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Demarcating and highlighting in Papuan Malay phrase prosody

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ABSTRACT:
Phrase-level prosody serves two essential functions in many languages of the world: chunking information into units (demarcating) and marking important information (highlighting). Recent work suggests that prosody has a mainly demarcating function in the Trade Malay language family. That is, the use of pitch accents in these languages is limited or absent, as the main prosodic events occur on the final two syllables in a phrase. The current study investigates the extent to which Papuan Malay phrase prosody is used for demarcating and highlighting, taking into account the potential influence of word stress. This is done by means of acoustic analyses on a corpus of spontaneous speech. Both the form (F0 movement) and the possible functions (demarcating and highlighting) of the final two syllables in Papuan Malay phrases are investigated. Although most results favor the demarcating function of Papuan Malay phrase prosody, a highlighting function cannot be ruled out. The results suggest that Papuan Malay might hold an exceptional position in the typology of prosodic prominence. © *2020 Acoustical Society of America*. https://doi.org/10.1121/10.0001008

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I. INTRODUCTION

Traditionally, two basic functions of phrase prosody have been distinguished: marking boundaries between phrases (demarcating) and marking important elements within phrases (highlighting). Different approaches to the transcription or annotation of prosodic phenomena make use of this dichotomy, i.e., autosegmental-metrical (AM) approaches which have been applied to a variety of languages (e.g., Jun, 2005, 2014, for overviews), as well as transcription methods such as *rapid prosody transcription* (RPT; Cole and Shattuck-Hufnagel, 2016).

While the prosody of many languages fulfils both functions, recent research suggests that languages in the Trade Malay family, as well as in some varieties of Indonesian, mainly use prosody to mark phrase boundaries (e.g., Riesberg *et al.*, 2018). This would classify Papuan Malay as an edge-language (Jun, 2014), which does not have word stress. Such a classification seems problematic given recent evidence from speech production (Kaland, 2019) and speech perception (Kaland, 2020) favoring word stress patterns. How exactly Papuan Malay prosody fits existing models of prosodic prominence therefore remains to be seen. In fact, the current study provides some evidence that Papuan Malay phrase prosody mainly serves a demarcating function but may also serve a highlighting function to some extent.

The empirical literature on Trade Malay phrase prosody is currently limited and more research is needed to substantiate previous findings. In particular, an acoustic investigation of the potential prosodic functions in Papuan Malay is currently lacking. The current study reports acoustic analyses on a corpus of spontaneous narratives. Evidence for the functions of phrase prosody was taken from the size and distribution of silent pauses and F0 movements. As for phrase-final F0 movements, their distribution was compared to that of word-level stress in order to shed light on the possible interaction between the two levels. The remainder of this paper provides a discussion of the literature of typological models of prosodic prominence (Sec. I A) and the available studies on prosody in Trade Malay varieties with particular focus on Papuan Malay (Sec. I B). Section II reports the data collected, the acoustic analyses performed, and the results thereof. Finally, Sec. III gives an overall conclusion and discussion with a tentative proposal for a phonological analysis of phrase-final F0 movements.

A. Typological models of prosodic prominence

This section discusses three typological models of prosodic prominence at the phrase level. Although the models differ to some degree, they all share the aim of capturing typological differences observed in the prosody of the world's languages. The discussion in this section should provide a theoretical framework within which the results of the current study can be interpreted. Moreover, the models can help to classify the prosody of Papuan Malay typologically.

1. Jun (2014)

Based on the AM theory of intonational phonology, Jun (2014) proposes a typological model of prosodic prominence based on *macro-rhythm*. Macro-rhythm is defined according to the recurrence of phrase-medial prominent F0

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peaks as part of pitch accents, accentual phrases, or word tones (henceforth, F0 movements) with steeper F0 movements constituting a higher degree of macro-rhythm than shallower F0 movements. Three criteria for predicting the degree of macro-rhythm are given: (1) the number of possible F0 movement types with small inventories constituting higher degrees of macro-rhythm than large inventories, (2) the most common F0 movement type with rises and/or falls constituting a higher degree of macro-rhythm than level tones, and (3) the frequency or domain of F0 movements with the movements occurring more regularly constituting a higher degree of macro-rhythm than those occurring less regularly.

Apart from macro-rhythmic properties, the proposed typological model categorizes languages according to their prominence type, i.e., whether phrasal prominence is marked by the head, the edge, or both, and word prosody, i.e., whether the language makes use of word stress, lexical tones, both, or none (see Fig. 1).

The model is primarily based on the characteristics of F0 as an acoustic cue to prosody, following studies that have shown the strength of F0 as a cue to perceived rhythm (e.g., Barry *et al.*, 2009; Dilley and McAuley, 2008). For examples from the individual languages classified in Fig. 1, see Jun (2014). Furthermore, prominence type and word prosody category are not fully independent in the assumptions that underlie the model. That is, languages with word stress are generally classified as head-languages even when F0 movements are bound to the edge of the phrase (e.g., Kuot; Lindström and Remijsen, 2005). Thus, in Jun's model (2014) edge-languages cannot have word stress, following the assumption that stressed syllables at the word level provide anchor points for phrase-level accents.

2. Lindström and Remijsen (2005)

Given the rather unusual position of Kuot in the prosodic typology, Lindström and Remijsen (2005) propose a revision of the typological grid provided in Ladd (1996, p.156); see Fig. 2. The original AM-based model in Ladd (1996) also assumed that when a language has word stress these are anchor points for phrase-level F0 movements and this model is similar to that of Jun (2014) in this respect. However, Lindström and Remijsen (2005) showed that word stress in Kuot is cued by duration and vowel quality and is not accompanied by F0 movements. At the phrase level, F0 appeared only as a functional cue to signal the structure or type of clause, mainly at the right edge of the phrase. In Ladd's (1996) initial model, the two dimensions used to classify languages concerned "phonetic typology" and "lexical typology" (Fig. 2). Phonetic typology classifies languages according to whether they make use of word stress as signalled by duration and loudness (i.e., *stress accent*, following Beckman, 1986). Lexical typology classifies languages according to whether F0 is functional at the lexical and/or post-lexical level and is most closely resembled in Jun's (2014) "word prosody" categories. This broad typology could distinguish closely related stress-languages like English and Swedish, the latter making use of F0 at the

Prom. type	Word prosody	Macro-rhythm		
		Strong	Medium	Weak
Head	Stress	Brazilian Portuguese, Castilian Spanish, Catalan, Egyptian Arabic, Greek, Italian, Samoan	Dutch, English, German, Jamaican Creole English, Lebanese Arabic	European Portuguese, Wolof, Kuot
	Tone/lexical pitch accent	*(Kihehe, Safwa[a], Somali[b])*	*(Isthmus Zapotec[c], Kimatuumbi[a], Skou[d])*	Cantonese
	Both	Papiamentu, Swedish		Mandarin
	None			
Head/ Edge	Stress	Bengali, Georgian, Kiche, Tamil, Tongan	Bininj Gun-wok, Dalabon	
	Tone/lexical pitch accent	Japanese, Leketio Basque		
	Both	Serbo-Croatian	Chickasaw[7]	
	None	French, Standard Basque		
Edge	None	Accentless dialects of Japanese, Halh Mongolian, Oirat Mongolian, Seoul Korean, West Greenlandic		

FIG. 1. Model of prosodic typology by Jun (2014, p. 535).

Lexical typology	Phonetic typology: Stress accent	Phonetic typology: Non-stress accent
Lexical pitch	e.g. Swedish	e.g. Japanese
Postlexical pitch only	e.g. English	e.g. Bengali
No pitch-accents	Wolof	<<impossible>>

FIG. 2. Model of prosodic typology by Lindström and Remijsen (2005, p. 847), adapted from Ladd (1996, p. 156).

word level. Lindström and Remijsen (2005) proposed an additional category for languages without pitch accents (Fig. 2, bottom row) such as Wolof (Rialland and Robert, 2001). Kuot would group with Wolof in this typology, which accounted for languages exhibiting more independence between word-level and phrase-level prosody.

