–120 for K'iche'). If this analysis were correct for STz' as well, then the result of the harmony process would only materialize on the /ʃ/ segment of the passive /-Vʃ/.

     However, this morphological decomposition is not justified for STz'. First, the STz' nominalizations never surface with the vowel that is part of the passive morpheme. Second, some Kaqchikel nominalizations come in two versions, with a different voice morpheme in each (passive versus antipassive). Observe that the nominalization in (22a) contains a passive morpheme, whereas the nominalization in (22b) has an antipassive:

(22) Nominalizations in Kaqchikel (Burukina & Kubatieva 2021)
      a. < N-Ø-inw-ajo'   ri   ru-kan-**ux-ik**   ri   llave. >
         INC-B3S-A1S-√want DET A3S-√search-**PASS-NMLZ** DET key
         'I want (someone) to look for the key.'
      b. < N-Ø-inw-ajo'   ri   nu-kan-**un-ik**   aninäq. >
         INC-B3S-A1S-√want DET A1S-√search-**AP-NMLZ**   quickly
         'I want someone to quickly look for me.'

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[8] The data in García Ixmatá (1998: 120–121) imply that CVC transitive roots in San Pedro Tz'utujil are nominalized directly via the nominalizer /-ik/, while derived transitives must be passivized first via the suffix /-ʃ/. This cannot be the correct generalization for STz', since some CVC transitives are nominalized via /-ʃik/ and others via /-ik/; see discussion below (compare (20) and (23)). Dayley (1985: 179) reports that in San Juan Tz'utujil, CVC roots are passivized via the infix /-χ-/ and then undergo nominalization. We observe no such requirement in STz', given that in examples like (23b), the nominalizer attaches to an underived CVC root.

Voice exponents are thus in complementary distribution in Kaqchikel nominalizations. In contrast, we have been unable to replicate similar data in STz' and examples like (22a-b) are not discussed by Dayley (1985) or García Ixmatá (1997; 1998). Thus, there is no evidence from voice alternations in Tz'utujil that the sibilant segment in the nominalizer is an exponent of voice. Finally, the nominalizer suffix surfaces without a sibilant segment altogether in some nominalizations:[9]

(23) Nominalization without sibilant
      a. /ʃ-Ø-in-t͡saq   k'ij   wej/ → [ʃint͡saq k'ij βej]   'I made many tortillas.'
         COM-B3S-A1S-√make   many   tortilla
      b. /nuu-mχuon ruu-t͡saq-ik   wej/ → [numχuon rt͡saqik βej] / *[rt͡saqʃik] *[rt͡saqsik]
         A1S-PROG   A3S-√make-NMLZ   tortillas   'I am making tortillas.'

The same can be observed with transitive roots that are passivized via the /-Vʃ/ suffix in general (see example (10c)):

(24) /ruu-mχuon ruu-t͡s'aχ-ik χal χaan/ → [rumχuon rt͡s'aχik χal χaan] / *[rt͡s'aχʃik] / *[rt͡s'aχsik]
      A3S-PROG A3s-√smash-NMLZ that fly   'She is smashing that fly.'

There is no morphophonological generalization regarding which roots combine with the form of the nominalizer that surfaces as [-ik] versus [-ʃik] / [-sik]. We thus could not posit that the sibilant is present underlyingly and undergoes deletion in a specific environment. As a result, we propose that the nominalizer has two lexically conditioned allomorphs: the allomorph /-ik/ combines with roots like /t͡saq/ 'make (tortillas)' (23) and /t͡s'aχ/ 'smash' (24), whereas /-ʃik/ combines with roots like /t͡s'uχ/ 'mock' (20b) and /loq'/ 'buy' (21c) (pace Levin, Lyskawa & Ranero 2020: 341).

    To summarize, sibilant harmony in STz' is not morpheme specific, since it targets (i) the /ʃ/ segment in the passive /-Vʃ/ and (ii) the /ʃ/ segment in one of the allomorphs of the nominalizer, namely /-ʃik/.

