1. Introduction

The basic mechanisms of tonogenesis have been understood for several decades, largely due to the work of historical linguists applying the comparative method to Southeast Asian languages and discovering that lexical tone contrasts originated in segmental ones (Matisoff 1973). Additionally, tone is a feature which languages seem to acquire most readily under contact. This is clearly the case in both Africa and Southeast and East Asia, where languages from several different families have all converged on similar tonal templates due their historical proximity (Svantesson 2001) One of the clearest such cases is found in Chamic, Austronesian languages which are spoken on the Chinese island of Hainan, and, more prevalently, in Vietnam and Cambodia, where they have likely been for at least 2000 years (Amonier & Cabaton 1906, cited in Han et al. 1993). The languages are split between those with tone and those with register, based largely on the prosodic typology of their immediate neighbors (Thurgood 1996). Thus, while tone has been internally reconstructed from the loss of initial voicing distinctions, as well as the loss of contrasting finals, the role of contact cannot be dismissed.

Contact predisposed Chamic to tone in part by pressuring it towards the mainland Southeast Asian iambic norm; like drawn by a magnet, stress has shifted to the final syllable. Iambicity, like monosyllabicity, has in turn led to the development of tone and register.

This paper presents evidence that another Austronesian language is on the same path. Moken is an endangered language spoken primarily by a group of 3,000 to 5,000 maritime hunter-gatherers in the Andaman Sea’s Mergui Archipelago. Pittayaporn (2005) observes that Moken has shifted in several crucial respects towards the mainland Southeast Asian norm, adding phonological contrasts in both vowel height, vowel length, and stop voicing/aspiration, while regularizing its stress to be unexceptionally iambic. Moken, then, is primed for tonogenesis. Moken is also in steady contact with Thai and Burmese, both of which are tonal languages.

This paper presents data collected during trips to Ranong Province in Thailand in the summers of 2006 and 2007 suggesting that Moken is becoming tonal: the realization of pitch on stressed syllables, or tonic pitch, varies with the length of the vowel and the type of coda making up its rime. However, there are discrepancies between the distribution of tonic pitch and other well-attested cases of tonogenesis.
which give reason to pause before jumping to the strongest available conclusion, which is be that tonic pitch in Moken supplies evidence for a new path of tonogenesis. This paper lays out the current prospects for tone in Moken, and proposes a path for the historical development of tonic pitch.

2. Moken as a mainland Southeast Asian language

Despite being an Austronesian language, Moken has developed several features which are characteristic of mainland Southeast Asian (SEA) languages. Ranging over several families including (Tai)-Kradaï, Tibeto-Burman, Mon-Khmer, and Hmong-Mien, the languages of SEA comprise a distinctive sprachbund defined by several features including large inventories of vowels, lexically contrastive tone or register, monosyllabic or fixed iambic words, and isolating morphology.

Moken has shifted towards these SEA properties. Pittayaporn (2005) presents how this typological shift, or metatypy, arose as the result of internal restructuring, though under the influence of languages with which it was in heavy contact, such as Thai and Burmese\(^1\) (see also Larish 1999). Pittayaporn presents the following phonological features which are indicative of Moken’s SEA status:

(1) **FEATURES CHARACTERISTIC OF MAINLAND SEA LANGUAGES** (Pittayaporn 2005:192)

   a. 3-way stop contrast: \(p^h \sim p \sim b\)
   b. Voicing/aspiration neutralization in coda position
   c. Three-height vowel contrast
   d. Vowel-length contrast
   e. Contrastive diphthongs
   f. Phonological word = Foot
   g. Bimoraicity of foot head = “major syllable”
   h. Iambicity: CV.CVX

None of these features are typical of Austronesian languages, which usually have a simple 2-way voicing contrast on stops, simple vowel systems, and variable stress. In

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\(^1\) It is difficult at this point to assess whether the impact on Thai is much larger than other contact languages, such as Burmese. Generally, Thai loanwords are quite transparent, indicating relatively recent borrowing. In addition, fieldworkers such as Pittayaporn, Chantanakomes (1980), and the author all made contact with Moken via Thai. As such, the influence of Burmese on the Moken vocabulary is unclear. My suspicion is that it is significant, especially the Moken territory in the Mergui Archipelago is in Burma. In the community I worked with in Ranong Province of Thailand, more of the Moken spoke Burmese than Thai, and several Moken were married to Burmese men and women. There was only one case of Thai-Moken intermarriage.
This section I briefly review Pittayaporn’s findings, as they will provide a foundation for the discussion of tonogenesis in section 3-4.

