ICHL 2023 Workshop - The diachrony of tone: connecting the field

Friday, September 8 2023 – afternoon – preferred talk orders

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2	Accent and tone: the double origin of the Paici tone system	Lionnet
3	Tone and voicing in Cao Bằng Tai: implications for tonal evolution and change	Kirby & Pittayaporn
4	Tone splits from vowel height in the Austronesian language of Raja Ampat	Arnold
5	A diachronic study of grammatical tone in northwestern Bantu	Grimm
6	A Database of Tonogenetic Events (DTE) and what it can tell us about tonogenesis	Sæbø, Moran, Grossman
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The diachrony of tone: connecting the field

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Tone, that is the use of pitch to distinguish lexical and/or grammatical forms, is an integral feature of many—possibly a majority of—languages across the world (Yip 2002). Despite this, tonal phenomena are conspicuously absent from most studies on language change, so that interest and progress in the understanding of the origins and evolution of suprasegmental contrasts lags behind that of segmental contrasts (Janda & Joseph 2003, Dockum 2019, Campbell 2021).

Nevertheless, starting in the latter half of the 20th century, steady progress has been made in the investigation of tonogenesis, i.e. in the emergence of tonal contrasts. This research has identified various pathways for a language to acquire tonal contrasts from segments. Haudricourt's (1954) model of tonogenesis in the so-called *Sinospheric Tonbund* (Matisoff 2001) connects the emergence of tonal contrasts with originally segmental material and processes of simplification of syllable structure. Similar progressions, from segmental contrast to tonal, can be observed in other languages and language families, such as Athabaskan (Kingston 2005), Mayan (see discussion in Bennett 2016, 497-499), Uto-Aztecan (Manaster-Ramer 1986; Guion et al. 2010), Punjabi/Northwest Indo-Aryan (Baart 2014; Evans et al. 2018), Malagasy (Howe 2017), and Afrikaans (Coetzee et al. 2018), among others. Prosodic contrasts can also give rise to tones, as in

Cushitic (Kießling 2004). Formerly predictable stress patterns, for which pitch has become salient, became unpredictable in conjunction with syllable or word structure reduction. Tonal contrasts can also be acquired through contact and bilingualism of a non-tonal language with a tonal one. Such developments have been observed in languages such as Southern Qiang (Evans 2001) and Mal (L-Thongkum & Intajamornrak 2008), for example.

There are, however, language families in which tonality has such a long history that its origins might not ever be discoverable. This is the case in Otomanguean, where all the daughter families are reconstructed as tonal, e.g. proto-Mixtecan (Longacre 1957) and proto-Mixtec (Dürr 1990), proto-Chinantec (Rensch 1968), proto-Oto-Pamean (Bartholomew 1965), proto-Mazatec (Gudschinsky 1958; Kirk 1966), proto-Popolocan (Gudschinsky 1959), proto-Zapotec (Benton 2001), and proto-Chatino (Campbell 2013). It is thus assumed that proto-Otomanguean also had tonal contrasts (Rensch 1976, Kaufman forthcoming). Proto-Niger-Congo has also been reconstructed with tonal contrasts (Hyman 2016). Tone change *per se* is much less well studied than tonogenesis, and often not addressed even in language families with old tone systems. This can be at least partially attributed to impressionistic statements on the volatility of tones (Ratliff 2015; Cahill 2011; Beam de Azcona 2007; Morey 2005; Dürr 1990, among others), leading to the assumption that tones play at best a minor role in unraveling the history of a language family.

There is thus a considerable gap in the field of historical linguistics when it comes to the diachronic study of tones. A welcome exception to this is the recent collected volume on tone neutralization and phonetic tone change, Kubozono and Giriko 2018, and see also the overview by Yang & Xu (2019) of existing tone change work in Asia. This gap also applies to computer-assisted methods, such as automatic alignment and cognate detection (List et al. 2018), and quantitative methods, such as Bayesian phylogenetics (Greenhill et al. 2020), which have gained traction in the field over the past two decades. Studies using such methodologies have been applied to few language families with tonal contrasts (e.g. Sagart et al. 2019 and Zhang et al. 2019, both on Sino-Tibetan) and none have addressed tone, despite evidence of historical tone categories having significant phylogenetic signal (Dockum 2019).

