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THE ORGANIZATION OF CHINANTEC TONE PARADIGMS

Matthew Baerman

Surrey Morphology Group, University of Surrey

Enrique L. Palancar

SeDyL-CELIA (UMR8202), CNRS

Surrey Morphology Group, University of Surrey

Abstract

The tonal paradigm of verbs in Tlapeuzco Chinantec counts as one of the most complex and opaque ever described, with five tone values distributed over twelve cells (distinguishing person/number and aspect) to yield c. 70 distinct paradigm types, with no consistent mapping between morphological form and morphosyntactic function. We suggest that useful generalizations will emerge only when we consider units of analysis larger than the individual inflected form, which we dub *inflectional series*. For Tlapeuzco Chinantec this means concatenating the three aspectual forms for each person/number value. The resulting units allow us to see structural relationships between the elements of the paradigm which were previously inaccessible.

1 Introduction¹

Chinantec (or Chinantecan) is a language family spoken in Mexico which is a branch of Oto-Manguean, which in turn is one of the most diverse linguistic phyla in the Americas. Chinantec verb paradigms have served as the poster child for complex inflectional systems (*e.g.* Finkel & Stump 2009), mainly because there is no clear form-function mapping and little predictability of inflection classes. In this paper, we attempt a step in the right direction, looking at the person marking of the verbs of Tlapeuzco Chinantec (henceforth TlCh), a Central Chinantec language. Our analysis is based on

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the study of the data and the grammatical description in the large dictionary by Merrifield & Anderson (2007).

1.1 Some preliminaries about Tlatempuzco Chinantec.

Like the other Chinantec languages, TlCh uses tone as an exponent of inflection. Tonal inflection consists of three level tones (1, 2, 3 = high, mid, low) and two contour tones (31, 32 = high rising, mid rising). Verbs mark subject person/number and aspect. While the pronominal system distinguishes six person/number values, verbs distinguish just four, namely first person singular, first person plural, second person and third person. This can be seen in (1).

(1)	‘I bent it’?	ka ³ -hú ³	hni ²
	‘we (INCL) bent it’	ka ³ -hú ³ ³¹	hniaŋ ¹
	‘we (EXCL) bent it’	ka ³ -hú ³ ³¹	hnieŋ ¹
	‘you (SG) bent it’	ka ³ -hú ³	ʔniŋ ²
	‘you (PL) bent it’	ka ³ -hú ³	ʔniaŋ ³²
	‘she, he, they bent it’	ka ³ -hú ²	dsa ²

There are three aspectual stems (PRS, FUT, CPL),² from which additional TA values can be derived through simple prefixation, as shown in (1). For example, the PRS stem on its own expresses incompletive and habitual aspectual values, while the addition of the prefixes *mi*¹- and *ma*²- yield the so-called “Imperfect tense” and the “Perfect tense”. For the purposes of this paper, it is sufficient to focus just on the bare stems in (3).

(1)	TA	1SG	1PL	2	3	Stems
	Present	hú ³²	hú ³²	hú ³²	hú ²	PRS
	Imperfect	mi ¹ -hú ³²	mi ¹ -hú ³²	mi ¹ -hú ³²	mi ¹ -hú ²	
	Perfect	ma ² -hú ³²	ma ² -hú ³²	ma ² -hú ³²	ma ² -hú ²	
	Future	hú ³¹	hú ³¹	hú ³¹	hú ²	FUT
	Potential	mi ¹ -hú ³¹	mi ¹ -hú ³¹	mi ¹ -hú ³¹	mi ¹ -hú ²	
	Past	ka ³ -hú ³	ka ³ -hú ³¹	ka ³ -hú ³	ka ³ -hú ²	CPL
	Hodiernal	na ² -hú ³	na ² -hú ³¹	na ² -hú ³	na ² -hú ²	

² Following the practical system employed by Merrifield and Anderson (2007) we employ tense labels ‘present’ and ‘future’, for the first two stems, when in reality they could be alternatively characterized as ‘incompletive’ and ‘irrealis’.

