

## **Final lowering in contacting African tone languages: A study of variation in postlexical prosody**

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### **Abstract**

This paper explores a critically understudied phenomenon, multilingual sociotonic variation involving two contacting African tonal languages, Guinean Mano and Guinean Kpelle. Based on manual annotation and automatic  $f_0$  extraction from semi-spontaneous data, we explore variation in utterance-final H→M lowering rule in Mano. We study tone production in Mano speakers having various degrees of exposure to Mano and Kpelle and compare bilingual Mano tone production with that of baseline Mano and Kpelle L1 speakers. We demonstrate that the presence of final H lowering correlates with the degree of Mano/Kpelle exposure. First, final lowering is not attested in Mano L2 tone production similarly to Kpelle L1 speech. Second, its realization in simultaneous bilingual speakers depends on their socialization background; namely, it is identical to baseline Mano speech in bilinguals who were socialized in Mano-speaking families; and it is less consistent in speakers from bilingual and Kpelle-speaking families.

### **Introduction**

Final lowering is a common prosodic boundary phenomenon attested in different languages, such as English, Danish, Japanese and Kipare (Arvaniti, 2007 and references therein). For example, in English, the final H in a series of downstepping H peaks is significantly lowered (Liberman & Pierrehumbert, 1984, p. 182). The broad typological scope of languages having final lowering suggests that it may be physiologically

conditioned, e.g. due to relaxation of laryngeal muscles, yet it has been phonologized in some tone languages (Gussenhoven, 2004).

There is a growing literature on contact-induced variation in lexical prosody of tonal languages, i.e. languages having contrastive pitch specifications relevant for lexical and/or grammatical meanings (Wee, 2019), and which constitute around a half of world languages (Maddieson, 2013). Sociotonic research on the interaction between tonal languages and linguistic varieties remains scarce and focussed on Southeast Asian languages (Stanford, 2008, 2016; Mok et al., 2013; Jingwei, 2014; Yeh & Lin, 2015; Jingwei et al., 2023). Even less is known about the acquisition of allotonic rules (Qin, 2022) and sociotonic variation in African level tone languages. Furthermore, current sociotonic research has mainly focused on controlled speech data, i.e. word lists, sentence frames, and phrase lists (Stanford, 2008; Jingwei, 2014), which limits the scope of study to lexical tones and leaves variation in intonation almost completely unexplored.

Located at the intersection of sociotonics and research of multilingualism, this paper explores a critically understudied phenomenon, multilingual variation in prosody involving two contacting African tonal languages, Mano, or Manon [iso 639-3:mev] and Kpelle, or Guerzé [iso 639-3:gkp], based on both manual annotation and automatic  $f_0$  extraction from semi-spontaneous data.

Mano and Kpelle have different tonal systems, with Kpelle featuring a binary tonal contrast (Low/High) and

Mano has three contrastive level tones (Low/Mid/High), as well as a specific utterance-final rule of H lowering.

In this paper, we focus on utterance-final H lowering rule as a sociotonic variable in Mano tone production. We explore variation in Mano speakers having various degrees of exposure to Mano and Kpelle, and compare bilingual Mano tone production with that of baseline Mano and Kpelle L1 speakers.

We demonstrate that the presence of final H lowering correlates with the degree of Mano/Kpelle exposure. It is not attested in Mano L2 tone production; and it varies in simultaneous bilinguals, depending on their socialization background.

### Sociolinguistic situation

Kpelle and Mano belong to the different branches of the Mande family: Southwestern Mande (Kpelle) and Southern Mande (Mano). Both languages are spoken in Northern Liberia and in the Southeastern Guinean region named Forest Guinea (Guinée Forestière), which is the locality that we study here. In Forest Guinea, Mano and Kpelle are spoken by 57 000 and 332 000 people, respectively. While Mano and Kpelle have distinct ethnic identities, they have closely intertwined economic activities and similar cultural patterns, with widely practiced intermarriages. The numerical dominance of Kpelle speakers over Mano speakers commonly results in asymmetrical bilingualism, whereby the Mano speak Kpelle more often than the other way around (Khachatryan & Konoshenko, 2021, p. 980).