Workshop content and goals

As a result of the issues described above, comparatively few linguists focus on the diachronic study of tone. Individual specialists tend to sort themselves into regional and language family niches, leaving the field fragmented with little dialogue or cross-pollination between interested scholars. Given that the diachronic study of tone is in need of intensified research, the absence of exchange between scholars creates a further impediment to progress in this area.

This workshop brings together linguists from different regions and language families who work on tone diachrony and initiating an ongoing dialogue. Our goal is to form and strengthen collaborations between participants and attendants to advance this research area in the future. Presentations address topics including but not limited to:
- phonological environments that condition the emergence of tone contrasts or tone changes in existing tones;

- morphosyntactic patterns involving the innovation of new tone contrasts or changes to existing tone contrasts;
- underlying articulatory, acoustic, and perceptual mechanisms of tonogenesis and/or tone change;
- methodological considerations in the study of tone diachrony, e.g. the comparability of tonal systems in the absence of detailed phonetic studies, and the creation of reusable datasets and databases;
- addressing similarities and differences, both theoretically and empirically, in the study of tonal and segmental change;
- the contribution of tone to our understanding of the linguistic past, including subgrouping and classification in a language family, explaining historical contact phenomena between languages and language families, etc.;
- the relationship of historical tone studies with language documentation and description of tonal languages and language families;
- descriptions of tone change in under-described languages

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Tone, stress and length interactions in Central Neo-Štokavian

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This paper discusses a set of hitherto unobserved or underdescribed prosodic phenomena in the Central Neo-Štokavian (sub)dialect of Serbo-Croatian (SCr). SCr has inherited and innovated in various ways a relatively complex pitch-accent system from Proto-Slavic, based on the interaction of tone, length and stress (ictus). Tone and stress interactions are particularly complex in the Neo-Štokavian dialect, where an innovative Stress Retraction rule (SRR) has operated to produce a rather skewed distribution of pitch contours. Namely, as a result of SRR, stress coincides with a H tone in Neo-Štokavian only if the syllable bearing H is word-initial. Otherwise, stress is assigned to the syllable immediately preceding H, thus producing a rising contour tone (L*H). Standard SCr is based on this prosodic system (cf. Lehiste & Ivić 1986, Inkelas & Zec 1988, Zec & Zsiga 2009).

The most innovative central group of Neo-Štokavian dialects (spoken in Bosnia and adjacent areas), however, tends to differ prosodically from standard SCr in a number of ways. First of all, they are characterized by a length-based qualitative vowel reduction, affecting all tonic and posttonic syllables. When disyllabic words with a rising pitch on the initial syllable are affected by the reduction, they will surface as monosyllables with a rising pitch (e.g. *kònji* 'horses' > *kònj*, *dóđi* 'come-IMP' > *dóđ*), a situation dispreferred in standard SCr. In addition, in a number of polysyllabic words, an innovative rising pitch appears on the initial syllable instead of the etymological falling one (e.g. *májka* 'mother' for the etymological *mâjka*, *kárta* 'card' for the etymological *kârta*, etc.), thereby effectively manifesting tone reversal.

In this paper, I examine more closely the diachronic evolution of the Neo-Štokavian prosodic system, in the context of tone-stress interaction and co-evolution over time. I show how Central Neo-Štokavian prosodic innovations represent a series of repair strategies for the Neo-Štokavian skewed distribution of pitch contours, that was brought about by the SRR. As a consequence, Central Neo-Štokavian features as a transitory idiom between different tone-stress interaction types (from tone governing stress, as in standard SCr, to dominantly stress governing tone), but also from a relatively complex and unstable standard SCr pitch-accent system to a more stable, but still typologically awkward, rising-contour initial stress system, with word-initial L tone attracting stress while avoiding the lexical H altogether. Therefore it doesn't fit easily into the general typology of tone and stress interactions (de Lacy 2002), where systems such as Central Neo-Štokavian, in which stress tends to be attracted to L tone while simultaneously H tone is ignored, are explicitly excluded. In that sense, the innovative Central Neo-Štokavian data discussed here may contribute to a more fine-grained understanding of the possible tone-stress interaction types, but also of the exact mechanisms and motivations for tonal change and transition between different prosodic systems.