(3)

	1SG	1PL	2	3
PRS	húʔ ³²	húʔ ³²	húʔ ³²	húʔ ²
FUT	húʔ ³¹	húʔ ³¹	húʔ ³¹	húʔ ²
CPL	húʔ ³	húʔ ³¹	húʔ ³	húʔ ²

1.2 The nature of the problem.

In a maximally transparent inflectional system, we would expect a one-to-one mapping between form and function. That TlCh is not like this is already patently obvious from the repertoire of inflectional formatives: given that there are five tonal formatives distributed across twelve functions (four person/number values x three aspects), a one-to-many mapping (syncretism) is inevitable. And in fact, it works in the other direction as well, with the multiple tonal formatives mapping onto the same function (allomorphy), depending on the lexeme. For a concise illustration, compare the tonal paradigms of *ʔnai*³² ‘sell something’ and *kieg*² ‘lie down’ in (4a) and (4b): both employ the same set of tones, but in an almost completely different distribution.

(4) a. [*ʔnai*³² ‘sell something’, Class 13b] b. [*kieg*² ‘lie down’, Class 51f]

	1SG	1PL	2	3
PRS	32	2	2	32
FUT	31	1	1	3
CPL	3	1	1	3

	1SG	1PL	2	3
PRS	2	2	32	2
FUT	1	31	31	3
CPL	2	31	3	2

While such many-to-many mappings are a familiar feature of inflectional systems, TlCh – and indeed all Chinantec languages – takes this to an extreme. An impression of the full extent can be gleaned from Table 1, which charts the tone formatives found in the inflected forms of 613 verbs of TlCh for each person/number value and each TA stem.³ There is an almost complete lack of form-function mapping, *e.g.* all tone units are used for all possible values.

³ Verbs from Merrifield & Anderson’s (2007) dictionary that have complete paradigms, *i.e.* omitting intransitive inanimates that lack first and second person subject forms, as well as a few items with incomplete or contradictory information.

Tone	1SG			1PL			2			3		
	PRS	FUT	CPL	PRS	FUT	CPL	PRS	FUT	CPL	PRS	FUT	CPL
1	149	198	149	146	265	264	151	289	225	10	7	10
2	96	21	92	172	20	43	184	20	85	242	200	240
3	11	67	287	11	68	56	11	67	176	31	335	300
31	70	315	71	74	248	237	70	226	86	12	22	12
32	287	12	14	210	12	13	197	11	41	318	49	51
Total	613	613	613	613	613	613	613	613	613	613	613	613

Table 1: Tone formatives in the inflected forms of 613 verbs of TlCh

At first glance one might believe this is an almost random distribution of forms, but the fact that they fall into ‘only’ around 70 distinct paradigm types suggests that there is some kind of order to them.⁴ But what? As a first step, consider the entropy measures in Table 2, generated using Raphael Finkel and Gregory Stump’s *Analyzing Principal Parts* software.⁵ The table illustrates the predictability of the forms shown in columns, given the forms shown in the rows (measured in bits x 100), factoring in type frequency. The higher the number, the less predictable the form; thus the correct form of the 3rd person present for a given verb can relatively easily be predicted from the 3rd person completive (value of 19), while the correct 2nd person completive is very difficult to predict if one knows just the 1PL future.

	1sgP	1sgF	1sgC	1plP	1plF	1plC	2P	2F	2C	3P	3F	3C
1sgP	---	72	70	121	139	140	40	98	95	53	103	65
1sgF	106	---	34	136	127	142	133	38	131	135	70	134
1sgC	95	25	---	128	140	131	123	63	110	123	94	113
1plP	177	158	158	---	75	64	177	156	190	160	153	170
1plF	186	140	161	66	---	54	188	139	194	178	139	173
1plC	186	155	152	54	54	---	186	153	185	174	152	165
2P	40	99	97	121	142	140	---	66	90	43	98	56
2F	134	40	73	135	128	142	101	---	126	131	58	129
2C	87	89	76	126	139	130	81	83	---	90	119	84
3P	65	113	109	116	144	139	55	107	110	---	63	21
3F	139	72	105	133	128	142	134	59	163	87	---	84
3C	75	110	98	125	137	129	66	104	103	19	58	---

Table 2: Conditional entropy of the tone formatives

What is striking about these figures is that, overall, the entropy measures divide the paradigm into cross-cutting distinctions of person and aspect, as broken down in Table 3.