3. Gordon (2014)

The distribution of word stress and pitch accents was analyzed in a typological framework by Gordon (2014). It was argued that the phonological concept of word stress originates from phrase-level prosody. In other words, the driving factor behind stress patterns in the languages of the world is phrase prosody, in particular F0 movements. In this analysis, the common occurrence of penultimate word stress across languages is seen as an avoidance of tonal crowding (edge repulsion) at the phrase level, where final F0 movements occur virtually universally to mark the phrase end. Specifically, a classification of languages is proposed according to two criteria: whether a language shows edge repulsion and whether word-level stress and phrase-level accents are attracted by the same syllable (symmetrical) or not (asymmetrical); see Fig. 3. Crucially, no languages classified as asymmetrical show edge repulsion only at the word level (and not at the phrase level). The reverse pattern, edge repulsion at the phrase level but not at the word level, is attested in several languages (Gordon, 2014). This typological distribution was taken as an indication of the dominant role of phrase prosody, and as an explanation for the relative frequency with which penultimate (edge-repelled) word stress occurs in the languages of the world.

4. Summary

The typological models discussed above have in common that F0 is taken as the primary feature for prosodic (metrical) prominence. Furthermore, all models make a distinction between phenomena at the word level and phenomena at the phrase level. The concepts of word stress and pitch accents are adopted by all models as well, although they are not always used as classifying dimensions (e.g., Gordon, 2014). In this respect, Jun's model (Jun, 2014) and Ladd's original model (Ladd, 1996) are particularly similar as they both assume stressed syllables to act as anchor points for F0 movements at the phrase level, an assumption revised in the model by Lindström and Remijsen (2005). The models differ in the extent to which they cover phrase-internal or phrase-peripheral phenomena. That is, Jun's model (Jun, 2014) focuses on phrase-medial rather than phrase-final F0 movements to define macro-rhythm. In Gordon (2014), only edge phenomena are taken into account. Note that there is some discrepancy between the models as to the categorization of certain languages (e.g., Bengali), which is likely to be the result of new insights from research conducted in the time between publication of the different models. It remains to be seen how newly acquired data from under-described languages fit the prosodic typologies discussed here. To this end, the current study focuses on Papuan Malay. An overview of what is known about this language and related languages is provided in Sec. I B.

B. Phrase prosody in Trade Malay and Indonesian varieties

Trade Malay varieties are spoken in the eastern part of Indonesia and include Manado, North Moluccan, Ambonese, Kupang, Larantuka, and Papuan Malay (Paauw, 2008). Most varieties have been documented and described to some extent, however, little empirical testing of initial observations has been carried out. In particular, not a lot is known about the prosody of Trade Malay varieties. In the current section, the discussion of Trade Malay prosody is limited to the varieties for which phrase prosody has been

	Edge repulsion: Word	Edge repulsion: Phrase	Languages
Symmetrical	Yes	Yes	English, Egyptian Arabic
	No	No	Hebrew, Farsi
Asymmetrical	No	Yes	Chickasaw, Cayuga, Seneca, Central Alaskan Yup'ik, Onondaga
	No	No PA	Wolof
	Yes	No	Unattested?
	Yes	No PA	Unattested?

FIG. 3. Model of prosodic typology by Gordon (2014, p. 21).

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described or empirically investigated. These include Manado, Ambonese, and Papuan Malay.

1. Manado

The only account of phrase prosodic phenomena in Manado Malay is an AM-based description of the most common pitch accents and their distributions (Stoel, 2007, 2013). Remarkably, this is the only Trade Malay variety for which both demarcating and highlighting functions have been described. Based on graphic representations of F0 contours, pitch accents are shown to occur commonly at the end of phrases to mark focus. Exceptions are reported in which non-final words are prosodically highlighted, for example, when unaccented discourse particles appear at the end of the phrase or when focus is shifted to a non-final constituent. Furthermore, phonological phrases and intonation phrases are distinguished as relevant levels for the intonational grammar. Demarcation by means of high (H) or low (L) boundary tones is only attributed to phonological phrases of which minimally one constitutes an intonation phrase. The location and shape of pitch accents is determined by which syllable in the word is stressed (alignment point, indicated by "*") and the type of focus (predicate, subject, object, or verb); see (1) and (2) below and Fig. 4 for examples.

(1) (Predicate focus: "What is Yulia doing?")

L	H	L	H*	L
[yulia	]	[da	mandi	]
Yulia		ASP	bathe	

'Yulia is bathing.'

(2) (Subject focus: "Who is bathing?")

L	H*	L		L
[	yulia	]	[da mandi	]
Yulia			ASP bathe	

'Yulia is bathing.'

Thus, in Manado stressed syllables at the word level are reported as anchor points for phrase-level F0 movements. Word stress is reported to be predominantly penultimate with a number of loanwords exhibiting ultimate stress. The F0 movements at phrase ends are furthermore determined by polar/echo questions (rise), information questions (fall), encliticized intonation phrases (rise), and enumerations/exclamations (level). Crucially, no acoustic measurements for the reported observations are given, and no data are provided as an indication of how frequently the contours occur in spontaneous speech.

2. Ambonese

For Ambonese Malay prosody, an AM-based account supported by acoustic measurements of scripted speech from four speakers covered both word-level and phrase-level phenomena (Maskikit-Essed and Gussenhoven, 2016). As for word-level prosody, previous descriptive accounts (Van Minde, 1997) analyzed this variety as having penultimate word stress. No consistent acoustic evidence for this claim was found in the duration, F0 alignment, or spectral tilt of the two final syllables in a word (Maskikit-Essed and Gussenhoven, 2016). The same result was obtained for the phrase level, which led to the conclusion that this language does not make use of pitch accents. Further evidence from

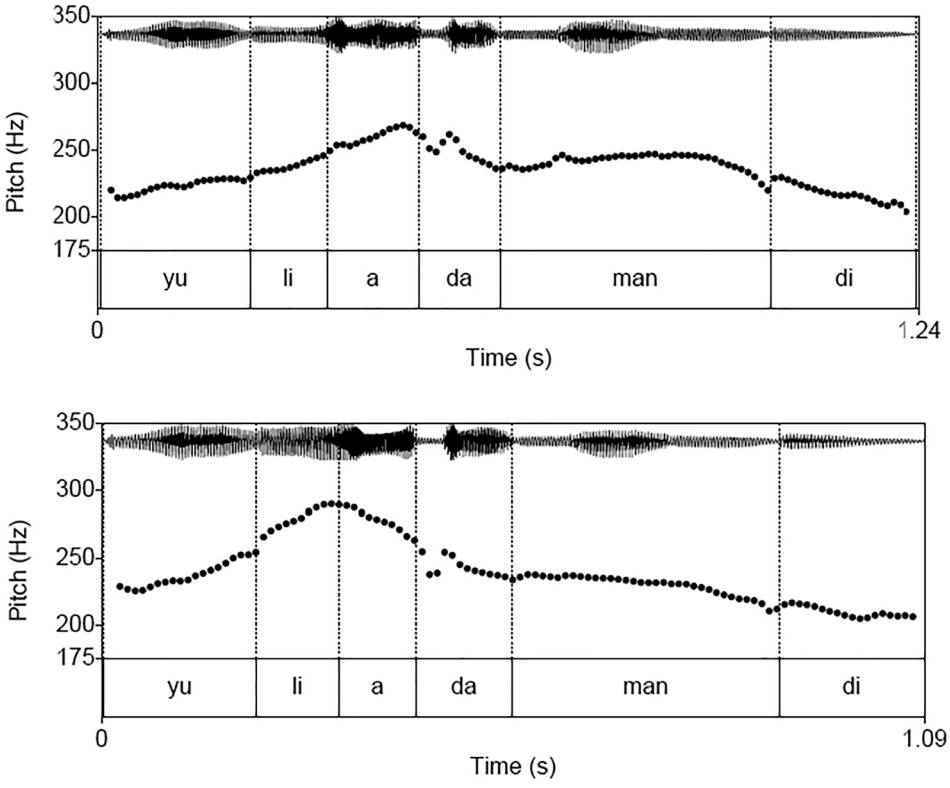

FIG. 4. Example F0 contours for the Manado Malay phrase *Yulia da mandi* ("Yulia is bathing") with predicate focus (top) and subject focus (bottom), from Stoel (2007, pp. 125–126).