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Accent and tone: the double origin of the Paicî tone system
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Introduction. Tone mostly originates from the phonologization of redundant F0 differences caused by segmental laryngeal features – i.e., from non-prosodic features (Michaud and Sands 2020, a.o.). Languages where tone originated from prosodic features (e.g. accent) appear to be the exception rather than the rule (e.g., Scandinavian languages, cf. Kingston 2011). What has yet to be fully documented is what happens when an accentual language develops a tonal contrast from laryngeal features: is the accent system kept alongside the new tone contrast? Is it lost? Do both prosodic systems merge?

In this paper, I present the typologically interesting tone system of Paicî (Oceanic, New Caledonia), which illustrates the latter outcome: tonogenesis occurred in an accentual language and caused the former accent system to be reinterpreted as tonal.

Paicî data – Tone. Paicî is one of five tonal languages of New Caledonia, all Oceanic (Grace 1955; Haudricourt 1968, 1971; Rivierre 1993, 2001). These languages are famous for being the only Oceanic languages that have developed tone without any external influence. They are thus particularly interesting for what they might reveal about the historical development of tone systems.

Paicî has arguably the most complex tone system in New Caledonia (Rivierre 1974, 1993, 2001). The tonal inventory itself is simple, with only two tonemes, H(igh) and L(ow), as shown in (1).

(1)   *í*   'to cry'   *ì*   'louse'
       pʌ́dí 'to thrash' *pʌ̀dì* 'to divide'

This tonal contrast results from the transphonologization of a former aspiration contrast on plosives and voicing contrast on sonorants (Rivierre 1993, 2001), e.g. *tíí* 'to strip bark' (cf. Nemi *tʰi-*) vs. *tìì* 'letter, book' (cf. Nemi *tii*).

Paicî data – Downstep. More complex is the behavior and history of downstep in Paicî. Two types of downstep are attested: a metrically conditioned downstep systematically marking the boundary between the first two L-toned bimoraic feet within a prosodic word (2), and underlying downstep found in about 20 tonal enclitics (3) (cf. Rivierre 1974, Lionnet 2022).

(2)   /tɛ̀ɛ̀pàà/   →   (tɛ̀ɛ̀)⁺(pàà)   'to arrive'

(3)   /gɔ̀ =⁺ì   bwɔ̀ /   →   gɔ̀ ⁺ì bwɔ̀   'on the banyan tree'
       on =DET banyan

The Paicî downstep has many typologically rare properties (Lionnet 2022): (i) it affects only L, and is incompatible with H; (ii) it is mostly autonomous from lexical tone; (iii) it is culminative (i.e. there cannot be more than one) within the prosodic word; (iv) it is (partly) metrically conditioned; and (v) it is realized utterance-initially. Properties (ii)-(v) give it a strong accentual flavor, giving the impression of two parallel prosodic systems in Paicî : a H vs. L tonal contrast, and a downstep-based accent.

Comparative data and diachronic hypothesis: Comparative evidence from neighboring (non-tonal) Xârâcùù strongly suggests that downstep in Paicî was indeed originally an accentual system (Rivierre 1978). It is not accentual anymore in contemporary Paicî, as can be seen from the fact that it lacks obligatoriness, one of the definitional criteria of accent (cf. Hyman 2006) – indeed it is never found with H-toned words, i.e. one third of the lexicon. It can even be shown to interact with the tonal system – at least in stating distributional constraints, e.g. "no downstep on words carrying a H tone".

The complexity of the Paicî tone system is thus the result of its double historical origin: accentual and tonal. Tonogenesis innovated a H tone in a downstep-marked accentual system. Consequently, the innovative H-toned words were, so to speak, removed from the "regular" accent system, while the rest of the lexicon maintained its former accentual behavior, only reinterpreted as involving a L tone, as a consequence of which downstep was reinterpreted as a property of L-toned words. This double origin offers a simple explanation for the typologically rare features of the Paicî downstep listed above.

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Tone and voicing in Cao Bằng Tai: implications for tonal evolution and change

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This study examines the phonetic variation in the realization of lexical tones and onset consonants in the Tai dialect of Cao Bằng province (CBT), Vietnam [tyz]. As a rare specimen of a language in the late stages of a tone split, CBT is important for our general understanding of tonal diachrony, because it provides us a chance to study up close how phonetic realization and phonological patterning interact in phonologization.