### Tones in Mano and Kpelle

#### Tones in Kpelle

Guinean Kpelle has a binary Low vs. High contrast with morpheme-level tone melodies, e.g. /H/ *kélé* ‘raffia palm’, /L<sup>H</sup>/, *kèlè* ‘small bee’, /HL/ *kélè* ‘shed’, /L/ *kèlèŋ* ‘bird species’, /LHL/ *kèlèŋ* ‘African fox’. Underlying melodies are

subject to several surface tone rules, which are not relevant for the present discussion (Konoshenko, 2014, 2022). Crucially, utterance-final H tone is faithfully realised as H in Guinean Kpelle, as shown in Figure 1. Guinean Kpelle also features a boundary extra-high H% tone, which is not covered in this study.

#### Tones and final lowering in Mano

Guinean Mano has three contrastive lexical Low/Mid/High tones, e.g. *lè* ‘place’, *lè* copula, *lé* attention drawing marker (Khachatryan et al., 2022).

Crucially, in Mano, High tone surfaces as Mid on the utterance-final tone bearing unit (1); and final H lowering only appears on utterance boundaries. This is further illustrated in Figure 2.

(1) H → M / \_##

While final lowering is gradient in intonation-only languages like English, the Mano H lowering results in a change of tone category, as is often the case in African tone languages (Gussenhoven, 2004, pp. 110–113), e.g. in Kukuya (Hyman, 1987).

Phonologically, final H lowering in Mano is, however, rather peculiar. Bisyllabic morphemes like *sónó* ‘near’ are arguably lexically associated with a single underlying /H/ melody in Mano since lexical rules refer to the underlying tones in Mano, e.g. Imperfective lowering: *pélé* ‘wash’ → *pèlè* ‘wash:IPFV’. Yet, final High lowering only affects H associated with the last TBU in Mano: /sónó###/ → [sónó###], [\*sónó###]. It thus does not refer to the underlying lexical /H/, but rather to the surface string of H tones, picking the last TBU. Therefore, while its phonological implementation is categorical (H → M), it operates as a late postlexical rule, just like the intonational phenomena.

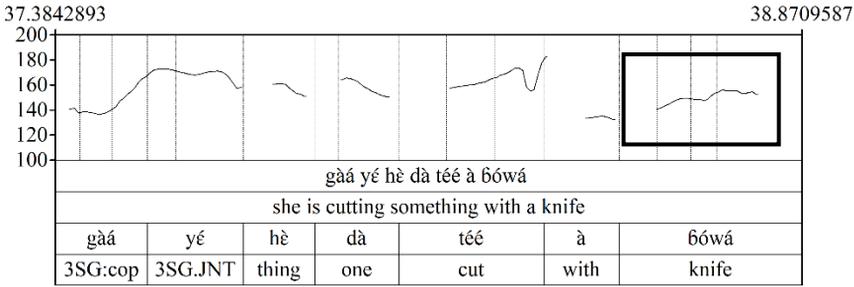


Figure 1. No final lowering in L1 Kpelle production

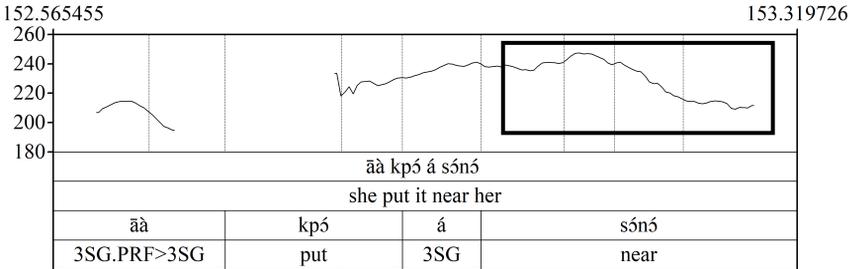


Figure 2. Final lowering in L1 Mano production

## Data collection and methods

### Data and participants

In this study, we analyse a dataset containing semi-spontaneous utterances based on a questionnaire with 20 pictures, originally devised and recorded to study the variation in Mano reflexive marking (Khachaturyan et al. 2024) and not intended for phonetic/phonological analysis. The collected data were recorded using a Zoom Q8 camera with in-built stereo microphone in a natural setting, usually in the speakers' households in their villages of residence. Hence, the average quality of the available recordings was rather poor, so we only selected the recordings where the participant's voice was stronger and having no overlapping noises.