4. Typological contextualization. In this section, we lay out (and modify slightly) Hansson (2010)'s typologies of sibilant harmony systems and observe that the STz' pattern is an outlier. In section 4.1, we argue that the STz' phenomenon is an instance of progressive sibilant harmony that cannot be reduced to stem control, which is otherwise unattested. In section 4.2, we show that only one other language (Tlachichilco Tepehua) has been described as exhibiting harmony where only [+ant] sibilants are triggers. The combination of having sibilant harmony that is (i) progressive and (ii) triggered only by [+ant] sibilants makes the STz' phenomenon unique. We end by suggesting that sibilant harmony in STz' has been diachronically stable because the target is always in the stressed syllable.

4.1. SIBILANT HARMONY IN SANTIAGO TZ'UTUJIL IS NOT STEM-CONTROLLED. We established that STz' has the following sibilant harmony process:

(25) Sibilant harmony in STz'
      ʃ → [+ant] / [+ant, +strid] … _

One of the properties that make sibilant harmony in STz' typologically unusual is that it is progressive (see below)—the trigger always precedes the target. At this juncture, let us consider whether an alternative analysis that does not invoke directionality can characterize the STz' data:

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[9] Inanimate plural objects need not control plural agreement (see Levin, Lyskawa & Ranero 2020).

(26) Alternative interpretation of STz' sibilant harmony
    STz' sibilant harmony is stem-controlled, not progressive.

There are empirical and theoretical reasons to entertain (26). Baković (2000) assesses vowel harmony systems cross-linguistically and argues that stem-control gives rise to directionality in harmony systems, but directionality is epiphenomenal.[10] In a nutshell, progressive harmony arises in languages that employ suffixes because there is a trigger in the stem, which is to the left of a target in the suffixal field. Conversely, regressive harmony arises in languages that employ prefixes because there is a trigger in the stem, which is to the right of a target in the prefixal field. Baković argues that apparent cases of left-to-right (progressive) or right-to-left (regressive) harmony can be reduced to a single mechanism of stem-control, as opposed to two mechanisms (regressive and progressive spread), thus simplifying the grammar. Consider as an illustration sibilant harmony in Koyra (Omotic), which appears to be progressive (much like in STz'). The examples below show that the sibilant in the causative suffix /-(u)s/ surfaces as [-ant] if there is a [-ant] sibilant preceding it (27c):

(27) Koyra sibilant harmony (Hayward 1988 cited in Hansson 2010: 274)
    a. pug-u**s**-   'cause to blow'   c. go:**t͡ʃ**-u**ʃ**-   'cause to pull'
    b. ke**s**-u**s**-   'cause to go out'

The process in (27) can be analyzed as stem-controlled, as opposed to progressive, given that the trigger is always part of the stem of affixation. Since this is a suffixing context, stem-controlled harmony gives rise to a "progressive" pattern epiphenomenally.

Hansson (2010: 145) notes that seven languages exhibit what appears to be progressive sibilant harmony: Aari, Koyra, Benchnon, Zayse (Omotic); Rumsen (Costanoan); Izere (Bantu); and perhaps Wanka Quechua (Quechuan). However, he observes that sibilant harmony in *all* these languages can be analyzed as a stem-controlled process, raising the question of whether true left-to-right sibilant harmony exists (see Archangeli & Pulleyblank 2007: 367 for related discussion). Demi (Omotic; Seyoum 2008) and Sidaama (Cushitic; Kawachi 2007) should also be added to this list, since they are suffixing languages in which the result of sibilant harmony materializes to the right of the stem of affixation.

With this background in mind, two questions arise that serve to evaluate (26) as an analysis of STz' sibilant harmony. First, do we have definitive empirical reasons to reject the encoding of directionality altogether (left-to-right *and* right-to-left) for the representation of sibilant harmony? Second, can STz' sibilant harmony specifically be analyzed as stem-controlled? The answer to both questions is no.

First, while Baković (2000) shows that most vowel harmony processes can be reduced to stem-control (though see Rose & Walker 2011), directionality must be invoked to account for several cases of sibilant harmony. Samala (also called Ineseño; Chumashan) illustrates this most clearly.[11] In this language, the rightmost sibilant in a word determines the [± ant] feature of all sibilants that precede it, whether they be segments in the stem or prefixal field. In the following examples, the stem is underlined, /s-/ indicates 3rd person subject, /-it/ indicates 1st person object, /-us/ indicates 3rd person object, and /-waʃ/ is a past marker:

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[10] We set aside dominant-recessive systems, which seem unattested in consonantal harmony (Hansson 2010: 142).

