

Prosodic phrasing, pitch range, and word order variation in Murrinhpatha

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Abstract

Like many Indigenous Australian languages, Murrinhpatha has flexible word order with no apparent configurational syntax. We analyzed an experimental corpus of Murrinhpatha utterances for associations between different thematic role orders, intonational phrasing patterns and pitch downtrends. We found that initial constituents (Agents or Patients) tend to carry the highest pitch targets (HiF0), followed by patterns of downstep and declination. Sentence-final verbs always have lower HiF0 values than either initial or medial Agents or Patients. Thematic role order does not influence intonational patterns, with the results suggesting that Murrinhpatha has positional prosody, although final nominals can disrupt global pitch downtrends regardless of thematic role.

Index Terms: Murrinhpatha, intonation, pitch range, downstep, declination

1. Introduction

Murrinhpatha is a non-Pama-Nyungan polysynthetic language from the Daly River region of northern Australia (Figure 1). Like many other Indigenous Australian languages, it has flexible word order (see [1], and [2] for a general overview), with a recent psycholinguistic study confirming that Murrinhpatha has no default, underlying syntactic order for agent, patient and verb ([3]). In this paper we analyse phrasal intonation patterns produced by Murrinhpatha speakers from the same study to see whether this apparent lack of configurational syntax translates into prosodic flexibility in terms of intonational phrasing.

With perhaps the exception of various studies on Jaminjung (e.g. [4], [5]) the focus of previous work on intonation in Australian languages has tended to be on the interaction between prosody and information structure (e.g., [6], [7], [8]), with very little quantitative investigation of prosodic patterning associated with word order variation more generally. This study therefore has implications for our understanding of the interaction between post-lexical prosody and syntactic structure in Australian languages more broadly.

Whilst it is widely acknowledged that syntax has an influence on intonational phrasing, it is also generally accepted that it is mediated by prosodic structure [9, 10]. As shown in Australian languages with associated intonation system analyses, the intonational phrase boundaries and clause boundaries typically align (see [11] for a general overview). However, some important exceptions have been observed in languages like Wubuy [12] and Dalabon [13], where there can be a mismatch between prosodic phrasing and grammatical word hood. Other

languages can show a high level of prosodic integration of complex verbal elements, particularly in highly agglutinative polysynthetic languages such as Bininj Kunwok [14].

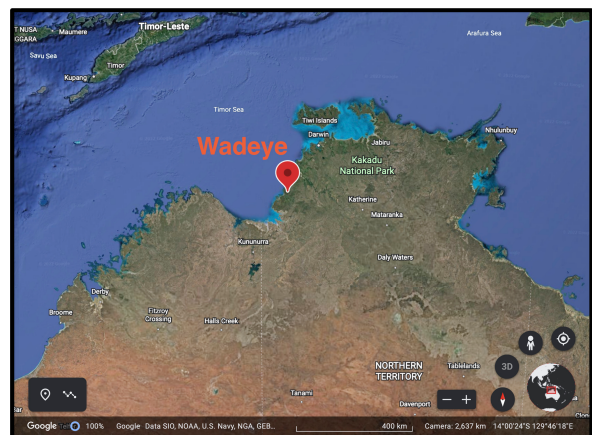


Figure 1 Map of Northern Australia showing Wadeye where Murrinhpatha is predominantly spoken.

Various features of Murrinhpatha phrasal prosody have been described previously in [15]. Nominals are usually realised in separate prosodic phrases. Verbal elements that combine with subject or object elements show flexible order and can be realised as multiple prosodic phrases i.e. there is a degree of prosodic and syntactic independence. This fits well with the core finding reported in [3], that there is no underlying default order for thematic roles in Murrinhpatha. It also suggests that regardless of participant order, we will observe the normal varied patterns of prosodic or intonational phrasing that are found in studies of narrative discourse for other Australian languages [4, 14, 16], with no particular pattern associated with either Agent- or Patient-initial or -final order. It is further predicted that pitch downtrends and phrasal contours will reflect commonly observed patterns in other Australian languages. For example, it has been shown that, regardless of word order, there is default “positional” prosody whereby the first constituent bears the highest f0 target in a sequence of intonational phrases [11, 16], and subsequent normal downtrends (i.e. pitch declination) across the rest of the utterance are observed. If positional prosody is the norm, then we would not expect to see any major deviation from this pattern among the different thematic orders. On the other hand, previous investigations of word order variation in Australian languages have revealed evidence of local pitch range reset in final nominals when they are realised as separate intonational

phrases (e.g. [13], [16]). It is therefore also important to consider intonational phrasing patterns and their interaction with pitch range trends. In general, the intonational typology of the language appears to be phrasal with strongly delimitative edge-marking pitch patterns.