⁴ As pointed out by an anonymous referee, five allomorphs over twelve cells yields 248,832 possible paradigm types, so we would expect closer to 613 types.

⁵ <http://www.cs.uky.edu/~raphael/linguistics/analyze.html>

3 rd person:	55
1PL:	61
1SG:	67
2 nd person:	91
Present:	94
Future:	108
Completive:	123
Differing in both person and aspect:	129

Table 3: Average entropy within restricted domains of the paradigm

That is, within a given value for person, it is easier to predict the different aspectual forms for a lexeme than it is to predict the different person forms within a given aspect, and both are easier than predicting between forms that differ in both person and aspect. In this way person and, to a lesser extent, aspect, are organizing parameters of the paradigm, in that they define domains of relative interpredictability. This suggests that, in spite of the apparent amorphousness of the tonal paradigm, it is in some sense built on conventional featural distinctions, with person playing a dominant role. We propose here to pursue this idea further by providing an account of the TlCh tonal paradigm as a person-marking system, in which the properties of and relationships between morphological exponents can be described in relatively simple terms. This allows us to demystify, at least somewhat, the otherwise puzzling complexity of the system.

The crucial point to be gleaned from comparing the figures in Tables 1 and 3 is that the discernible role of person in the organization of the paradigm only begins to emerge when we look at its exponence across multiple aspect values. We propose therefore to treat as our basic unit of form not the individual exponents of person and aspect, but rather the combination of all aspect values for a given person. But before we attempt to characterize the paradigm in such terms, we need to dispense with other possible explanations for the tone patterns and the resulting wealth of inflection classes.

2 Rejected explanations

We need to discard first a set of possible alternative explanations for the variation we observe.

2.1 Semantic explanations

Verbs fall into a few different syntactic/semantic classes based on transitivity and animacy. These are relevant for valence increasing mechanisms, for the syntax of agreement and for the syntax of voice (inverse, passive), but have no observable relationship to the tonal formatives. For example, the verbal lexicon is largely split according to the animacy of the ABS argument (object

of transitive or subject of intransitive). The members of animate/inanimate pairs differ along various morphological parameters, including tone, but there are no dedicated animate or inanimate tone patterns. Consider for this purpose the tone of the CPL stem of three gender pairs in Table 4.

CPL	inanimate				animate			
	1SG	1PL	2	3	1SG	1PL	2	3
'buy'	lá ²	lá ³¹	lá ³	lá ³	lán ²	lan ³¹	lán ³	lan ²
'grab'	gúu ²	guu ³¹	guu ¹	guu ³	guén ²	guen ³¹	guén ³	guen ³
'hit'	bá ²	bá ³¹	bá ³	bá ²	bán ²	bán ³¹	bán ³	bán ²

Table 4: Completive tonal paradigm of three animate/inanimate pairs

The inanimate verb 'buy (something inanimate)' has the same tonal inflection as the animate verb 'grab (somebody)', but its animate counterpart 'buy (something animate)' has the same tone pattern as the pair of verbs meaning 'hit', which do not mark animacy through tone. This lack of correlation between tone patterns (or indeed any individual tone value) and animacy is typical of the verbal lexicon as a whole.⁶

2.2 Resegmentation

Besides tone, there is an additional prosodic feature, involving the contrast between the so-called 'ballistic stress' ("characterized by an initial surge and rapid decay of intensity, with a resultant fortis articulation of the consonantal onset" (Foris 2000: 16) and 'controlled stress' (characterized by a longer duration and medium intensity) (see Foris 2000 or Pace 1990; for an alternative phonological oriented account as a glottis phonation feature, see Silverman 1994). If we combine this with tone, it doubles the number of morphological exponents, but it does not bring any noticeable clarity.

2.3 Stem phonology

Tonal alternations do not obviously correlate with any other phonological properties of stems, e.g. nasalization, nucleus quality, etc.