[11] Nkore-Kiga sibilant harmony must also be analyzed as regressive (Hansson 2010: 305–306; but see Bennett & Pulleyblank 2018), while Navajo sibilant harmony may require such an analysis (Hansson 2010: 277). The data in (30) show that Tseltal's sibilant harmony must be analyzed as right-to-left, since the rightmost sibilant is the trigger.

(28)   Samala sibilant harmony is regressive (Applegate 1972 cited in Hansson 2010: 261)
      a. /s-api-t͡ʃʰo-it/   → [ʃapit͡ʃʰolit]   ‘I have a stroke of good luck.’
      b. /s-api-t͡ʃʰo-us/   → [sapit͡sʰolus]   ‘He has a stroke of good luck.’
      c. /s-api-t͡ʃʰo-us-waʃ/   → [ʃapit͡ʃʰoluʃwaʃ]   ‘He had a stroke of good luck.’

Since directionality must be invoked for sibilant harmony like Samala's – in this case, a right-to-left spread mechanism – this undermines the case for disallowing a left-to-right mechanism *a priori*. We thus reject a theoretical prior for adopting the alternative in (26) as an analysis of STz' harmony.

    Moving to the second question – whether a stem-control analysis holds water at all specifically for STz' sibilant harmony – consider what Hansson (2010: 144) observes about stem-controlled harmony in general: "*the clearest cases of stem-control are those where harmony affects prefixes and suffixes alike, yielding bidirectional harmony 'outwards' from the root.*" Akan (Niger-Congo, Kwa) vowel harmony illustrates this. Note that the [± ATR] value of the affix vowels below is determined by the stem, which is underlined:

(29)   Stem-controlled vowel harmony in Akan (adapted from O'Keefe 2003: 25)
      a. /O-bE-tu-I/   →   [obetui] ‘he came and dug it’
      b. /O-bE-tʊ-I/   →   [ɔbɛtʊɪ] ‘he came and threw it’

With this in mind, the data we discussed in section 3 pose a significant challenge to a stem-control analysis of STz' sibilant harmony. Recall that much like Akan, STz' employs both prefixes and suffixes. As we showed, however, STz' is *unlike* Akan in that the relevant segments in the prefixal field never alternate. This is unexpected for a stem-controlled harmony process. In order for (26) to be descriptively adequate, then, one would need to stipulate that the domain of application for sibilant harmony in STz' excludes three morphemes in the prefixal field: (i) the completive aspect /ʃ-/, (ii) the potential aspect /ʃt-/, and (iii) the B2P agreement /iʃ-/.

    At this juncture, one could point out the empirical observation that some sibilant harmony systems do seem to be limited to specific domains – i.e., the root and derivational affixes in Totonacan languages (Hansson 2010: 326). This appears only to be an empirical tendency, however, and given the small number of languages exhibiting sibilant harmony (see (31)), it is unclear whether this tendency reveals something deep about limitations on the representation of sibilant harmony. For instance, data that contrast with the Totonacan pattern are readily available. In Tseltal (Mayan), the effect of sibilant harmony materializes on the incompletive aspect and A3S agreement prefixes (30b-c):

(30)   Tseltal sibilant harmony (adapted from Polian 2013: 102–103, 376)
      a. /ot͡ʃ-es/   → [ot͡ses]   ‘to put in’
           √enter-CAUS
      b. /ja   ʃ-t͡s'ilax/   → [ja st͡s'ilax]   ‘It spoiled.’
          INC INC.I-√spoil.B3S
      c. /s-t͡ʃ'uxt'/   → [ʃt͡ʃ'uxt']   ‘her womb’
          A3S-womb

We conclude, then, that (26) fails to characterize sibilant harmony in STz'.