This study is based on a subset of recordings from 22 adult participants (8 females and 12 males; 5 speakers were recorded in Kpelle and 17 in Mano) collected by Pé Mamy, our Guinean collaborator, between February 2022 and July 2023. Prior to elicitation, a sociolinguistic questionnaire was collected for each

speaker. There were 687 utterances in total in our dataset.

We use the term Mano L1 to refer to speakers who were socialized exclusively in monolingual Mano families (biological and adoptive) and reside in Mano-dominant villages. We compare their tone production with that of three bilingual speaker groups (Mano 2L1 speakers socialized in Mano-speaking families, Bi/Kpelle 2L1 speakers socialized in bilingual and Kpelle-speaking families, Mano L2 speakers having Kpelle as their L1), as well as baseline Kpelle L1 speakers. By 2L1 we understand speakers who were exposed to both Mano and Kpelle from early childhood; and Mano L2 speakers in our sample were exposed to Mano primarily from adolescence or adulthood, from 15 years or later.

### Transcription and annotations

Both Mano and Kpelle recordings were originally transcribed in Elan software (ELAN, 2023) by Pé Mamy, a native speaker of Mano and Kpelle. The transcriptions were later manually checked for accuracy by the co-authors, based on

their language expertise, and exported to Praat (version 6.03.05, Boersma & Weenink, 2023). The recordings were segmented into several units on separate TextGrid tiers: utterances, morphemes with glosses, and segments, i.e. consonants and vowels.

The vowels were annotated on two additional tiers receiving two labels: the *expected* surface tone, based on our prior expertise and the Mamy’s transcription, and second, the *attested* surface tone, based on the first author’s auditory impression complemented by visual inspection of the  $f_0$  trace in Praat. Utterance-final H was labelled as expected H#.

The segmented and annotated text-grids for each speaker were then fed to a Praat script written by Juraj Šimko. The script (i) collected all the categorical labels in the relevant tiers, (ii) extracted mean  $f_0$  from the vowel segments with manually adjusted speaker-specific floor and ceiling settings. During the post-processing phase, raw  $f_0$  values were transformed to semitones with speaker-specific reference (individual median  $f_0$ ).

### Measurements and statistics

The present study is based on a dataset containing 189 tokens of utterance-final H# tones in Mano and Kpelle recordings, including 109 HH#, 64 LH# and 13 MH# transitions. As we demonstrate in Konoshenko et al. (n.d.), automatic downstep influences the realization of H after both L and M. For this reason and given that the other two transitions are less frequent, we only focus on HH# sequences here.

For each pair of adjacent tones, a *transition* between mean  $f_0$  values was calculated by subtracting  $f_0$  value of the present vowel segment from that of the preceding one. In our previous study (Konoshenko et al. in prep), we found that tone space, operationalised as the difference between median H and median L values, was different across speaker types, being the largest in Mano

L1 and the smallest in Kpelle L1. For this reason,  $f_0$  transition values were normalised for speaker-type specific tone space before statistical modeling.

To explore the variation in HH# transitions, we fitted a linear mixed-effect regression model having the normalized  $f_0$  *transition value* as dependent variable and *speaker type* as a fixed categorical predictor. Individual *speakers* and *lexical items* were modelled as random intercepts.

The statistical analysis was implemented by using `lme4` package (Bates et al., 2024) in RStudio (RStudio Team, 2024), with the `lmerTest` package (Kuznetsova et al., 2017) for estimating  $p$ -values (alpha level set at .05).

### Results

Table 1 shows how the utterance-final /H#/ realisations were categorically labelled in different speaker types.

Table 1. Expected /H#/ across speaker types

Speaker type	[H]	[H?]	[M]	[M?]
Mano L1	0	1	<b>34</b>	1
Mano 2L1	0	0	<b>11</b>	1
Bi/Kpelle 2L1	<b>9</b>	1	<b>6</b>	0
Mano L2	<b>21</b>	0	1	2
Kpelle L1	<b>20</b>	0	0	0

Table 1 suggests that Mano L1 and Mano 2L1 speakers generally lowered /H#/ to [M], while both non-lowered [H] and [M] were attested in Bi/Kpelle 2L1 speakers. Non-lowered [H] was strictly dominant in Mano L2 production, and there was no lowering in Kpelle L1 speech.