F0 range measures indicated no difference between focused and unfocused constituents, suggesting that Ambonese Malay prosody is not used for highlighting (Fig. 5). As for demarcating, two phrase-final contours were distinguished: a rise-fall in discourse-final statements and a rise-rise in non-discourse-final statements and questions. Finality was also marked by means of lengthening the final syllable in the phrase.

3. Papuan

Papuan Malay phrase prosody has been investigated by means of RPT (Cole and Shattuck-Hufnagel, 2016) carried out by native speakers (Riesberg *et al.*, 2018). In this transcription task, participants had to mark prominences and boundaries for a number of phrases taken from a corpus of spontaneous speech. The analysis was based on agreement ratings between the transcribers. Higher agreement was found for the transcription of boundaries compared to those of prominences. This outcome led to the conclusions that prominence might not be a relevant concept in Papuan Malay, and the main function of its phrase prosody is demarcating. It was also predicted that this language does not have word stress based on the assumption that phrasal prominence coincides with word prominence. This conclusion would fit with the analysis of Ambonese Malay (Maskikit-Essed and Gussenhoven, 2016), in which acoustic evidence was only found for phrasal boundary tones. However, the word prosody of Papuan Malay shows consistent evidence of word stress in several acoustic cues (e.g., duration, vowel quality, and spectral tilt) except F0 (Kaland, 2019). This outcome is in line with the stress claim in the descriptive grammar by Kluge (2017), namely, that word stress is regularly penultimate except when that syllable contains /ɛ/, in which case stress is ultimate. It should be noted that phrase-final syllables were excluded in Kaland (2019), leaving open the question of whether word stress affects phrase-final F0 movements. Subsequent perception experiments have shown that stress patterns can facilitate word recognition to some extent (Kaland, 2020), indicating the relevance of word prosody in Papuan Malay.

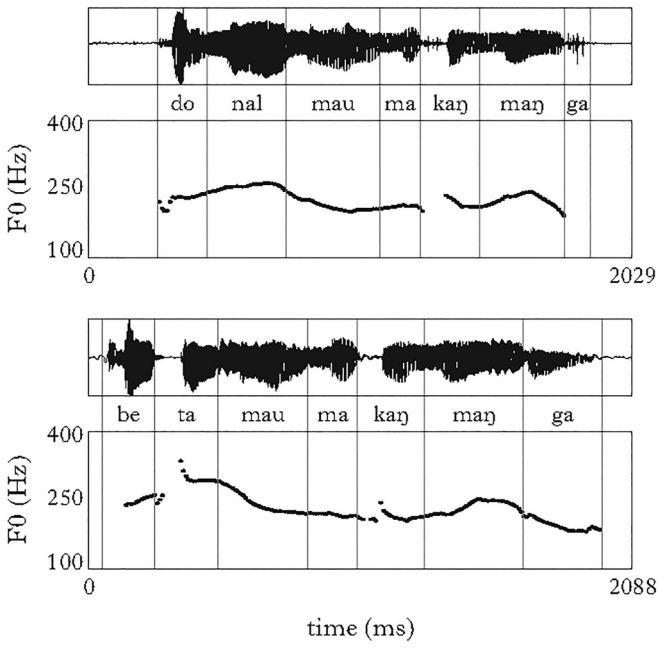

FIG. 5. Example F0 contours for the Ambonese Malay phrases *Donal mau makang mangga* ("Donald wants to eat a mango") and *Beta mau makang mangga* ("I want to eat a mango") with *mangga* in focus (top) and post-focus (bottom).

The evidence for word stress in Papuan Malay challenges current prosodic accounts of Austronesian languages. A proposal for prosodic prototypes grouped languages based on their geographical location and prosodic characteristics (Himmelmann and Kaufman, 2020). Papuan Malay was tentatively analyzed as the "Java prototype" because of the presumed lack of word stress and the common occurrence of a final rise-fall F0 movement at the phrase level. Other languages that fit this prototype are Javanese, Sundanese, and Madurese. This prototype is further characterized by the occurrence of phrase-final F0 movements on both content and function words. This observation constitutes the evidence for "edge tones," that is, the demarcating function of prosody in these languages. It remains to be seen to what extent the prototypical generalisations just discussed capture the fine-grained linguistic diversity observed in Austronesia. Moreover, when it comes to word prosody, for example, there seem to be substantial differences among the Trade Malay varieties alone (cf. Maskikit-Essed and Gussenhoven, 2016; Kaland, 2019). It is therefore plausible that the phrase prosody in these varieties also exhibits differences. The limited F0 data available for Papuan Malay do not necessarily shed light on this issue. A recent study (Kaland and Himmelmann, 2019) investigated the extent to which repeated words in discourse were prosodically reduced. Although duration showed the expected reduction effects, F0 was unexpectedly higher in second mentions than in first mentions. Neither the narrative style nor any other known characteristics of Papuan Malay prosody could explain these results. The outcomes once more confirm the need for more research on phrase prosody in this language.

Thus, the existing research on Papuan Malay suggests that while this language has word stress, phrase-level prosodic phenomena are restricted to edges. This conclusion fits the outcome that F0 is not a correlate of Papuan Malay word stress (Kaland, 2019) and is compatible with the common observation that F0 marks right phrase edges in Austronesian languages of Indonesia (Himmelmann and Kaufman, 2020); see Fig. 6. Thus, the current state of the research suggests that the prosody of Papuan Malay is highly similar to Wolof (Rialland and Robert, 2001) and Kuot (Lindström and Remijsen, 2005), which challenged typological models of prosody (Sec. I A). The reason for this challenge appears to lie in the assumed anchoring function of phrase-level accents to stressed syllables in traditional AM approaches (e.g., Pierrehumbert and Hirschberg, 1990). Phrase prosody in Wolof and Kuot shows F0 movements that do not necessarily align with stressed syllables, despite

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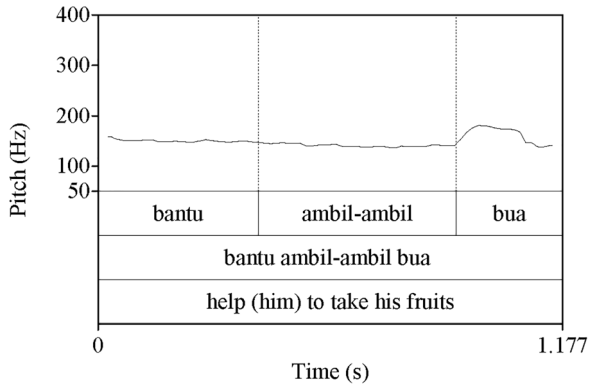

FIG. 6. Example F0 contour of a Papuan Malay phrase taken from the production data of the present study.

their function of marking the right phrase edge. The extent to which such an analysis holds for Papuan Malay needs further research.

C. Research questions

Following the discussion of the literature, there are remaining issues with respect to the functions of phrase prosody in Trade Malay varieties and Papuan Malay in particular. First, recent empirical research suggested that the core function of prosody in these languages is demarcating (Maskikit-Essed and Gussenhoven, 2016; Riesberg *et al.*, 2018). To investigate this hypothesis, the current paper provides a first explorative study of a number of phrase prosodic aspects that are assumed to give more insight into the respective functions. Three aspects are distinguished: (1) the shape of F0 contours, in particular in phrase-final positions; (2) the use of F0 and pausing at phrase breaks (demarcating); and (3) the use of F0 in, and distribution of, different word classes (highlighting). In addition, it remains to be seen to what extent phrase-level prosody interacts with word stress patterns, a possibility that needs to be accounted for given the recent findings on Papuan Malay (Kaland, 2019).

The current study investigates the abovementioned issues using a corpus of spontaneous Papuan Malay speech. Spontaneous speech has the advantage of being more representative of natural language than speech produced in controlled laboratory settings. The disadvantage of the corpus is the need for resource-intensive annotation, in particular annotations at the phoneme level or at the level of discourse structure. The current study is based on the syllable-level and word-level annotations and additional labels for phrase position, word class, word stress, and pausing. It should be noted that word class only provides indirect evidence for focus marking. For a direct investigation of focus, a more controlled data sample is needed. The methodological choices involved in collecting the production data are further explained in Sec. II. Section III provides an interpretation and discussion of the results within the typological literature.