    To summarize this section, we considered an alternative analysis of the STz' harmony process that would take it to be stem-controlled, rather than progressive (26). We argued against this analysis, since (i) there is no justification for rejecting the representation of directionality altogether in sibilant harmony and (ii) such an analysis must resort to stipulation. We maintain, then,

that STz' instantiates an instance of truly progressive sibilant harmony that cannot be reduced to stem control.[12]

4.2. A TYPOLOGY OF TRIGGER CLASSES. Sibilant harmony patterns may be divided into three types based on the class of segments that triggers the process (Hansson 2010: 356–367).[13] To Hansson's typology below, we add Slovenian (Jurgec 2011; see Hansson 2020), Dime (Seyoum 2008; see Hansson 2010: 50), and Sidaama (Kawachi 2007; see Rose 2011) as type (31b) languages, and move Tseltal from type (31b) to (31a). Finally, we add STz' to type (31c):[14]

(31)   Sibilant harmony typology based on trigger type (modified from Hansson 2010: 356–367)
        a. symmetrical: both [+ant] and [-ant] sibilants are triggers   10-11 languages
        b. asymmetrical: only [-ant] triggers (e.g., ∫ = trigger)   18 languages
        c. asymmetrical: only [+ant] triggers (e.g., s = trigger)   2 languages

In what we have termed type (31a), Hansson identifies the following: Navajo, Chiricahua Apache, Plains Apache, Tanana (Athabaskan), Barbareño, Samala, Ventureño (Chumashan), Southern Paiute (Uto-Aztecan), Nebaj Ixil (Mayan), and possibly Misantla Totonac (Totonac); we add Tseltal (Mayan). The second type (31b) seems to be the most common. Hansson identifies several languages (some with multiple dialects) that fit this type: Tsuut'ina, Dene-tha (Athabaskan), Wiyot (Algic), Aari, Koyra, Benchnon, Zayse (Omotic), Moroccan Arabic (Semitic), Berber (various dialects; Afro-Asiatic), Coptic (various dialects; Afro-Asiatic), Nkore-Kiga, Rwanda, Rundi, Shambaa and Izere (Bantu); we add Slovenian (Slavic), Dime (Omotic), and Sidaama (Cushitic).

    As is clear from (31), languages are unevenly distributed across the possible types, an empirical observation that has the potential to shed light on the source and representation of sibilant harmony processes. What is most interesting for our purposes is the dearth of languages in type (31c). Before our addition of STz' to type (31c), Hansson (2010) had identified a single language where only [+ant] sibilants are triggers: Tlachichilco Tepehua (Totonacan).[15] As shown below, sibilant harmony is regressive in Tlachichilco Tepehua, unlike in STz':

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[12] Other cases that might qualify are Navajo, which may have progressive harmony within the prefixal field (see Hansson 2010: 148–152 for discussion and qualifications) and Teralfene Flemish (Hansson 2010: 145), though the latter requires more investigation. We leave a formalization of the representation of truly progressive harmony for the future. Note that certain models of consonantal harmony are built to disallow genuine progressive systems; see Hansson (2010: 261–294) for discussion.

[13] This typology excludes languages with sibilant co-occurrence restrictions in roots that may or may not evidence a synchronically active process.

[14] Hansson (2010) notes that classifying some languages as (31b) instead of (31a) can be an analytical choice. For instance, two languages classified as (31b) by Hansson (Nkore-Kiga and Tseltal) actually exhibit a symmetrical system. However, Hansson claims that [+ant] triggers are more restricted than [-ant] ones. For example, he argues that Tseltal exhibits ∫ → s only if the target is sandwiched between two /s/ triggers (Kaufman 1971):

(i)   /s-wàka∫/ → [∫wáka∫]   'his cattle'   (ii)   /s-kù∫-H-es-ik/ → [skúsesik]   'they revive'
(iii)   /∫-pàs-H/ → [spás]   'it is made'

Example (ii) leads Hansson to classify Tseltal as an asymmetrical type (31b) language rather than (31a). However, (iii) above from Kaufman seems to show that the [+ant] trigger need not surround the target on both sides. This data point and the description in Polian (2013) (see (30)) lead us to classify Tseltal as a (31a) language.

[15] Hansson (2010: 46) observes that Tz'utujil has sibilant harmony (citing Dayley 1985), but he does not classify the pattern into his typology. On page 389, he classifies Tz'utujil sibilant harmony as being a static morpheme structure constraint on roots, so Hansson must have been referencing syllable internal co-occurrence restrictions (Dayley 1985: 31), rather than the rule in (1); see section 5 below.