At the time the binary register split, CBT had a four-way contrast between aspirated *pʰ-, unaspirated *p-, modal *b- and implosive *ɓ- onsets, in addition to voiced and voiceless fricatives and sonorants (*f- *v- *m- *ʰm-). Subsequently, tones following *b-, *m- and *v- were lowered in pitch; the historically modally voiced stops *b- became breathy-voiced /b̤-/, while implosive *ɓ- became modal voiced /b-/; and the voicing contrast in sonorants was ostensibly lost (*ʰm- and *m- > /m-/). This resulted in a system where six tones are found in syllables headed by sonorants, while in the obstruent sub-system, only high-register tones (1, 3, 5) are found after /b- p- pʰ-/ and only low-register tones (2, 4, 6) are found after /v-/ and /b̤-/ (Hoàng Văn Ma 1997; Pittayaporn 2009).

The details of the process, however, remain murky. Previous work (Hoàng Văn Ma 1997; Pittayaporn & Kirby 2017) indicated that older CBT speakers may still realize *b as breathy-voiced [b̤-], while younger speakers may produce a devoiced [p-], consistent with tonogenetic models which ascribe a central role to voice quality (Thurgood 2002). However, acoustic-phonetic and electroglottographic data from a more recent age- and gender-stratified sample of 19 speakers revealed a linguistically homogeneous speech community, in which *b > /b̤-/ appears to have merged acoustically with /pʰ-/. This means that tonal register is no longer predictable after /pʰ-/, illustrating a further step in the evolution of how tone splits evolve over time.

In addition, we observed some unexpected differences in the pitch trajectories following different onset types. For syllables bearing high-register tones (1, 3, and 5), we found a marked tendency for raised f0 following /pʰ-/ compared to /b-/ and (in some cases) /p-/, but /m-/ was found to pattern with /pʰ-/ in this respect. For syllables bearing low-register tones (2, 4, and 6), we observed a less marked tendency for raised f0 following /b̥-/ > [pʰ-] and /v-/ relative to /m/. These findings suggest that the historically voiceless sonorants still retain at least some of the acoustic properties they presumably shared with voiceless plosives prior to conditioning the tone split. In other words, in an important sense there are still two kinds of sonorants in CBT, illustrating that the phonetic specification of tonal categories may be much richer than the apparent phonological patterns suggest.

These findings show that the timing of the interrelated processes of tonal register split and neutralization of laryngeal contrast may be more complex than previously assumed: while historical sonorant voicing may well have conditioned the initial split (L-Thongkum 1997), it is does not appear that the sonorant voicing merger must necessarily be completed prior to the devoicing of originally voiced obstruents. Our study of CBT thus provides new insights into the internal complexities of the tonogenetic process, reminding us that the temporal ordering implied by stages in diachronic models cannot be taken too literally, and illustrating how careful analysis of synchronic acoustic-phonetic variability can contribute to our understanding of the diachrony of tone change.

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Tone splits from vowel height in the Austronesian language of Raja Ampat

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Tone is very rare in Austronesian languages: of the 1,200 or so languages in the family, only around two dozen are described as tonal (Blust 2013: 657–659; Himmelmann & Kaufmann 2020: 371–372). Austronesian languages are thus rarely included in typological overviews of and theoretical discussions about tone. In this contribution to the workshop, I seek to boost the mainstream visibility of the diachrony of tone in the Austronesian family, by discussing a cross-linguistically rare sound change that has occurred in multiple Austronesian languages spoken in the Raja Ampat archipelago: splits in tone systems conditioned by vowel height.

Raja Ampat lies just off the northwest tip of the island of New Guinea. It is home to six Austronesian languages, all of which belong to the understudied South Halmahera-West New Guinea subbranch of the family. All six languages are tonal. The tone systems are typologically diverse: from Ambel, which has a single underlying tone contrasting with toneless syllables in a system that is culminative but not obligatory (Arnold 2018a); through languages which distinguish two (Maʼya, Salawati, Biga) or three (Batta) underlying tones on word final syllables (van der Leeden 1993; Remijsen 2001; Arnold 2021); to Matbat, with six tones that can occur anywhere in the word (Remijsen 2001, 2007).

Tone splits conditioned by vowel height have occurred at least twice in Raja Ampat, in the ancestors of Maʼya and Ambel. In an ancestor of Maʼya, reconstructed *High tone split: it remained High on syllables with close vowel nuclei, and merged with Rise elsewhere (Arnold 2018b). In proto-Ambel, toneless syllables remained toneless if the vowel was close, otherwise merged with High tone (Arnold 2020). Preliminary investigations suggest that similar splits may have occurred several more times in the Raja Ampat languages.