II. PRODUCTION

A. Data collection

Speech was collected in a storytelling task. In this task, speakers were instructed to watch a short video clip and then relay what they had seen to an interlocutor (another native speaker) who had not seen the video. The video clip depicts a short story about a man picking pears. The actors in the video clip do not use any speech. The video clip has been used previously in crosslinguistic studies on narrative production ("Pear Film," Chafe, 1980). Recordings were made at the Center for Endangered Languages Documentation (CELD) in Manokwari, West Papua (Riesberg and Himmelmann, 2012). Participants received instructions about the experimental procedure before the start of the task. The video clip was shown to the participants on a laptop computer and lasted six minutes. Thereafter, participants were introduced to their interlocutor and instructed to retell the story from the video clip. The participant and the interlocutor were seated next to each other during the retelling. The interlocutor was allowed to ask clarification questions during the participant's retelling. This happened up to three times per participant.

No soundproof or silent rooms were available at the recording location. Therefore, recordings were made outside behind a building where background noise was as minimal as possible. The recordings were made using a Sony ECM-MS957 unidirectional stereo microphone connected to a Sony HDR-SR11 portable video camera (Sony, Sony City, Minato, Tokyo, Japan). The microphone was placed in front of the participant and interlocutor and recorded the speech of both. The experimenter supervised the entire recording procedure. The duration of the recordings ranged from two to five minutes ($M = 3.16$ min).

B. Participants

All participants were students at the University of Papua. There were ten male and nine female participants ($M_{age} = 22$ years, age range = 20–28 years old). All were native speakers of Papuan Malay.

C. Data preparation

Audio tracks were extracted from the recordings on the portable video camera and converted to 48 kHz, 16 bit, stereo wave files. Native speakers of Papuan Malay transcribed the participant's speech and segmented it into phrases. The segmentation was carried out at the level of intonation units (Chafe, 1994), corresponding to intonation phrases in the phonological hierarchy (e.g., Nespor and Vogel, 2007). The intonation units were defined on the basis of auditory boundary cues such as boundary tones and pauses. In a previous crosslinguistic comparative study, these boundaries were found to be perceived in highly similar ways by native and non-native speakers (see Himmelmann *et al.*, 2018, for a detailed description of the boundary cues). Thereafter, a group of six labelers annotated all words and syllables produced by the participants for each wave file using Praat

textgrids (Boersma and Weenink, 2017). All labelers received phonetic training on how to set label boundaries by auditory and visual inspection of the wave-form and they were familiar with the syllable structure of Papuan Malay. Phrase lengths varied from 1 to 25 syllables ($M = 7$ syllables/phrase), word length varied from 1 to 5 syllables ($M = 2$ syllables/word), and the word average per phrase was 3.50. Phrases with one syllable were not taken into account in the analysis. This was done in order to be able to distinguish stressed versus unstressed syllables in words (Sec. III 1). Table I provides an overview of the counts per phrase length.

D. Labelling

Furthermore, each syllable was given a label corresponding to its position in the phrase according to a five-way distinction: first, second, medial, pre-final, or final. Although the focus of the analyses in this study is mainly on the final two syllables in the phrase (see Sec. I), a five-way distinction takes into account other potentially relevant phrase positions and allows us to compare the respective positions to each other. The most relevant phrase positions for Papuan Malay are expected to be the syllables at the edges, in particular the rightmost one. Phrase-medial syllables are not necessarily expected to be relevant given the results on phrase prominences and boundaries in Riesberg *et al.* (2018). Nevertheless, phrase-medial positions are taken into account to provide a more complete coverage of the Papuan Malay phrase. These positions are grouped when they are more than two syllables away from either phrase edge. The occurrence of word stress was also labelled for each syllable, based on the stress indications in word lists in Kluge (2017), that is, either penultimate (most frequent) or ultimate.

TABLE I. Count of phrase lengths (in syllables) in the collected data.

Phrase length	Count
2	221
3	221
4	274
5	229
6	263
7	262
8	188
9	165
10	139
11	97
12	79
13	58
14	42
15	32
16	17
17	20
19	6
20	6
24	2
25	2

Additionally, each syllable was labelled for word class, referring to the word in which that syllable occurred. Word-class labels were given in two rounds. First, labels for the most common word classes were taken from the word lists in Kluge (2017), which provide indications of word class for a large set of Papuan Malay words. If words could not be found in these lists, they were labelled by consulting native speakers. Second, a two-way distinction between content words (adverbs, nouns, verbs) and function words (conjunctions, demonstratives, numerals, prepositions, pronouns, question words, tags) was used for labelling. Note that words which translate to adjectives in English are generally expressed by stative verbs in Papuan Malay (Kluge, 2017).

E. Data selection

A subset of the labelled syllables was selected for further analysis of F0 movements on the basis of the following criteria. Syllables in utterances that were interrupted or cut off were omitted. Reduplicated words (e.g., *tiba-tiba*) were omitted, whereas the syllables of single occurrences (e.g., *tiba*) were taken into account. This was done because reduplication could affect the acoustic properties of the reduplicated word and make that word less comparable to single occurrences. The syllables of words produced with hesitation or that were unidentifiable due to laughter, severe speech reduction (i.e., mumbling), or background noise were also omitted. Words containing double vowel sequences were also omitted as these sequences allow two options for syllabification (either as VV or V.V; see Kluge, 2017), which appeared to lead to ambiguous annotations. After applying these criteria, the subset consisted of 10 566 syllables.

F. F0 movement size

For each syllable, several F0 measures were taken from the voiced part of the syllable. This part was determined by Praat (Boersma and Weenink, 2017) using a script. That is, each voiced subinterval consisted of speech material for which Praat was able to detect consecutive periodicity. In cases in which the syllable consisted of more than one voiced interval, the longest would be taken as representative for that syllable. The boundaries of the voiced interval either occurred within or coincided with (one of) the syllable boundaries. For each voiced subinterval, the F0 minimum and maximum in semitones (henceforth ST) and their timestamps were measured. Thereafter, for each syllable the size of the F0 movement was calculated by subtracting the minimum F0 from the maximum F0.

G. F0 movement direction

The direction of the F0 movement was calculated by comparing the timestamps of the F0 minimum and F0 maximum for each syllable. When the F0 minimum occurred before the maximum, the movement was labelled "rise," and when the F0 minimum occurred after the maximum, the

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movement was labelled "fall." Rise-falls within one syllable were rare ($N = 49$) and therefore omitted.

In an additional selection round, two further criteria were applied in order to narrow down the set of F0 movements to those that are potentially meaningful in Papuan Malay prosody. First, only syllables were selected from two-syllable words at the end of a phrase. This was done in order to assess the extent to which word stress patterns affect phrase-final F0 movements. It should be noted that the most frequent word length in Papuan Malay is two syllables (Kluge, 2017 and Sec. II C). Second, F0 movements were selected when they were realized above a perceptual threshold (g_{thr}), measured in ST per second for a given F0 movement duration T, as expressed in the formula $g_{thr}(\mathrm{ST/s}) = 0.16/T^2$ (see 't Hart *et al.*, 1991, p. 32). In this way, F0 movements for which the minimum and maximum lie close together (i.e., no clear movement) were excluded, and the resulting distribution of F0 movements were limited to the ones that were perceptually relevant. The resulting subset that matched these two criteria consisted of 978 F0 movements/syllables.

H. Pauses

Data annotations also indicated for each syllable whether that syllable occurred before a silent pause. Silent pauses were defined as breaks in the speech material in which the speaker did not produce speech sounds. Two types of pauses were distinguished: those that occurred within phrases and those that occurred between phrases. Pauses due to hesitation or turn-changes with the interlocutor (Sec. II A) were omitted.

I. Analyses

This section describes the statistical analyses carried out on the data extracted from the corpus and are divided according to which aspect of phrase prosody they test (shape, demarcating, highlighting). All statistical analyses were carried out in *R* (R Core Team, 2019). Linear mixed model analyses (LMMs) fit by maximum likelihood (using Satterthwaite approximations to degrees of freedom to calculate *p*-values) were carried out using the "lme4" package (Bates *et al.*, 2015). Pairwise comparisons were carried out using the "multcomp" package (Hothorn *et al.*, 2008). For clarity, all predictors in the statistical analysis are reported in the text using SMALL CAPS.