The phonological inventory of Moken consonants is given below. The chart is based on Pittayaporn 2005:190, though I add velar nasals, which were not included there despite occurring frequently in every position of the Moken word. Aspirated stops are represented as <Ch>.

(2) **Moken consonant inventory**

<table>
<thead>
<tr>
<th>phoneme</th>
<th>phoneme</th>
<th>phoneme</th>
<th>phoneme</th>
<th>phoneme</th>
</tr>
</thead>
<tbody>
<tr>
<td>ph</td>
<td>th</td>
<td>ch</td>
<td>kh</td>
<td></td>
</tr>
<tr>
<td>p</td>
<td>t</td>
<td>c</td>
<td>k</td>
<td>(?)</td>
</tr>
<tr>
<td>b</td>
<td>d</td>
<td>ḷ</td>
<td>g</td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>n</td>
<td>ɲ</td>
<td>η</td>
<td></td>
</tr>
<tr>
<td>w</td>
<td>l</td>
<td>j</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The symmetry and depth of the stops, in particular, are strikingly reminiscent of Moken’s mainland neighbors like Thai. Notable differences include the presence of /g/, /ɟ/, and /ɲ/ in Moken, both of which Thai lacks, though Burmese does not. Thai and Burmese also have larger inventories of fricatives than Moken. The realization of these consonants is relatively straightforward, with the following exceptions. The voiced stop /d/ alternates with a flapped /ɾ/ intervocalically, and /c(h)/ can be realized as /s/ in many contexts, though with my speaker it usually was not. Because PAn *s has disappeared in Moken, Wolff (to appear) observes that the /c~s/ alternations reflect the fact that /c/ is currently undergoing change to /s/. Pittayaporn observes that the distribution of the glottal stop is predictable, occurring wherever the CVCVC template of Moken words lacks a consonant. In final position, the glottal stop freely alternates with the lengthening of the open vowel. We will see below that the presence of the glottal stop affects the tonic pitch of the syllable.

Historically, the new development in Moken is the voiceless series of stops. Pittayaporn identifies three sources for voiceless stops: 1) borrowing, particularly from Thai 2) aspiration of Proto-Austronesian (PAn) *c > ch 2) irregular devoicing of voiced stops. We see examples of borrowing below. All but the first example are Pittayaporn’s (193):

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2 See fn 1. It seems likely that voiceless stop loans from Burmese could also be identified.
(3) **BORROWING OF ASPIRATED STOPS FROM THAI TO MOKEN**

<table>
<thead>
<tr>
<th>Moken</th>
<th>Thai</th>
<th>‘thing’</th>
<th>‘to use’</th>
<th>‘to carry on one’s head’</th>
<th>‘hole’</th>
</tr>
</thead>
<tbody>
<tr>
<td>khɔːŋ</td>
<td>khɔːŋ³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mɔčaj</td>
<td>cháj</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mɔthuːn</td>
<td>thuːn</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>phɔluːŋ</td>
<td>phroŋ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These cases seem to be quite frequent. The fact that these stops were borrowed with aspiration may indicate this occurred after the two changes below. The second source of aspirated stops, according to Pittayaporn, is the irregular aspiration of PAN *c, e.g. mɔčhɔŋ < *qucuŋ ‘to carry.’ The third source is the irregular devoicing and aspiration of certain voiced PAN stops, e.g. phulaː < *bəlac ‘husked rice.’ Wolff (in progress:542) speculates that these cases may be borrowed from Chamic, which devoiced initial stops concomitantly with the development of its breathy vs. modal registers.

The other major change in the Moken consonant inventory was the neutralization of these voicing distinctions in final position. As in Thai, they are neutralized to unreleased voiceless stops.

The Moken vowel inventory is given below, again following Pittayaporn (2005).

(4) **MOKEN VOWEL INVENTORY**

<table>
<thead>
<tr>
<th>i, iː</th>
<th>u, uː</th>
</tr>
</thead>
<tbody>
<tr>
<td>e, eː</td>
<td>ə</td>
</tr>
<tr>
<td>o, oː</td>
<td></td>
</tr>
<tr>
<td>ε, eː</td>
<td>a, aː</td>
</tr>
<tr>
<td>ə, əː</td>
<td></td>
</tr>
<tr>
<td>iə</td>
<td>uə</td>
</tr>
</tbody>
</table>

The low front and back vowels ə and ə derive from *i and *u, respectively, a lowering process which was blocked before PAn *-q and *-ɣ. These finals were then lost, merging with *-k and *-n, respectively, resulting in a phonemic height contrast where there was none before (‘tail’ from Pittayaporn 2005:194): PMP *taqun ‘year’ > Mk takon ‘dry season’ vs PA *ikuɣ > Mk ʔiku:n ‘tail’. We can see that the same environment also conditioned lengthening on preceding vowels, a contrast which also became phonologized when