In this talk, I will exemplify the Maʼya and Ambel splits, and touch on two points of theoretical significance. First, only a handful of other tone changes conditioned by vowel quality have so far been attested worldwide (Kingston 2011; Köhnlein & van Oostendorp 2017; Michaud & Sands 2020). The Maʼya and Ambel splits thus contribute to the growing body of evidence demonstrating that, contrary to what some have claimed (e.g. Hombert 1977; Hombert et al. 1979), vowel height can and does condition diachronic tonal developments. Second, in all attested cases thus far, syllables with close vowel nuclei develop higher tones; the Ambel split, in which non-close vowel nuclei developed High tone, has not previously been attested.

I conclude this talk by discussing a phonetic mechanism that may explain the unusually frequent tone changes conditioned by vowel height in Raja Ampat: the phonologisation of differences in the intrinsic fundamental frequency (IF0) of vowels in these languages. IF0 is a near-universal phenomenon in which, all else being equal, close vowels are produced with a higher F0 than open vowels; cross-linguistically, the mean difference in IF0 between close and open vowels is 1.65 semitones (Whalen & Levitt 1995). Recent production data, however, suggests that IF0 differences in the Raja Ampat languages are much larger than average: in Salawati and Biga, the mean difference is as large as 2.8 semitones in some contexts (Arnold et al. submitted). As

well as describing the phonological environments that condition tone changes in these understudied languages, this talk will therefore also provide a potential articulatory explanation for these changes, thus deepening our theoretical understanding of tonal diachrony more generally.

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A diachronic study of grammatical tone in northwestern Bantu

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Tone in Bantu languages: There is considerable variation among the around 500 Bantu languages with respect to tone systems, ranging from fully tonal languages (e.g. Kikuyu) to non-tonal languages (e.g. Swahili) and a "bewildering variety of intermediate types" (Clements & Goldsmith 1984). Meeussen (1967) reconstructs Proto-Bantu with two tonemes: H and L, which are associated with vowels and syllabic nasals. Synchronically, Bantu languages vary a great deal in the nature of their tonal systems and the functions that tone encodes, despite some common themes such as tonal inventories and processes or functional domains. While there is a decent amount of reconstruction accomplished for lexical tone in Bantu (Meeussen 1967, Hyman & Katamba 1990, Marlo & Odden 2019) and, more broadly, Niger-Congo (Hyman 2016a), grammatical tone and its historical changes is vastly understudied.

   Grammatical tone in northwestern Bantu: Northwestern (NW) Bantu languages show significant differences from PB and synchronic Bantu languages of other areas (South, East, and West). They are often reported to distinguish L, H and Ø TBUs and exhibit similar tonal processes (floating tones, high tone spreading). However, "the nature of these [tonal] systems as a whole is not well understood" (Odden & Bickmore, 2014: 3). Reasons for that include the fact that i) distinctive tones are still left out of some descriptions or only described for certain parts of the grammar, ii) there is a bias towards eastern Bantu languages in tone descriptions, which have very different tonal systems, and iii) we are still lacking an investigative framework to collect and compare tonal data, with the result that data is not complete and/or comparable (but see Marlo 2013).

   In this talk, I investigate an important tonal feature that is common in NW Bantu, namely grammatical H tones in the verb phrase. These floating H tones share similar targets across languages of the area (subject markers, the finite verb, phrase-medial verb position, object noun class prefixes) and surface under similar conditions, often determined by certain tense/aspect/mood categories. Tonal phenomena of H tones in this domain have been described in the literature under differing terms in different Bantu areas, including "metatony" in NW Bantu (Hyman & Lionnet 2011), a "conjoint/disjoint distinction" in eastern and southern Bantu (Hyman 2016b), and "tone-case" in western Bantu (Kavari et al. 2012, Van der Wal 2015). It is, however, unclear how they developed historically. Based on data from the literature on NW Bantu languages (e.g. Bakweri, Basaa, Abo, Mpiemo, Kwasio, Eton) and my own fieldwork on Gyeli (Grimm 2021), I propose that tonal change in NW Bantu is largely driven by changes in phonology (segmental loss and constraints on syllable numbers) and interrelated morphological complexity. In languages where grammatical tone is a co-phonology of segmental material, e.g. a tense marker, its functional load is relatively weak and it is often not clear what tone contributes to the meaning or functional category. In contrast, when segmental material erodes and only the tone survives, tone takes on a higher functional load and may develop into entirely tonal paradigms to distinguish functional categories. Such an extreme case is found in Gyeli (Grimm, forthcoming).