1. Shape

As for the tests concerning shape, the sizes and directions of the F0 movements in phrase-final positions were investigated, in particular, to the extent they are influenced by word stress placement. F0 alignment was not taken into account due to the lack of segment-level annotations. That is, the available syllable boundaries only give a limited insight into peak alignment, failing to capture potential fine-grained differences in alignment with varying segmental material.

A LMM was carried out with F0 MOVEMENT SIZE as response, with PHRASE POSITION (five levels: first, second, medial, pre-final, final) and STRESS (two levels: stressed, unstressed) as predictors and with participants and items (words) as random intercepts and slopes. *Post hoc* pairwise comparisons using the Tukey honestly significant difference (HSD) test (Bonferroni corrected) were performed between all PHRASE POSITIONS. In addition, chi-square tests were performed on the distribution of rises and falls in the two final syllables in the phrase. This was done in three separate tests. In one test, the distribution was assessed for the entire dataset. In the other two tests, the position of word stress (penultimate, ultimate) was taken into account, and therefore the dataset was limited to two-syllable words.

2. Demarcating

Concerning the demarcating function, the tests asses the relationship between phrase length, pauses, and F0 movements. This enables an investigation of the extent to which pauses and f0 movements play a role in marking prosodic boundaries in Papuan Malay. As for phrase length, pauses circumjacent to longer phrases are expected to be longer due to speech planning times (e.g., Krivokapić, 2007). It can therefore be hypothesized that the longer the phrase, the higher the likelihood of within-phrase pauses. Such a relationship can be explained by planning mechanisms as well, i.e., longer phrases take more speech planning effort, making the speaker more likely to pause during their production. As for F0, there appears to be a relationship to the size of F0 movements and the strength of a phrase break (Choi, 2003). That is, larger F0 movements signal stronger phrase breaks. It can therefore be expected that phrase-final syllables in Papuan Malay phrases show the largest F0 movements compared to other phrase positions.

The demarcating function was assessed in two tests. First, the Pearson correlation coefficient was calculated for the relationship between the probability that a pause would occur within a phrase (pause probability) and PHRASE LENGTH as measures in syllables. Pause probability was calculated by dividing the number of pauses found within a phrase by the number of phrases in the data. This was done for each phrase length; for example, the dataset consisted of two phrases with a length of 24 syllables (Table I). For this phrase length, one within-phrase pause was found, yielding a pause probability of 0.50 (one out of two). Second, LMM was carried out on the data from the final two syllables before a pause ($N = 2165$) with F0 movement size as response, with PAUSE TYPE (two levels: within, between) and PHRASE POSITION (two levels: pre-final, final) as predictors, and with participants and items (words) as random intercepts.

3. Highlighting

As for the highlighting function, it was tested whether F0 movements in pre-final phrase position differ in size from the ones in other positions, taking into account

possible effects of word stress and word class. Given the acoustic evidence for regular penultimate word stress in Papuan Malay (Kaland, 2019), the pre-final syllable can be expected to constitute a prosodically prominent position. Concerning word class, content words are expected to occupy more important positions in the prosodic structure compared to function words. Under the assumption that phrase heads are marked prosodically, the domain is generally defined relative to content words (Jun, 2014, p. 529). It should be noted that all statistical tests involving the five-level factor phrase position were performed on syllables taken from phrases that were at least five syllables in length ($N = 9208$). This avoids ambiguous phrase position labels for the second syllable in a three-syllable phrase (second/pre-final), for example.

Three statistical tests assessed the highlighting function. First, a chi-square test was carried out on the distribution of perceptible rises and falls ($N = 978$; see Sec. II G) in content and function words. Second, two LMMs were performed with F0 MOVEMENT as response, with WORD CLASS (two levels: content, function), PHRASE POSITION (two levels: see description below), and STRESS (two levels: stressed, unstressed) as predictors, and with participants and items (words) as random intercepts. Because STRESS was included as predictor, the dataset was limited to two-syllable words ($N = 6100$). Random slopes were omitted as shown by a lower Akaike information criterion (AIC) when when they were included. It should be noted that the two LMMs differed in how the predictor phrase position was defined. In each LMM, PHRASE POSITION had two levels; in one LMM, PHRASE POSITION compared pre-final syllables with all other syllables in the phrase, whereas in the other LMM, PHRASE POSITION compared final syllables with all other syllables in the phrase. Third, a chi-square test was carried out on the distribution of content and function words in the five phrase positions (first, second, medial, pre-final, final). In addition to the statistical analyses, the occurrence of word classes was computed by means of proportions for each of the five phrase positions. The computation was repeated for each phrase position by dividing the total number of syllables taken from words in a specific class by the total number of syllables. This was done for the proportion of content words (as opposed to function words) and for each of the word classes in Kluge (2017). Word-class distribution may shed light on whether Papuan Malay uses lexical means for highlighting (e.g., focus) such as focus adverbs as reported in Kluge (2017). The lexical information combined with the prosodic investigation in this study may together reveal the relative importance of prosody for highlighting. Furthermore, phrase-final particles in Manado are reported to affect the regular F0 contour of phrases (Stoel, 2007; Sec. I B), reconfirming the importance of word classes for the F0 contour.

TABLE II. Pause counts and mean durations with standard deviation (in ms) per pause type.

	Pause type	
Statistic	Within phrases	Between phrases
Count	158	1717
Duration (*M*,SD)	278.30 (*217.70*)	460.66 (*368.84*)

J. Results

Table II provides descriptive statistics concerning the pause distributions. All descriptive statistics are reported in Table III, while the results of the respective inferential statistics are reported in Table IV.

TABLE III. F0 movement size in ST (*M*,SD) for all contours, rises, falls, content word proportions, and word-class proportions (three most frequent classes in bold) for syllables ($N = 9208$) across phrase positions.

		Phrase position				
Section	Measure	First	Second	Medial	Pre-final	Final
Shape	F0 movement all	1.71 (*2.18*)	1.91 (*2.22*)	1.97 (*2.21*)	2.38 (*2.71*)	3.30 (*3.17*)
	F0 movement rise	1.68 (*2.07*)	2.18 (*2.25*)	2.11 (*2.28*)	2.46 (*2.57*)	3.69 (*3.36*)
	F0 movement fall	1.74 (*2.27*)	1.73 (*2.19*)	1.88 (*2.17*)	2.31 (*2.87*)	3.03 (*3.00*)
Highlighting	Content proportion	0.81	0.82	0.83	0.70	0.66
	Adverbs	**0.13**	**0.12**	**0.14**	**0.19**	**0.18**
	Nouns	**0.20**	**0.18**	**0.24**	**0.18**	**0.15**
	v (other)	0.01	0.02	0.02	0.01	0.01
	v (bivalent)	**0.31**	**0.33**	**0.24**	0.15	0.14
	v (monov. dyn.)	0.03	0.06	0.05	0.04	0.03
	v (monov. stat.)	0.11	0.06	0.10	0.09	0.09
	Conjunctions	0.10	0.06	0.01	0.02	0.02
Highlighting	Demonstratives	0.04	0.04	0.06	**0.20**	**0.20**
	Numerals	0.05	0.09	0.11	0.05	0.05
	Prepositions	0.00	0.00	0.01	0.00	0.00
	Pronouns	0.01	0.01	0.01	0.03	0.03
	Question words	0.01	0.01	0.01	0.04	0.04
	Tags	0.00	0.00	0.00	0.00	0.05

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TABLE IV. LMM results of the effects on F0 movement size.