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³ Thai has five tones:

<table>
<thead>
<tr>
<th>Tone</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>high rising</td>
<td>45 á</td>
</tr>
<tr>
<td>mid</td>
<td>33 a</td>
</tr>
<tr>
<td>low falling</td>
<td>21 à</td>
</tr>
<tr>
<td>low rising</td>
<td>214 â</td>
</tr>
<tr>
<td>high falling</td>
<td>53 âå</td>
</tr>
</tbody>
</table>
they were lost. The other source of vowel length was PAn *a > Mk a: vs. PAn *ə > Mk a. Modern schwa only occurs in unstressed syllables in Moken.

The last SEA property of Moken, and the most crucial one for tonogenesis, is iambic stress, which Wolff (in progress) notes is due to the SEA tendency towards monosyllabization. While PAn had variable stress and trisyllabic roots, words in Moken are disyllabic at most and sometimes monosyllabic. Disyllabic words always have iambic stress. Pittayaporn applies the term sesquisyllabic to Moken, coined in Matisoff (1973) to describe iambic Mon-Khmer languages where the first syllable is prosodically weakened to the point of exhibiting only limited vowel contrasts. Like in many other SEA languages, in Moken the unstressed (or minor) syllable is only allowed one mora or timing slot, meaning that it has neither contrastive vowel length nor closed syllables. In contrast, the stressed (or major) syllable exhibits the full range of contrasts in diphthongs and vowel length, and can have closed syllables, including with long vowels. Thus, the maximal word in Moken is CVCVVC. Pittayaporn observes that iambicity constraints require that the major syllable be either a long vowel or a closed syllable. Some PAn roots have been lengthened to meet this requirement, e.g. PAn *mata > Mk mata:/mataʔ ‘eye, face.’ Additionally, Pittayaporn (2005) outlines how the minor syllable shows a reduced vowel inventory, not allowing o and e, and allowing schwa where the major syllable does not. Pittayaporn also discovers that the choice of minor vowel has been influenced by major syllable controlled height harmony.

Pittayaporn (2005) and Wolff (to appear) observe trisyllabic PAn roots have been reduced to the disyllabic Moken template. Wolff details how syncope of the antepenultimate vowel was followed by cluster simplification, e.g. *sehapúy > ñapuy ‘fire,’ *buqáya > kaya ‘crocodile’ (to appear:525), though there are a number of exceptions to this generalization, including cases where PAn roots had antepenultimate stress, usually resulting in loss of the penult: *dásuwen > daʔon ‘leaf’ (to appear: 525). The details are much more complex and many problems remain. The reader is referred to Pittayaporn and Wolff for discussion of these details.

For the present purposes, it should be clear that the internal restructuring of Moken lexicology has led uniformly towards the SEA norm. Like Chamic languages (Thurgood 1996), its closest Austronesian relatives along with Acehnese (Larish 1999, , Moken phonology is defined by SEA syllable structure. Yet Moken lacks contrastive tone or register, which nearly of the languages in contact with Moken do have, and which Chamic has developed. In the following section, I detail the effects of syllable shape on the realization of pitch on the major syllable in Moken. Based on these facts, I put forward the hypothesis that Moken is in the beginning stages of tonogenesis.
3. **Tonic pitch in Moken**

This section introduces generalizations about pitch in major syllables in Moken, which I will call *tonic pitch*, that I take as evidence that tonogenesis is underway. Specifically, the realization of pitch on major syllables depending on the length of the vowel and the presence and type of coda. However, as we will see in the following section that the environments and the pitch they trigger do not precisely accord to the environments which have given rise to tonogenesis in other languages.

Major syllables fall into three categories in the conditioning of tonic pitch. High pitch is realized on major syllables with short vowels closed by obstruents, including /h/. This pitch is thus quite short. Second, low pitch is realized on major syllables with long vowels, whether closed or open. I call it low only in opposition with the high pitch, and it is phonetically characterized by lacking a rising pitch contour. Third, major syllables with a final nasal or glide are realized with a sharply falling pitch. This section lays out these patterns in more detail and provides acoustic evidence for the phenomena.

We start with the high pitch. As was just stated, high pitch occurs on major syllables with short vowels and a final stop, including glottal stops, or a final /h/. Below we see words with each of these pitches accompanied by a pitch track.⁴ Words with medial nasals were selected to avoid the perturbations to the pitch which are caused by articulation of obstruents. The pitch is given in Hertz.