2.4 Morphological correlations

Around a fifth of the verbs (137/613) display stem alternations. While these show some interesting interactions with prosodic alternations there is again no clear predictability in either direction (cf. Baerman, forthcoming).

⁶ The relation between animacy and inflection class is a conceivable one which is for example observed in the distribution of the subject suffixes of another Chinantec language such as Lealao Chinantec (for more details, see Palancar, submitted).

3 The proposal: redefinition of the morphological unit

Following Palancar (forthcoming), and the reasoning outlined in §1.2, we suggest dividing the paradigm up not into twelve cells marking person and aspect, as in (5a), but into four cells marking person, as in (5b). Palancar calls the resulting units ‘inflectional series’.

(5) a. The 12-cell paradigm

	1SG	1PL	2	3
PRS				
FUT				
CPL				

b. The 4-cell paradigm

	1SG	1PL	2	3
PRS				
FUT				
CPL				

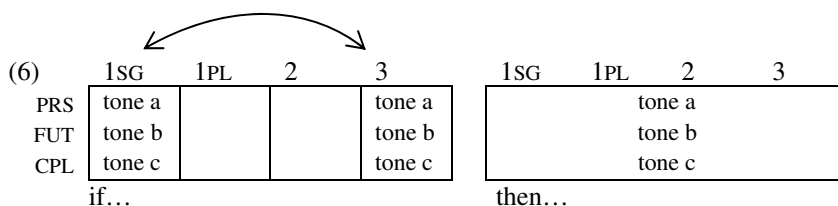
This is the concept of morphological unit we will adopt in this paper, and it will have the shape [# # #], consisting of *present-future-completive tone*. In the following sections, we will show that this new segmentation of the cell reveals a certain degree of regularity both in inflection class assignment and in form-function mapping.

This notion of inflectional series should be distinguished from other types of subparadigmatic unit. For example, Finkel and Stump (2007) employ the concept of *segregated inflection classes*. As an example they take the Sanskrit verb paradigm, which can be divided into the present system and the aorist system. Each of these constitutes a self-contained system, with its own stem and its own set of inflection classes. By contrast, the mapping between the two systems is arbitrary and unsystematic. The Chinantec inflectional series is in effect the mirror image of this. That is, while the individual inflectional series do not themselves constitute morphologically coherent units, once this grouping is made, there is a certain degree of predictability between the resulting units. By analogy, we can think of the inflectional series as phonemes, and the individual tone values as constitutive, distinctive features.

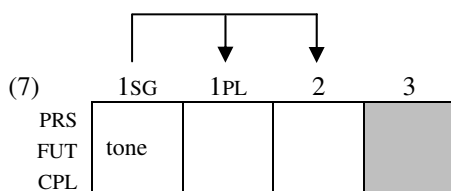
3.1 Inflection class assignment

Applying the concept of an inflectional series to inflectional allomorphy makes it possible to obtain two interesting generalizations. We treat inflectional series as principal parts, employing a maximum of two: one for the 3rd and another for the 1SG (the 1PL and the 2nd would serve equally well, with very minor changes in the numbers):

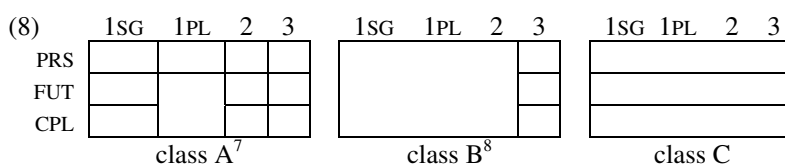
- As shown in (6), if the 1SG form is the same as the 3rd person, then the forms for the 1PL and 2nd person are the same too. This accounts for 123 lexemes, with only one exception.



- As shown in (7), if the 1SG form consists of three identical tones, the 1PL and 2nd person are identical to it. This accounts for 198 lexemes, with five only exceptions.



Overall these two generalizations cover $321/613 = 52\%$ of the lexicon, mapping onto what Merrifield & Anderson (2007) classify as types B & C (there are five exceptional lexemes). Everything else belongs to their class A. This is shown in (8).