Section	Response	Predictor	β	SE	df	z/t	p
Shape	F0 movement/pairwise comparisons ($N = 9208$)	Stress	0.14	0.06	4646.84	2.18	<0.05
		First-second	0.24	0.11		2.15	not significant (n.s.)
		First-medial	0.26	0.10		2.72	<0.05
		First-pre-final	0.68	0.11		6.05	<0.001
		First-final	1.68	0.12		14.09	<0.001
		Second-medial	0.02	0.08		0.25	n.s.
		Second-pre-final	0.44	0.10		4.30	<0.001
		Second-final	1.44	0.10		13.85	<0.001
		Medial-pre-final	0.42	0.08		5.30	<0.001
		Medial-final	1.42	0.08		17.28	<0.001
		Pre-final-final	1.00	0.10		9.65	<0.001
Demarcating	F0 movement ($N = 2165$)	Pause type	−1.59	0.36	2107.21	−4.40	<0.001
		Phrase position	−1.10	0.12	2090.44	−9.01	<0.001
		pause type (p.type) * phrase position (ph.position)	0.98	0.52	2020.90	1.89	=0.06
Highlighting	F0 movement: pre-final - other (two-syllable words) ($N = 6100$)	Word class	0.31	0.19	105.54	1.70	=0.09
		Phrase position	0.46	0.11	6068.31	4.13	<0.001
		Stress	−0.28	0.07	5961.49	−4.05	<0.001
		Word class (w.class) * ph.position	−0.48	0.20	6065.64	−2.41	<0.05
	F0 movement: final - other (two-syllable words) ($N = 6100$)	Word class	0.07	0.17	98.80	0.43	n.s.
		Phrase position	1.53	0.12	6015.73	13.00	<0.001
		Stress	0.12	0.07	5883.10	1.66	=0.09
		w.class * ph.position	−0.20	0.20	6074.34	−1.01	n.s.

1. Shape

As for the shape of F0, the results of the LMM showed that STRESS had a significant effect on the size of the F0 movement in that stressed syllables had a smaller F0 movement [$M = 2.09$, standard deviation (SD) = 2.39] than unstressed syllables ($M = 2.19$, $SD = 2.49$). It should be noted that in all pairwise comparisons involving the pre-final or the final PHRASE POSITION, the F0 movement size was significantly larger in those syllables than in the syllable with which either of them was compared (Table IV). This contrasts with the comparisons involving only the first, second, or medial phrase position, which did not always show significant F0 movement-sized differences.

As for the distribution of rises and falls in the final two syllables in the phrase, the most frequent pattern was a combination of a rise and fall on the pre-final and final syllable, respectively (Table V). Separate chi-square tests for WORD STRESS POSITION showed that a rise-fall pattern was dominant for penultimate stress, whereas a fall-rise pattern was dominant for ultimate stress. This became clear from the standardized residuals, which provide a relative measure of whether the observed counts were above (positive value) or below (negative value) the expected counts (Agresti, 2007). For the rise-fall pattern, the standardized residuals were 3.26 for penultimate stress and −1.46 for ultimate stress with only the former exhibiting a distribution that was significantly different from random. It should be noted, however, that only a small number of ultimate-stress cases were available for analysis (i.e., reflecting the natural distribution of word stress in Papuan Malay). Predominant patterns are illustrated in Fig. 7 with example F0 contours from phrases that had either a final rise (discourse continuation) or a final fall (discourse finality).

TABLE V. Results of chi-square tests on the distributions of perceptible rises and falls in phrase positions (pre-final, final) and word classes (content, function). Data are taken from phrase pre-final and final syllables in two-syllable words ($N = 978$).

			Perceptible F0 movement		Statistic	
Section	Data (subset)	Phrase position	Rise	Fall	χ^2	p
Shape	Overall	Pre-final	227	182	13.53	<0.001
		final	248	321		
	Penultimate stress	Pre-final	165	136	10.65	<0.01
		final	147	203		
	Ultimate stress	Pre-final	2	5	2.14	n.s.
		Final	11	7		
Highlighting	Overall	Content	326	353	0.28	n.s.
		Function	149	150		

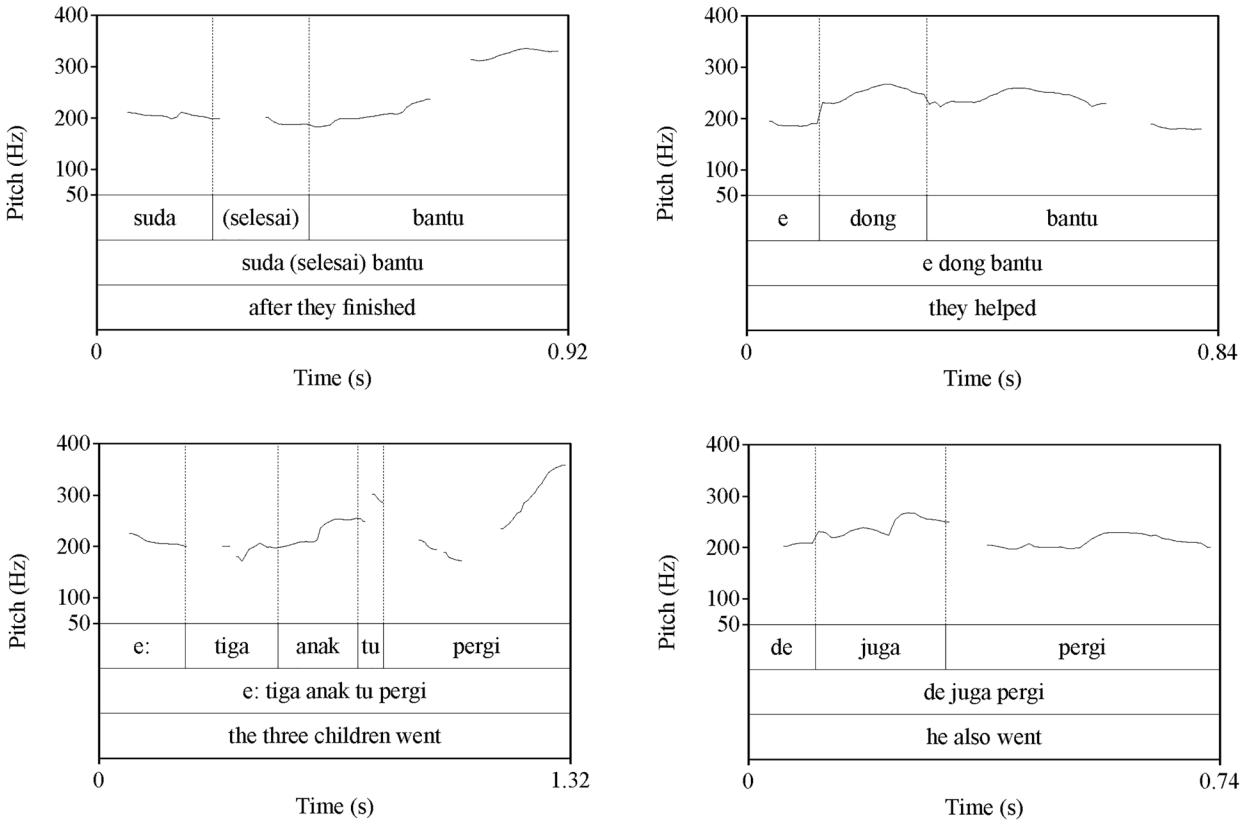

FIG. 7. Example F0 contours for phrase-final two-syllable words with penultimate stress (*bantu* "to help"; left) and ultimate stress (*pergi* "to go"; right) with continuation rises (top) and finality falls (bottom).

2. Demarcating

The descriptive statistics on the pause durations (Table II) showed that pauses between phrases are generally longer than pauses within phrases.

The Pearson correlation coefficient showed that the probability of a within-phrase pause correlated strongly (Evans, 1996) with PHRASE LENGTH: $r = 0.68$, $n = 19$, $p < 0.01$ (Fig. 8).

The LMM showed that PAUSE TYPE affected the size of F0 movements significantly (Table IV) in that they were smaller in pre-final ($M = 1.82$, SD = 1.31) and final ($M = 1.94$, SD = 1.95) syllables before pauses occurring within phrases than they were in pre-final ($M = 2.33$, SD = 2.47) and final ($M = 3.41$, SD = 3.25) syllables before pauses occurring between phrases. These results also showed a significant effect of PHRASE POSITION (pre-final, final) in that pre-final syllables generally had smaller F0 movements ($M = 2.30$, SD = 2.43) than final syllables ($M = 3.33$, SD = 3.21). The interaction between PAUSE TYPE and PHRASE POSITION was marginally significant, indicating a trend in which the F0 movement size difference between pre-final and final syllables was smaller before within-phrase pauses than before between-phrase pauses (see means and standard deviations in this paragraph).