(5) **HIGH TONIC PITCH ON CLOSED SYLLABLES WITH SHORT VOWELS**

a. maneʔ ‘ask’

b. kɔnit ‘yellow’

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⁴ Pitchtracks were generated in Praat, made from recordings collected in July 2007 from a 25 year old woman named Si who was my primary consultant. She came from an island she called Koh Lemsat in Thai, which, based on her description, was either from the Lebi or Niawi dialects of Moken (Naw Say Bay 1995; Ivanoff 1985) They were elicited in isolation.
c. manāt ‘pineapple’  

\[ \text{N} \text{a} \text{m} \text{a} \text{t} \]

\[ \text{Time (s)} \]

\[ 0 \quad 0.5612 \]

\[ 80 \quad 120 \]

\[ m \text{a} \]

d. ṅaŋah ‘crack open’

\[ \text{N} \text{a} \text{n} \text{a} \text{h} \]

\[ \text{Time (s)} \]

\[ 0.08375 \quad 0.5841 \]

\[ 80 \quad 120 \]

\[ N \text{a} \text{h} \]

The high pitch is realized with remarkable consistency across words and tokens of a given word, even when items recorded sequentially and reordered. In a few isolated cases, such as cicaʔ < Th. čǐčòk ‘gecko’, the final H failed to emerge. It is interesting that the Thai source has a low tone on the final syllable there. Usually, the tonic high triggered by final stop is higher than the tonic high elicited by a final /h/; in some cases the latter even precipitated a brief fall at the end of the syllable. We will return to this observation in the following section.

Besides the glottal stop, which appears to be mostly epenthetic with short vowels, stops in Moken for the most part developed directly from PAn roots with closed syllables, e.g. *takut > nakot ‘fear’; *tulak > nɔlak ‘push.’ (Wolff in progress:538). In contrast, final /-h/ arises from both *-q and *-c: *ca-puluq > cəpoh ‘ten’; *nipaq ‘k.o. palm of tidal swamps’ > ńepah ‘thatch’; *balec > balah ‘revenge’; *sapedec > pađeh/pađeh ‘hot, sharp taste’ (539-540). Because the normal pattern for Moken is *-q > -k and *-c > Ø, Wolff proposes that these forms were early borrowings from Cham or Malay, both of which saw *-k > -h.

The next tonic pitch is mostly characterized by the lack of a peak and a steady fall. It is found on major syllables with a long vowel, regardless of whether it is closed. Earlier we discussed the fact that CVʔ and CV: were free alternants. The tonic pitch of the word changes with this alternation between the high pitch and the low pitch. This is among the clearest pieces of evidence that tonic pitch in Moken is not yet lexicalized:
(6) **LOW TONIC PITCH ON LONG VOWELS**

a. məla: ‘old’

b. pəna: ‘see’

c. kəta:m ‘crab’

d. kije:t ‘rambutan’

Like the high pitch, low pitch is realized with consistency across tokens, though the relative pitch of the minor syllable to the major syllable does seem to vary. In particular, when a schwa occurs in the first syllable, a peak will sometimes occur at the beginning of the major syllable or during its onset.

The last major category for tonic pitch is the sharp fall characteristic of short vowels followed by glides and nasals. Examples of these are given below:
Falling tonic pitch on short vowels with nasal or glide codas

a. banam ‘bad’

b. weŋ (lɔsa) ‘hunt’

c. kamoj ‘we’

d. kataj ‘heart/liver’

As the pitch tracks above show, the fall extends through the vowel onto the following sonorant. Again, these effects were consistent across tokens, though the peak sometimes was less clear in various examples. There is a clear difference in the relationship of pitch on the major and minor vowels in (6) and (7), and the overall pitch is much higher in (7), as an investigation of the Hz scale on the left side of the graph will reveal.

The three patterns are summarized below:

<table>
<thead>
<tr>
<th>Class</th>
<th>Pitch</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>High</td>
<td>VK, Vʔ, Vh</td>
</tr>
<tr>
<td>B</td>
<td>Low</td>
<td>V:(C)</td>
</tr>
<tr>
<td>C</td>
<td>Falling</td>
<td>VN, VG</td>
</tr>
</tbody>
</table>

Tonic pitch is not lexically contrastive tone. If it were, it would not be predictable from the segmental makeup of the major syllable. The clearest argument that this is true comes from the fact, already mentioned, that the pitch of major syllables which are
phonologically CV depends on whether they are lengthened, leading to the low tonic pitch, or there is an epenthetic glottal stop, leading to the high.