(32) Tlachichilco Tepehua sibilant harmony (Watters 1988 cited in Hansson 2010: 360)
    a. /ʔaqʃ-kis/ → [ʔaq**ski**s]   b.   /pa**s-t͡ʃ**aʃan/ → [pa**st͡ʃ**aʃan] / *[pa**ʃt͡ʃ**aʃan]
      CLF-five   CLF-six
      'five flat things'   'six bundles'

Hansson argues that the relative rarity of type (31c) languages is not accidental, linking it instead to the *Palatal Bias* – a robust empirical generalization related to speech errors in production:

(33) Palatal Bias in relation to sibilants (Shattuck-Hufnagel & Klatt 1979)
    Speech errors involving substitutions like s → ʃ are much more common than ʃ → s

In a nutshell, Hansson claims that whatever mechanism underlies the Palatal Bias (an empirical observation) also gives rise to sibilant harmony. We therefore expect more languages where sibilant harmony gives rise to s → ʃ only (31b), as opposed to ʃ → s only (31c).
    In light of this proposal, Hansson must explain the existence of Tepehua harmony, which is ʃ → s (31c). He speculates that Tepehua harmony has an extraordinary diachronic source: it arose from the grammaticalization of a language-specific sound symbolism pattern. Totonacan languages are characterized by sibilant alternations within a stem, where a stem with a [-anterior] sibilant maps to a meaning indicating a greater intensity than a stem with a [+anterior] sibilant:

(34) Sound symbolism in North Central Totonac of Apapantilla, Puebla (MacKay 1994)
    a. [tsutsu] 'she smokes'   b. [t͡ʃut͡ʃu] 'she sucks'

Hansson proposes that Tlachichilco Tepehua speakers reanalyzed a sound symbolism pattern as a purely grammatical process. The pattern of ʃ → s harmony in Tepehua is therefore not a challenge to the claim that whatever underlies the Palatal Bias also gives rise to sibilant harmony. Instead, it is an outlier that can be explained independently (see Hansson 2010: 360–363).
    STz', however, is a type (31c) language for which we cannot invoke an extraordinary diachronic source – e.g., there is no sound symbolism mechanism that could explain the outlier nature of the STz' process. Nevertheless, let us point out a characteristic of STz' grammar that might contribute to the diachronic stability of its sibilant harmony: the /ʃ/ in which the harmony process materializes is always in the final syllable of the word, which bears stress:

(35) STz' is stress-final (data repeated from (19))
    /ʃ-in-sin-ɓaa-Vʃ-a/   →   [ʃin.sin.ɓaa.**sá**]   'I was undressed.'

We conjecture that this property of STz' grammar makes the ʃ → s alternation particularly salient for the learner. If we assume that whatever underlies the Palatal Bias would make the STz' pattern diachronically *unstable*, then this particular characteristic of STz' grammar – the fact that the target of harmony always occurs in the final syllable – has contributed to the pattern's stability over generations of transmission.
    We end by noting that adding a single new outlier to the typology in (31) does not conclusively cast doubt on Hansson (2010)'s proposal connecting the mechanism underlying the Palatal Bias to the skewed patterning of sibilant harmony cross-linguistically. However, it appears that more detailed work in the Mayan family could establish even more examples of the rare (31c)

type. For example, DuBois (1981) briefly notes that Sakapultek, another language of the K'ichean branch, appears to exhibit the same sibilant harmony system as STz':[16]

(36) Sakapultek sibilant harmony (adapted from DuBois 1981: 137, 207)
   a. /**ts**ili-ʃ/　　　→　　　[**ts**ili**s**]　　　　　'it was returned'
      √return-PASS
   b. /kuʔum-a**s**a-ʃ/　→　　　[kuʔma**s**a**s**]　　　'it was moved'
      √move-CAUS-PASS
   c. /r-**ts'**unu-ʃ-iik/　→　　[r-**ts'**unu-**s**-iik]　　'its being asked for'
      A3S-√ask.for-PASS-NMLZ

At present, we do not have as detailed a description for Sakapultek as we do for STz', so we hesitate to conclude that a third language should be added to type (31c). DuBois (1981: 46) suggests that the same sibilant harmony process also exists in Poqom (K'ichean), though we have been unable to find corroboration in published sources (e.g., Santos Nicolás & Benito Pérez 1998; Malchic Nicolás, Mó Isém & Tul Rax 2000). Romelia Mó Isém and Carlos Humberto Cú Cab (p.c.) also point out to us that some dialects of Q'eqchi (K'ichean) have the same sibilant harmony process, though this has not been documented either.