Normalised HH#  $f_0$  transition values plotted in Figure 3 below confirm the results obtained from categorical annotation. Figure 3 shows that Mano L1 and 2L1 speakers generally lowered /H#/.

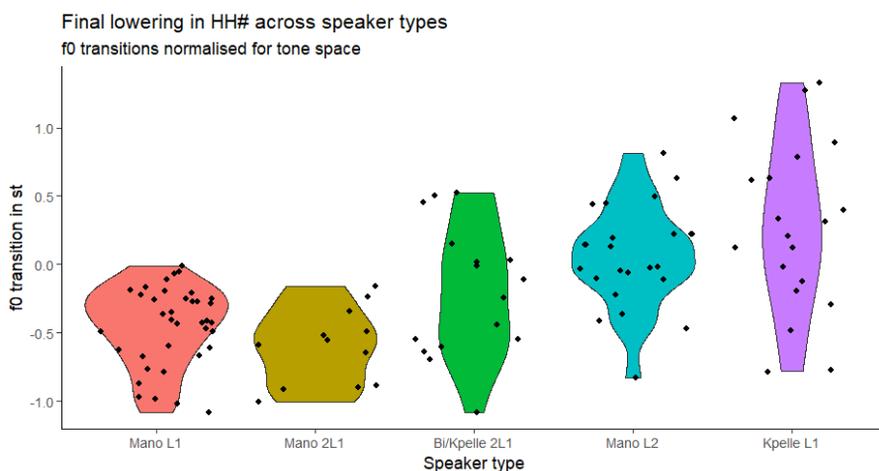


Figure 3. Final lowering across speaker types

Bi/Kpelle 2L1 type had both lowered and non-lowered realisations. Finally, the HH# transition was most often realised as a minimal rise of a little over 0 st in Mano L2 and Kpelle L1 production, which was typical for HH sequences in our data.

Regression model also returned a significant effect of speaker type on the normalised HH#  $f_0$  transition value. The transition value was significantly higher in both Mano L2 and Kpelle L1 types, as opposed to Mano L1 coded as the reference level ( $\beta = .49, t = 3.33, p < .01$  for Mano L2 and  $\beta = .74, t = 3.03, p < .01$  for Kpelle L1). Note that recoding Bi/Kpelle 2L1 type as reference returned no significant difference between this type and Mano L2 as well as Kpelle L1.

## Discussion

This study contributes to the discussion of sociotonic variation and the acquisition of allotonic rules (Qin, 2022) by showing that, unlike in Mano L1 production, final H lowering rule is generally not attested in Mano L2 speakers, despite their generally high tonal proficiency in Mano and, more specifically, in Mano Mid tone (Konoshenko et al., n.d.). Our tentative explanation is that, despite the clear functional association of final H lowering with utterance

boundaries, since Mano final H lowering is categorical in nature but applies postlexically, it may be more difficult to acquire than lexical rules, which are learned by L2 speakers as our prior evidence suggests.

This study also shows that 2L1 speakers socialized in Mano-speaking families systematically applied final lowering, while it was less consistent in 2L1 speakers socialized in bilingual or Kpelle-speaking families.

Methodologically, this study is based on recordings of semi-naturalistic speech allowing us to capture sociotonic variation in a more ecologically valid way (Stanford, 2016).

## Conclusions

This is the first sociotonic study of allotonic variation in African multilingual environment. We have shown that utterance-final H lowering varies depending on the speakers' backgrounds and, crucially, it is not learned by Mano L2 speakers. It remains to be seen whether final lowering operates differently from other tone rules in Mano due to its postlexical nature, or whether tone rules – both lexical and postlexical – generally tend to be less productive in multilingual speech.