3. Highlighting

The class of content words showed the lowest proportions in pre-final and final phrase positions (Table III). The proportions per word class indicated that in first, second, and medial position adverbs, nouns and bivalent verbs were most frequent, whereas in pre-final and final position, demonstratives, adverbs, and nouns were most frequent.

The LMMs showed no significant effects of WORD CLASS on the size of F0 movements (Table IV). The effect of PHRASE POSITION was significant in each LMM in that both pre-final ($M = 2.36$, SD = 2.71) and final syllables

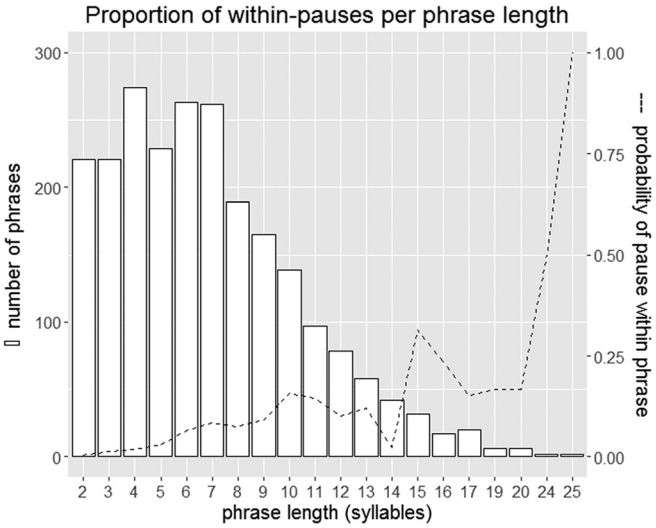

FIG. 8. Probability of pauses within a phrase (dashed line) and number of phrases (bars) as a function of phrase length in syllables.

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($M = 3.36$, SD = 3.26) exhibited a larger F0 movement compared to other syllables ($M_{\text{pre-f}} = 2.12$, SD = 2.44; $M_{\text{final}} = 1.99$, SD = 2.30) in the phrase. STRESS had a significant effect in the LMM comparing pre-final syllables and was marginally significant in the LMM comparing final syllables, in that stressed syllables had smaller F0 movements ($M = 2.07$, SD = 2.41) than unstressed syllables ($M = 2.21$, SD = 2.52). The interaction between PHRASE POSITION and WORD CLASS was significant only in the LMM comparing the pre-final syllable with all other syllables in the phrase. These effects showed that F0 movements in pre-final phrase position were generally larger compared to other phrase positions (see also above), and this difference was mainly present in content words ($M_{\text{pre-f}} = 2.66$, SD = 3.00; $M_{\text{other}} = 2.14$, SD = 2.48) rather than in function words ($M_{\text{pre-f}} = 2.12$, SD = 2.28; $M_{\text{other}} = 2.23$, SD = 2.55); see Fig. 9.

The distribution of rises and falls in content and function words was not significantly different from a random distribution (Table V).

K. Conclusions

1. Shape

The results on the shape of the F0 movements showed that they were the largest in pre-final and final phrase positions and a rise-fall pattern was the most common one (see also Figs. 6 and 7 for examples). Taking into account the (asymmetrical) distribution of word stress, further analyses found that the common rise-fall pattern was affected by word-stress placement (most frequent on the penultimate syllable).

2. Demarcating

The results pertaining to the demarcating function of Papuan Malay prosody showed that both the length and frequency of pauses are used to separate phrases from each other. That is, pauses between phrases were longer than pauses within phrases, and the latter were more likely to occur when the phrase was longer. Of note here is the fact that the longer the phrase, the less frequently it occurred in the corpus. This explains the variation in within-pause likelihood for longer phrases shown in Fig. 8. Furthermore, F0 movements were larger before pauses between phrases (i.e., at the end of phrases) than before pauses within phrases, indicating that larger boundaries were marked with larger F0 movements. This effect occurred on both pre-final and final syllables in the phrase, although the effect was larger on the final syllable in the phrase.

3. Highlighting

No evidence was found that the distribution of rises and falls is different in content words and functions words. A difference between these word classes was only found for the overall number of perceptible F0 movements with more occurring on the content than on the function words. As for the size of F0 movements, a difference was found between content and function words when the phrase position was taken into account. That is, syllables in content words occurring in pre-final phrase position had significantly larger F0 movements compared to when they occur in other phrase positions. As this difference did not appear for function words, and the effect of word stress was taken into account in the statistical analysis, this result indicates that Papuan Malay phrase prosody may perform a highlighting function. In particular, when the distribution of content and function words in the respective phrase positions is taken into account (Table III), it becomes clear that content words do not appear as frequently in these positions as in others. This is most likely caused by the use of demonstratives in phrase (pre-)final positions, which do not occur frequently elsewhere in the phrase (Table III). Demonstratives are markers of pragmatic focus in Papuan Malay (Kluge, 2017) and other languages (Diessel, 1999). Given these two observations, it can be concluded that the (pre-)final phrase position constitutes a marked location for content words.

4. Post hoc analysis

It is of note that F0 movements turned out to be smaller for stressed syllables in two of the analyses discussed above.

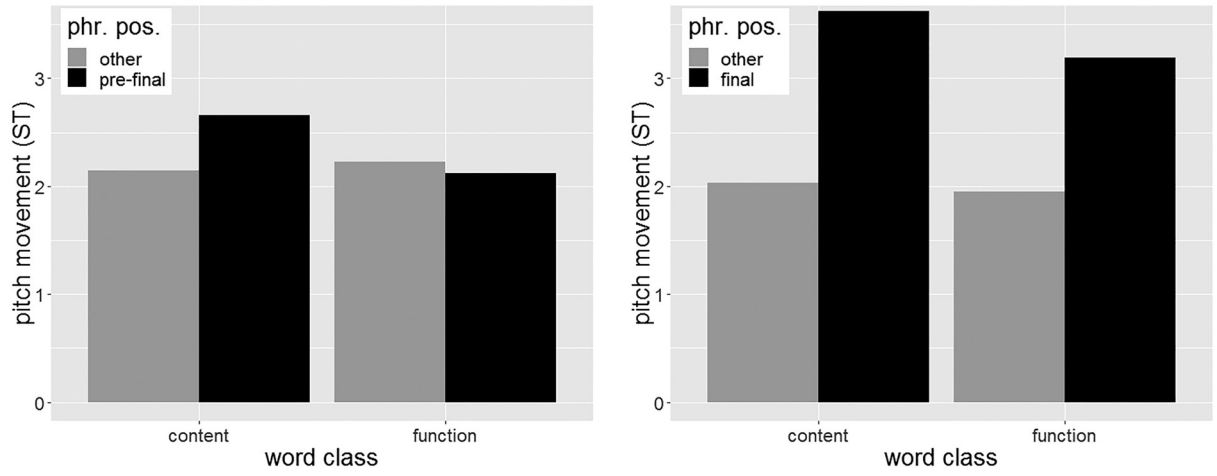

FIG. 9. F0 movement (ST) for content and function words in pre-final (left) and final syllables (right) compared to all other syllables in a phrase.

The outcome is somewhat surprising given that F0 was reported as the weakest correlate of word stress in Kaland (2019). To shed more light on this result, a *post hoc* analysis was carried out, which replicated the linear mixed model described in Sec. II I 1. This model was run on the same subset used for the direction of perceptible rises and falls (Table V), that is, the contours that correlated with stress placement. In the *post hoc* analysis, the effect of word stress did not appear to have a significant effect on the size of the F0 movements [$\beta = -0.12$, standard error (SE) = 0.31, degrees of freedom (df) = … 0.40, not significant (n.s.)]. To conclude, the direction of F0 movements in pre-final and final phrase positions appeared to correlate better with word stress than movement size. In this respect, it is worth noting that excursion size was shown to be more illustrative of phrase-level phenomena (e.g., Table III). Thus, the *post hoc* analysis hints at an intricate relationship between F0 and word stress (movement direction, weakly) on one hand and F0 and phrase prosody (movement size, strongly) on the other hand.