To summarize, we added STz' to the typological distribution of sibilant harmony based on trigger type, showing that it is one of two outlier languages where only [+ant] sibilants are triggers. We laid out Hansson's (2010) proposal that linked the scarcity of type (31c) languages to the mechanism underlying the Palatal Bias and conjectured that the stress-pattern in STz' might explain how the sibilant harmony process in the language has been stable diachronically.

5. Conclusions and future work. We showed that STz' exhibits a typologically unique process of sibilant harmony. The combination of properties that make it an outlier are the following: the process (i) is triggered solely by [+ant] sibilants, (ii) is progressive, and (iii) cannot be reduced to stem-control.

Our work toward understanding STz' sibilant harmony is not done, however. We end by noting an exception to the pattern we described. There is at least one instance of root-internal sibilant disharmony, the root /sat͡ʃ/ 'to lose':

(37) /ʃ-Ø-a-**sat͡ʃ**　　　　a-jaw/?　→　[ʃa**sat͡ʃ** ajaw] / *[ʃa**sats**]　　'Did you lose your key?'
      COM-B3S-A2S-√lose A2S-key

Interestingly, this root only passivizes via the infix /-ʔ-/, not /-Vʃ/, and combines with the /-ik/ allomorph of the nominalizer, not /-ʃik/. We therefore cannot determine whether the trigger can "skip" the /t͡ʃ/ segment in the root and trigger assimilation on a segment in the suffixal field:

(38) a. /ʃ-in-sa<ʔ>t͡ʃ-a/→ [ʃinsaʔat͡ʃa]　　b. /ruu-sat͡ʃ-ik/ → [rsat͡ʃik]
         COM-B1S-√lose<PASS>-INTR　　　　A3S-√lose-NMLZ
         'I got lost.'　　　　　　　　　　　'its losing'

To put (37) in context, Dayley (1985: 31) noted a restriction on the root-internal co-occurrence of sibilants disagreeing in anteriority in San Juan Tz'utujil. In Pérez Mendoza & Hernández Mendoza (2001), we indeed do not find any root internal combination of two sibilants where the

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[16] Hansson does not discuss Sakapultek. In contrast to DuBois (1981), a more recent grammar (Mó Isém 2007) does not describe sibilant harmony. Romelia Mó Isém (p.c.) informs us that she did not document any such process in her fieldwork, nor does she recall eliciting data akin to DuBois's.

sibilants disagree in [± ant], *except* for √sV$\widehat{t\int}$, as illustrated by (37) for STz'– see e.g., the entry <sachooj> 'to confuse'. In brief, there seem to be no instances in the dictionary of roots where the first sibilant is [+ant] and the second is [-ant]: √sV$\int$, √sV$\widehat{t\int}$', √tsV$\int$, √tsV$\widehat{t\int}$, √tsV$\widehat{t\int}$', √ts'V$\int$, √ts'V$\widehat{t\int}$, √ts'V$\widehat{t\int}$'. In a similar manner, we also do not find any instance of roots where the first sibilant is [-ant] and the second is [+ant]: √$\int$Vs, √$\int$V$\widehat{ts}$, √$\int$V$\widehat{ts}$', √$\widehat{t\int}$Vs, √$\widehat{t\int}$V$\widehat{ts}$, √$\widehat{t\int}$V$\widehat{ts}$', √$\widehat{t\int}$'Vs, √$\widehat{t\int}$'V$\widehat{ts}$, √$\widehat{t\int}$'V$\widehat{ts}$'. In our work on STz', we have never documented a root with these forms either.

The significance of the disharmonic root in (37) is unclear to us at this point. For instance, it could simply be a lexical exception. Alternatively, it might indicate that only a subset of [-ant] sibilants in STz' are targets, to the exclusion of /$\widehat{t\int}$/. We leave for future work whether (37) is the only lexical outlier or whether root-internal disharmony in STz' is more frequent.

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