## References

- Arvaniti, A. (2007). On the presence of final lowering in British and American English. In C. Gussenhoven & T. Riad (Eds.), *Tones and Tunes. Phonetic and Behavioural Studies in Word and Sentence Prosody: Vol. II* (C. & T., pp. 317–348). Mouton de Gruyter.
- Bates, D., Maechler, M., Bolker [aut, B., cre, Walker, S., Christensen, R. H. B., Singmann, H., Dai, B., Scheipl, F., Grothendieck, G., Green, P., Fox, J., Bauer, A., simulate.formula], P. N. K. (2024). *lme4: Linear Mixed-Effects Models using “Eigen” and S4* (1.1-35.2) [Computer software].
- Boersma, P., & Weenink, D. (2023). *Praat: Doing phonetics by computer [Computer software]* (6.3.05) [Computer software]. <https://www.praat.org>
- ELAN [Computer software] (6.7). (2023). [Computer software]. Max Planck Institute for Psycholinguistics. <https://archive.mpi.nl/tla/elan>
- Gussenhoven, C. (2004). *The Phonology of Tone and Intonation*. Cambridge University Press.
- Hyman, L. M. (1987). Prosodic domains in Kukuya. *Natural Language & Linguistic Theory*, 5(3), 311–333.
- Jingwei, Z. (2014). *A Sociophonetic Study on Tonal Variation of the Wuxi and Shanghai Dialects*. <https://www.lotpublications.nl/a-sociophonetic-study-on-tonal-variation-a-sociophonetic-study-on-tonal-variation-of-the-wuxi-and-shanghai-dialects>
- Jingwei, Z., Weijie, T., & Strelluf, C. (2023). Sociophonetics and Chinese. In *The Routledge Handbook of Sociophonetics*. Routledge.
- Khachaturyan, M., Carbo, M., & P. Mamy (2022). Dictionnaire mano-français. *Mandenkan. Bulletin semestriel d'études linguistiques mandé*, 67, Article 67.
- Khachaturyan, M., & Konoshenko, M. (2021). Assessing (a)symmetry in multilingualism: The case of Mano and Kpelle in Guinea. *International Journal of Bilingualism*, 25(4), 979–998.
- Konoshenko, M. (2014). The syntax of tone in Guinean Kpelle. *Annual Meeting of the Berkeley Linguistics Society*, 40, 233–252.
- Konoshenko, M. (2022). Tones and paradigms: A study of grammatical tones in Mande verbal inflection. *Journal of African Languages and Linguistics*, 43(2), 165–197.
- Konoshenko, M., Šimko, J., Mamy, P., & Khachaturyan, M. (n.d.). *Level tones in contact: A study of socioprosodic variation in Mano and Kpelle (Guinea)*.
- Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest Package: Tests in Linear Mixed Effects Models. *Journal of Statistical Software*, 82, 1–26.
- Liberman, M., & Pierrehumbert, J. (1984). Intonational invariance under changes in pitch range and length. In M. Aronoff & R. T. Oehrlé (Eds.), *Language, sound, structure: Studies in phonology presented to Morris Halle by his teacher and students* (pp. 157–223). MIT Press.
- Maddieson, I. (2013). Tone (v2020.3). In M. S. Dryer & M. Haspelmath (Eds.), *The World Atlas of Language Structures Online*. Zenodo.
- Mok, P. P. K., Zuo, D., & Wong, P. W. Y. (2013). Production and perception of a sound change in progress: Tone merging in Hong Kong Cantonese. *Language Variation and Change*, 25(3), 341–370.
- Qin, Z. (2022). The Second-Language Productivity of Two Mandarin Tone Sandhi Patterns. *Speech Communication*, 138, 98–109.
- Stanford, J. N. (2008). A sociotonic analysis of Sui dialect contact. *Language Variation and Change*, 20(3), 409–450.
- Stanford, J. N. (2016). Sociotonicics using connected speech: A study of Sui tone variation in free-speech style. *Asia-Pacific Language Variation*, 2(1), 48–82. <https://doi.org/10.1075/aplv.2.1.02sta>
- Wee, L.-H. (2019). *Phonological Tone*. Cambridge University Press.
- Yeh, C., & Lin, Y. (2015). *Tonal Change Induced by Language Attrition and Phonetic Similarity in Hai-lu Hakka*, 189–220.