III. GENERAL DISCUSSION AND CONCLUSION

This study confirmed earlier accounts of Trade Malay prosody which reported that the main prosodic events occur at the right phrase boundary. The acoustic analyses showed that in Papuan Malay, the final two syllables of the phrase stand out in terms of F0 and correlate with the length of an upcoming pause. The acoustic analyses further show that the F0 rise in pre-final position may be a marker of (prominent) content words, correlating with the regular penultimate word stress pattern. The F0 movement on the final syllable, however, appeared to correlate more strongly with the length and type of pauses. Although in terms of shape the final two syllables might act as one, support for highlighting was mainly found on the pre-final syllable, whereas evidence in support of demarcating was stronger in the final syllable.

The current study provides limited support for a highlighting function based on the distribution of word classes and their potential interaction with F0 movements. Compared to other phrase positions, the final two syllables were proportionally less likely to be from content words due to the frequent use of demonstratives in these positions. The larger F0 movements on content words compared to function words in phrase pre-final position suggested that phrase-final syllables provide a rather marked position for content words. In this respect, Papuan Malay can be seen as similar to the Eastern prototype proposed in Himmelmann and Kaufman (2020). That is, function words in this prototype are reported to not be prominently realized. It is, however, remarkable that in the current study demonstratives, which are assumed to have a highlighting function, did appear frequently in phrase-final position. Thus, when assuming that the final two syllables in the Papuan Malay phrase hold are highlighting positions, highlighting can be achieved in different ways. For functions (i.e., demonstratives), their frequent lexical occurrence in these positions could be seen as a means of highlighting, whereas for the relatively infrequent content words, a larger-sized F0 movement could be seen as a means of highlighting. Although these observations are based on all kinds of discourse contexts taken together, they seem to hint at the possibility that if focus were to be marked in Papuan Malay, the phrase-final disyllabic window is the place where it would be done. Although such a conclusion resembles the analysis of Manado Malay prosody, more evidence is needed before it can be confirmed. Finally, it should be noted that the occurrence of phrase-final demonstratives might be the result of a typical narrative style used when re-telling the Pear stories (Chafe, 1994). Therefore, some caution is necessary when interpreting the current results, and different speech styles should be considered in future work.

From a typological perspective, the current results do not immediately provide clarity on the position of Papuan Malay. First, as already suggested in the previous paragraph, the outcomes indicate that Papuan Malay matches the features of the Eastern prototype better than those of the proposed Java prototype. This would imply the existence of substantial differences in the prosody of Trade Malay varieties, as discussed in Sec. I, and would counter the assumption that all Trade Malay varieties adhere to a common prototype. As the current study shows, the division of languages according to the proposed prosodic prototypes may be too coarse grained, in particular, given the limited empirical research available to date. Second, within the context of the typological models of prosodic prominence, the current study shows once more that stressed syllables at the word level do not automatically receive phrase(-medial) pitch accents. Support for this outcome comes from the observation that acoustic cues can fulfil separate functions. F0 is a weak correlate of word stress in Papuan Malay phrase-medially, although at the right phrase edge this cue appears to be the main marker of boundaries and correlates with word stress to some extent. Thus, at least some interaction between the word level and phrase level seems possible. Therefore, it cannot be claimed that "intonation ignores stress" as in Kuot (Lindström and Remijsen, 2005). In Papuan Malay, the interaction appears to be limited to phrase-final positions; that is, no evidence was found for large F0 movements anchored to stressed phrase-medial syllables (Tables III and IV; Kaland, 2019; compatible with results in Riesberg *et al.*, 2018).

Thus, it is now possible to interpret the outcomes of the current study within the three typological models discussed in Sec. I A. Papuan Malay seems to be an edge-language with word stress according to the model proposed by Jun (2014). However, the strict interpretation of the model (Fig. 1) does not account for this group. This issue was solved for Wolof and Kuot by grouping them with head-languages that have a weak macro-rhythm (see Jun, 2014, footnote 5). As for Papuan Malay, the current results also suggest a rather weak macro-rhythm. This is mainly observable from the absence of major phrase-medial F0 movements and similar amounts of rises and falls. It should be noted that in the absence of a discourse structure analysis of

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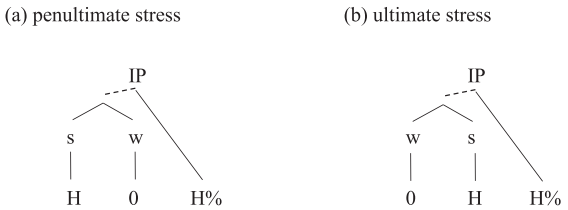
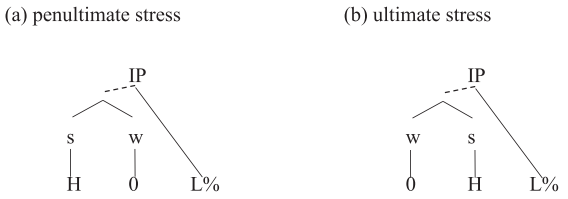
F0, little can be concluded about the existence of an inventory of F0 contours, which would also be needed to assess macro-rhythm in Papuan Malay. The current results suggest that a rise-fall is favored, but this is certainly not the only type of F0 contour (Table V). In the revised model by Lindström and Remijsen (2005), Papuan Malay would belong in the stress-accent column, although it is hard to conclude on the basis of this study that this language does not have pitch accents, as is the case for Wolof (Fig. 2). Although the main F0 movements are often found at the right phrase edge in Papuan Malay, the position of the prosodic head (i.e., stressed syllable) appears to have an influence on the F0 shape. It might therefore be speculated that Papuan Malay F0 movements at the right phrase edge are a hybrid form between a pitch accent and a boundary tone, combined into one phrase-final contour similar to a *phrase accent* as proposed by Grice *et al.* (2000). Finally, in Gordon's (2014) model, Papuan Malay appears to have edge repulsion at the word level (regular penultimate stress), and to some extent this pattern is found at the phrase level as well. However, the evidence for phrase-level edge repulsion is not as clear given that an F0 analysis in terms of pitch accent inventories is lacking for Papuan Malay. In this respect, Papuan Malay phrase prosody could turn out to be similar to Ambonese with only boundary tones at the phrase level. If this were the case, Papuan Malay would end up as an asymmetrical language without pitch accents (the bottom row of Fig. 3), constituting a language category that has not been attested previously (Gordon, 2014).

A tentative autosegmental-metrical analysis could look like those in (3) and (4) below. In these analyses the strength relations are represented by strong (*s*) and weak (*w*) nodes in a metrical tree and take into account the tonal patterns of continuation rises and finality falls (see Fig. 7). Note that in the proposed phonological structures in (3) and (4), only strong nodes are specified for a high or rising tone (indicated by "*H*") and not the weak ones (indicated by "0"), and potential intermediate phonological levels are not visualized (dotted line). Boundary tones (*H%* for rises and *L%* for falls) are directly associated with the intonation phrase (IP). Although there could be a reason to specify weak nodes in future analyses, the current data and the examples in Fig. 7 do not require them. This can be illustrated by the continuation rises when the phrase-final word has ultimate stress [Fig. 7, top, right and (3)(b)]. Here, the steepness of the final rise can be explained when assuming that two *H* tones need to be realized on the final syllable. Such steep final rises are not common, given the infrequent ultimate stress patterns in Papuan Malay, in accordance with the crosslinguistic tendency to avoid tonal crowding (e.g., Gordon, 2014). In addition, the reduction of the stress-avoiding /ɛ/ to schwa makes it plausible to leave weak nodes tonally unspecified. It is important to note that the analyses in (3) and (4) are based on the predominant patterns found in this study and only partially capture the actual variation in the observed patterns (Table V).

(3) Continuation rises



(4) Finality falls



To summarize, the current study has shown that Papuan Malay phrase prosody mainly serves a demarcating function, although some indications that it performs a highlighting function were also found. For more specific analyses, elicitation tasks on a particular type of highlighting (i.e., focus constructions) could give more insight. These are being undertaken at the time of writing, and results are expected in the near future. Furthermore, the prosody of Papuan Malay and the differences observed among its Trade Malay family members suggest that positioning them in a typological framework requires careful empirical investigation, which is most likely beyond the scope of a single study.

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