We might then ask what the correct synchronic analysis of tonic stress is. One attractive hypothesis is that tonic pitch patterns are part of the realization of stress in Moken. “Stress” is a feature of syllables as a whole, and is realized by duration and intensity, especially at higher ends of the frequency spectrum (Sluijter 1995), and the accurate articulation of articulatory targets (de Jong 1995). To the extent that tonic pitch is a realization of stress, it is merely the existence of a signature pitch pattern on the major syllable with signals stress, as the choice of pitch varies.

A more precise account of tonic pitch in Moken is as an enhancement for the difference in vowel length in the major syllable. As such, it likely has been developed, language internally, under the influence of tonal languages, as I will detail in the following section. This story is imminently plausible because vowel length is the primary predictor of pitch. Moreover, the difference between high and falling pitch can be collapsed if high pitch is phonetically associated with short vowels and the fall observed in final glides and nasals is simply due to the fact that the H target is located on the vowel. Perception studies on native Moken speakers where vowel duration was held constant and pitch manipulated would help determine whether pitch is, in fact, a cue for vowel length, a possible topic for future work.

Descriptively, two issues remain unsettled. More work remains to be done on detecting whether the voicing of the onset might play a hand in the relative pitch of Moro vowels, whether stressed or not. Such effects are historically common and are well-understood from an acoustic perspective (Abramson 2000). An indication that there may be more to say about Moken in this regard can be observed in the lowness of the vowel in the minor syllable of ‘bad’ (7a), which is likely due to the effect of the preceding voiced stop. Additionally, I had the impression of breathiness, especially on /ɛ/, and this may be an additional germ for future tonogenesis, as breathy voice has frequently been observed to lead to low tone (Thurgood 2007).

4. Moken and Tonogenesis

The classic model of tonogenesis, modeled on Vietnamese, is that contrasts in both the final and initial syllables give rise to tone. For Vietnamese, a final glottal stop is generally seen as giving rise to a rising tone while a final /h/ gave rise to a falling tone, leading to a three-tone contrast. This contrast was then split into six when Vietnamese lost an initial voicing distinction, as voiced initials gave rise to a breathy register which led further to a low tonal register (Haudricourt 1954, Matisoff 1973).
Thurgood (2007) revisits this classic analysis and argues that the transition from segmental contrasts to tonal ones is always mediated by changes in vowel quality. Thus, he argues that final glottal stops, for example, first lend their glottal feature to the vowel itself, creating a glottalized or creaky vowel. The higher glottal tension required to articulate these vowels subsequently evolves into a high tone. Likewise, a final /h/ leads to breathiness on the vowel which then leads to a falling tone.

However, Thurgood observes that final /h/ does not always lead to low or falling tone. Work by him and others recounts the case of Tsat, a Chamic language, where final /h/ served as a conditioning environment for a H tone (Thurgood 1996), and the same pattern has been attested in the development of H in Punjabi (Ohala 1973). Thurgood suggests that the existence of phonetic differences in the articulation of /h/ in different languages is the underlying cause of the discrepancy, and that only breathy h, /ɦ/, actually serves to give rise to L. That being the case, the fact that final /h/ triggers high tonic pitch in Moken is unsurprising. This is even more true final /h/ in Moken developed under Chamic influence, as suggested by Wolff (in progress).

However, the Moken facts are somewhat problematic Thurgood’s proposal. In particular, it does not seem to be the case that tonic pitch arose from any deeper difference in vowel phonation. Instead, Moken appears to have developed tonic pitch in order to distinguish short vowels from long ones. Thus, vowel duration has come to be directly mirrored by pitch, rather than pitch arising as a result of some segmental neutralization.

Historically, tonic pitch probably arose on short vowels as the anticipation of the glottalization associated with final stops, final glottal stops, and final /h/. The effect of coarticulation was reanalyzed by subsequent generations as part of the proper phonetic implementation of short vowels, which in turn led to the falling tone associated with short vowels closed by glides and nasals. It was likely that the low tonic pitch associated with long vowels developed in opposition to the high pitch associated with short ones.

If this explanation is correct, it seems that Moken may eventually provide a case of tonogenesis which is not directly triggered by phonation differences on vowels themselves. There are several imaginable routes by which this transition might take place: the most obvious one is that the vowel length contrast itself could be lost, leading directly to a H vs. L tone distinction (in fact, a synchronic analysis of Moken along these lines is not implausible). Other possibilities arise, but speculating too much might detract from the main point, which is that the same effects of contact which have led Moken speakers to radically restructure the segmental and prosodic makeup of their
language has already led to contextual differences in pitch which may well be the immediate precursors to Moken becoming tonal.

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