Advances in the understanding of GT and its historical dimension will not only shed light on patterns in tone system changes, but also contribute to current unknowns, such as quantifying a language as to the degree to which it employs grammatical tone (Rolle 2018), identifying the exact range of grammatical functions tone can encode, areas of grammar where tone carries more grammatical functions than in others, and identifying grammatical categories and sub-categories that are expected to be marked tonally in Bantu languages.

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A Database of Tonogenetic Events (DTE) and what it can tell us about tonogenesis

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Tonogenesis has become a topic of increasing interest, including numerous descriptions of tonogenetic events across a variety of language families (Haudricourt 1954, Arnold 2020, Hyslop 2009) with much recent work towards models (Dockum 2019, Gehrmann 2022) and typologies of tonogenesis (Hyman 2018, Hyslop submitted). To aid in these endeavors, we have constructed a preliminary database of tonogenetic events (DTE), which aims to organize the documentation that exists on tonogenesis into a format that is easy to filter, search, and compare.

The DTE currently describes 229 tonogenetic events from 90 language varieties in 26 language families across five macro-areas (North America, Africa, Asia, Europe and Papunesia). Along with language variety metadata, the database includes information about the triggering context of each tonogenetic event, the resultant tone, and a description of the effect that the tonogenetic event had on pitch. The triggering contexts have been divided into five main groups: onset, coda, nucleus (i.e. tonogenesis triggered by a feature of the vowel itself, such as for instance height (Ratliff 2015:253), stress and word type (i.e. tonogenesis triggered by the loss or gain of a syllable). Thus, the coding of the DTE provides a general classification of tonogenetic events reported in the literature, making it straightforward to see what kind of triggering contexts result in what kind of tones.

Our goal is to provide an open source and easily accessible resource that can be harnessed to ask, and answer, typological questions related to tonogenesis. Towards this aim, we have so far investigated two areas of tonogenesis that we will report on in this talk. The first is the relationship between the triggering context and the resultant tone, and the second is an areal classification of the distribution of different types of tonogenesis.

As to the first issue, our data largely concurs with trends already reported in the literature, such as the fact that voiced onsets tend to give rise to lower tones than voiceless onsets (Kingston 2011, Hombert, Ohala and Ewan 1979). While some triggers almost always have a given effect on the pitch, there were other triggers that could have various different effects. An example is voiceless aspirated and unaspirated stops, where there is no clear trend as to what trigger will give the highest tone. Regarding areality, the DTE for example shows that among the languages in the sample from Asia, it is very common to have undergone a two step tonogenetic process similar to that described for Vietnamese by Haudricourt (1954). That is, in the first step the coda consonants first create two or more different contour tones, and in a second step these tones are doubled by a second series of tonogenetic events based on the voicing/aspiration of the onset, generally creating a high and a low register. In our data, this kind of tonogenesis is not found outside of Asia. Other areal trends include the fact that the most common context for tonogenesis in North America is codas, while word-type tonogenesis is the most common in Europe. In this talk, we will discuss both topics in greater detail.

In accordance with principles for open cross-linguistic typological research put forth in the Cross-Linguistic Linked Data (CLLD) project (Forkel et al. 2018), we are making the DTE available as a CLDF data set. This makes its contents interoperable with Glottolog and numerous other typological databases (e.g., WALS, PHOIBLE, ASJP), so that new types of questions can be asked about tonogenesis. For example, one can investigate whether there are any correlations between the current phonological system of a language and the types of tonogenesis that it has undergone. Thus, in line with the goals of this workshop, we aim to bring together linguists and data sources to generate dialogue and collaboration to shed light on the diachronic study of tone and the processes of tonogenesis.

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Tonal density and its correlation with the types of tonal systems: Diachronic aspects

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Tonal systems are usually compared by the number of tones, by the character of tones (level or modulated), and by their function (lexical or grammatical). Following Gussenhoven (2004: 34), we suggest to compare these systems also by the criterion of tonal density, and introduce a Tonal Density Index (TDI), which equals the number of tonemes per 100 syllables. In order to make the calculation of the tonal density possible, it is necessary to define some key notions: toneme, tonal domain, marked tone and default tone, tonal and toneless syllables.