The lines in (8) represent the maximal permitted distinctions, but often there will be conflation within that, e.g. the following represents what would count as a class B paradigm (treated as B1f in Merrifield & Anderson, 2007):

⁷ Future/Completive syncretism in the 1PL is almost exceptionless.

⁸ Merrifield & Anderson (2007) characterize class B simply in terms of person syncretism, but since 97% (198/205) of the lexemes also display aspectual syncretism, we treat both as characteristics of this (revised) class.

(9)	1SG	1PL	2	3
PRS				32
FUT	3			
CPL				
	class B			

The remainder of the lexicon (class A) still needs another account. One option is to construe one of the inflectional series as the default exponent for each person value. We have chosen the most frequent ones, and they account for 55% (129/285) of the remaining data-points.

(10)	1SG	1PL	2	3
PRS	32	32	32	32
FUT	31	31	31	3
CPL	3	31	3	3
	233	156	105	135
	(82%)	(54%)	(37%)	(48%)

Note that the figures in (9) represent the frequency for each form in isolation, not a default paradigm as such; only 16 lexemes (class A11a) actually show all four at once.

3.2 Form-function mapping

3.2.1 The marking of person

The individual inflectional series can be seen as exponents of person, at least to a certain extent. This is shown in Table 5 below (in the table, everything with a token count under 6 (1%) is not highlighted). If we set aside the forms which do not distinguish person at all (C paradigms), the following two generalizations hold:

- (i) The 3rd person form is distinct from 1st (SG/PL) and 2nd person.
- (ii) While 1SG is always distinct from 1PL, 2nd person is usually syncretic with 1SG or 1PL.⁹

Considering now the C paradigms, we can make a third observation:

- (iii) C paradigm forms typically coincide with the distinct 3rd person forms found in the A and B paradigms (88/117).

⁹ 2nd person is [2 1 1] or [32 31 31] only if 1PL is too (65/67 and 15/15); 2nd person is [32 31 3] only if 1SG is too (102/105).

The broad generalization that emerges is that the system potentially distinguishes 1SG, 1PL, 2 and 3, but that (i) 2nd person often takes the form of either 1SG or 1PL, (ii) all 1st and 2nd person values may conflate in a dedicated non-3rd person form (B paradigms), and (iii) forms that do not distinguish person at all often coincide with 3rd person form.

3.2.2 The marking of aspect

The inflectional series are made up of tonal alternations for aspect. By looking now at the system from the perspective of aspectual marking, we gain some insight into how the series are constituted. Consider again the figures from Table 1 above. If we now divide them by paradigm type (A, B, C), we see there are some striking regularities in the distribution of the tonal components. Take first the A paradigm verbs illustrated in Table 6 (in the tables, figures under 12 lexemes (2%) are not highlighted).

The patterns emerge most clearly if we group the individual tonal exponents into three tone types:

- HIGH, made up of high tone (1) and ascending to high (31)
- MID, made up of mid tone (2) and ascending to mid (32)
- MID/LOW, made up of mid (2) and low (3)

Series	A				B		C
	1SG	2	1PL	3	1/2	3	1/2/3
[1 1 1]	4	6	1	1	137		6
[1 3 1]							3
[2 1 1]		67 ←	118				
[2 1 2]	52	46	4				
[2 1 3]		20					
[2 1 32]		10					
[2 2 2]	1			172		3	14
[2 2 3]				1			4
[2 3 2]				16		1	17
[2 3 3]				1		2	7
[2 31 3]							1
[2 31 31]			7				
[3 3 3]					1	21	10
[31 31 31]	1		4	1	60	1	10
[32 2 3]				1			2
[32 3 3]			1			76	
[32 3 32]							2
[32 31 1]		7					
[32 31 3]	233	→105	→2				9
[32 31 31]	1 ←	15 ←	155				
[32 3 2]				16			1
[32 3 3]				211			26
[32 31 32]		16					
[32 32 32]				15		24	11