Toneme as a meaningful tone, i.e. a tone (or tonal contour, in a larger sense) which can distinguish lexical and/or grammatical meanings. With some reserves, toneme can be compared with what is phoneme in the segmental phonology. For certain types of languages, distinction between tone and toneme is marginal, but for some others, it is of a primary importance. This term was introduced by Pike (1948), it reappears sporadically (Welmers 1959; Hyman & Leben 2021), however, we are unaware of any serious attempt to elaborate this notion and make it work.

The **tonal domain** is a segmental chain on which a toneme is realized. It may vary from zero (for floating tones) to a long sequence of syllables; its length is language-specific. In some languages, a segmental chain is entirely subdivided into tonal domains; in some others, certain segments can remain outside tonal domains.

With respect to the **marked and default tones**, it is important to distinguish between unmarked tones which can be still regarded as tonemes and those which should be interpreted as absence of tones (or zero tones).

Toneless is a syllable (or mora) to which no toneme is assigned at the underlying level. Toneless syllables are found even in some languages with very high tonal density.

When this approach is applied to tonal languages, it turns out that tonal systems can be roughly subdivided into three major types, and these types correlate with the tonal density: **omnisyllabic** type (the TDI close to 100); **tonemic** type (the TDI between 50 and 90); **privative** type, i.e. languages with marked and zero tones (the TDI is below 50); **pitch-accent** type (the TDI is below 30).

Distribution of tonal languages by these types follows a clusterization model, and existence of some intermediate (hybrid) types can be envisaged.

With respect to the tonal types, diachronic evolution of tonal systems can follow various patterns.

1) Emergence of tones in an originally toneless language (or loss of tones). This case can be illustrated by Tibetic languages going back to the atonal Old Tibetan which has split around 9-10 century. An atonal modern language Amdo (TDI = 0) retains voiced consonants as well as certain onset consonant clusters (Makley et al. 1999). In Utsang (Lhasa Tibetan), the tonogenesis resulted from the devoicing of originally voiced consonants and the simplification of the onset consonant clusters (Huang Bufan 1995). According to Jäschke (2018) and Tournadre & Dorje

(2003), Utsang has two meaningful tones (i.e. tonemes): high (H) and low (L). Their superficial realizations depend on the segmental structure of a syllable, the main factors being the syllable weight, and on the extension of the tonal domain which can be equal to one or two syllables. TDI for the Lhasa Tibetan is 51.

2) Mobility between the tonal types. For example, in the Baltic group (Daugavet 2012; Kushnir 2018), the Lithuaninan Aukštaitian is a typical pith-accent language. It has two tonemes (falling and rising) and a mobile stress (an accentuated syllable can occupy any position in a word-form). Only accentuated heavy syllables (i.e., containing long vowels, or diphthongs, or diphthongoids) carry meaningful tones. Light syllables (stressed or unstressed) and unstressed heavy syllables cannot carry meaningful tones. The TDI of this variety is 30.

The Old Latvian had a system close to the Lithuanian, but the situation in the modern literary Latvian is different. It has a word-initial stress and three tonemes: rising/high, falling and rising-falling, the latter also includes an interrupting phonation. Every heavy syllable (both stressed or unstressed) carries a meaningful tone, and light syllables are toneless. Because of the historical loss of short vowels and the subsequent syllabic contraction, two or more heavy (and, subsequently, tonal) syllables can appear in one wordform. As a result, the Latvian language has evolved from the pitch-accent type toward the omnisyllabic type, and its TDI equals 43; it can be regarded as a hybrid type.

3) Change of tonal density within the limits of one tonal type. For example, both Bambara (Manding < Western Mande, TDI = 66-67.5) and Kakabe (Mokole < Western Mande, TDI = 62.5) are tonemic languages with similar tonal systems. The decrease of TDI in Kakabe can be explained by a couple of innovations, such as: definitive loss of tones by light postpositions (in Bambara, this rule is facultative); reinforcement of the rule of the phrase-final high tone lowering if preceded by a low tone (in Bambara, this rule is also facultative); partial loss of tones by personal pronouns (Vydrina 2017).

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