Table 5: Inflectional series as exponents of person

Tone	PRS				FUT				CPL			
	1SG	1PL	2	3	1SG	1PL	2	3	1SG	1PL	2	3
1	3	0	5	1	53	120	144	1	3	118	79	1
2	51	127	139	120	1	0	0	104	51	2	44	131
3	0	0	0	0	0	1	0	168	234	3	123	141
31	0	4	0	1	235	168	146	1	1	167	16	1
32	236	159	146	163	1	1	0	11	1	0	28	11

Table 6: Tones and aspect in A paradigm verbs

The tone/aspect mappings that result are the following:

- (i) The PRS stem is MID tone.
- (ii) The FUT of non-3rd person is HIGH tone and MID/LOW for 3rd, keeping the marking of 1/2 vs. 3rd distinct.
- (iii) The marking of the CPL stem is complex: 1PL is syncretic with FUT; 2nd person can be realized by almost anything; and 1SG and 3rd person have MID/LOW tone. In the 3rd person, this means that the same tone profile as in the FUT, but the forms are not necessarily syncretic.

All this can give us a perspective on the syncretism of person values seen above in Table 5. For example, the distinct 3rd person FUT tone profile ensures that the 3rd person form will never be syncretic with the 1st and 2nd person forms. Other person values have distinct tone profiles only in the CPL. The fact that 2nd person CPL can have any tone means that sometimes it will be distinct from the others, sometimes coincide with them, accounting for the variable syncretic behaviour of the 2nd person seen in Table 5. Now let us see what happens in B and C paradigms.

Tone	B				C			
	1/2	3			(TA inflecting)			(uninflecting)
		PRS	FUT	CPL	PRS	FUT	CPL	
1	137	0	0	0	3	0	3	6
2	0	76	73	74	29	6	18	14
3	1	21	100	99	0	56	49	10
31	60	1	1	1	0	10	0	10
32	0	100	24	24	40	0	2	11

Table 7: Tones and aspect in B and C paradigm verbs

The aspectless 1/2 form of the B paradigms has the same tone profile (MID) as the 1/2 FUT of the A paradigms. Whereas C paradigm verbs that inflect for TA behave more or less like 3rd person forms, the tone of uninflecting verbs does not show any particular tendency, suggesting that tone assignment here is given in the lexical entry.

4 Conclusion

In this paper, we have argued that the notoriously opaque tonal inflection of TlCh can be at least partially tamed by a judicious choice of analytic units. First, we showed that person can be taken as the dominant organizing principle, in that person values define the most reliable domains of interpredictability within the paradigm. From this observation we extracted a

morphological unit that we have labelled inflectional series, made up of the three aspectual forms for each person value. By thus construing the tonal paradigm as a four-cell paradigm marking person, we were able to describe the distribution of forms in terms of a few patterns of syncretism, and concisely characterize the inflection classes in terms of implicational relationships between these forms. We then examined the nature of the inflectional series more closely by looking at aspectual marking in isolation, consolidating tonal marking into three major types. This showed that, given the person/number value and aspect, tonal inflection is highly constrained, the complexity of the system emerging at certain discrete points (*e.g.* the completive of A class verbs).

For obvious reasons, our analysis in terms of inflectional series cross-cuts an analysis in terms of optimal principal parts. Because of the relative interpredictability of individual tones within each inflectional series, optimal principal parts will tend to be spread across the series. For example, as Olivier Bonami (personal communication) has shown, if we limit ourselves to the four cells that are the best predictors of the entire inflectional paradigm, they will be drawn from each of the four inflectional series, as shown in (11). (These reduce the average conditional entropy of the remaining cells to 0.138 bits, or 138 in terms of the scale used in Table 2.)¹⁰ Significantly, these optimal principle parts are drawn from each of the three aspects as well; recall from Table 3 that aspect also defines a zone of interpredictability (though less reliable than person), so this is what we would expect. Thus the selection of principle parts is complementary to the parameters of paradigmatic organization that we have claimed operate in TlCh, namely person and aspect.

(11)

	1SG	1PL	2	3
PRS				
FUT				
CPL				

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¹⁰ Though note that this measure does not factor in type frequency; if it did, the figure would be lower.

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