2. Method and Materials

2.1. Participants

The corpus was recorded in Wadeye in the Northern Territory across three fieldtrips in 2016 and 2018 as part of a previous sentence production experiment [3]. The dataset described here is a subset of the original corpus and includes 637 utterances from eighteen adult speakers of Murrinhpatha (8 males, 10 females). Murrinhpatha is the first language for all participants.

2.2. Materials and Procedures

Participants were asked to describe 48 pictures of various transitive events that were presented on a laptop, interspersed amongst 96 fillers (mostly depicting intransitive events). Agent and patient humanness (+/- human) was manipulated in a 2x2 design. Two examples of pictures used in the original study are shown in Figure 2.



Figure 2 Example of two pictures used in the naming task

Pictures were randomized and presented to participants across four blocks. Each picture was mirror-reversed such that the agent appeared to the left for half of the participants and to the right for the other half. A portable eye-tracker attached at the bottom of the screen captured their eye-movements (for more details see [3]), and participants’ verbal descriptions of the actions in each picture were recorded using a Zoom H4n recorder.

2.3. Data processing and analysis

The data analyzed in this paper were chosen based on the quality of the original recordings. The recorded speech files were transcribed and glossed orthographically in ELAN and coded for thematic word order e.g. Agent – Verb – Patient (AVP) or Patient – Verb – Agent (PVA) by the third author. Annotated files were exported from ELAN into Praat, and word and phoneme-level segmentation was performed using the Montreal Forced Aligner [17]. A hierarchical database was constructed using the EMU speech database management system [18] using tiers for utterance, word, thematic role, phoneme, and intonational tone target. Each utterance was annotated manually using an adaptation of a simple Autosegmental-Metrical model of intonation, where peaks in the f0 contour were labelled H* and obvious troughs or terminal points of falling tunes at the right edge of a word or group of words was labelled L% [19] denoting an Intonational Phrase (IP) boundary.

Obvious downtrends were captured using the ! diacritic to represent downstepped !H* pitch accents. The majority of right-edge demarcative pitch movements at intonational phrase (IP) boundaries in the dataset were falling (H* L%), in keeping with earlier observations of Murrinhpatha phrasal prosody [15]. Other right boundary contours that were mid to high level (H* H%) were also sometimes observed in utterance-medial positions. There were also many cases of minor intonational phrases (iP) that had either falling (H* Lp) or level tunes (H* Hp). Minor intonational phrases show a smaller degree of juncture than major IPs but observable pre-boundary lengthening and a pattern of downstep within the major IP. Pauses were also annotated. These only occurred between IPs.

An example of an annotated f0 contour from the corpus is shown in Figure 3. The utterance shows an example of Agent-Verb-Patient thematic role order and is produced in two major intonational phrases separated by a pause. The first intonational phrase (IP) illustrates a clear downtrend from the Agent to the verb complex, which also shows localized downstep between the first and second pitch accents. There is a pause after the verb complex and an upwards pitch range reset for the final intonational phrase that includes the Patient.

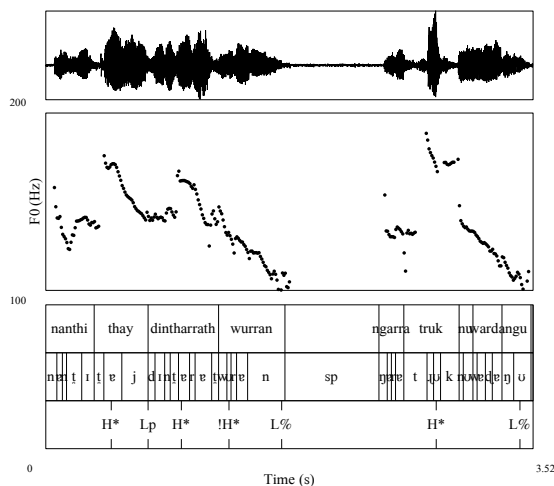


Figure 3 F0 contour showing downstep in the first intonational phrase produced by a male Murrinhpatha speaker for an AVP order utterance:

Nanthi thay dintharrath=wurran || ngarra truk-nu-warda-ngu
 CLF:THING tree 3sgS.nFut.fall on=3sgS.nFut.go LOC truck-DAT-NOW-DM
 “The tree is falling onto the truck”

F0 values were extracted for the highest f0 targets associated with pitch accents within each IP or iP akin to a ToBI-style HiF0 measure. They were converted to semitones using a 50 Hz benchmark and were normalized as z-scores to enable comparison across male and female speakers. Patterns of intonational phrasing were also noted for each utterance in relation for different thematic orders, as well as patterns of pausing. The normalized f0 values were included in a mixed effects model with fixed factors: Part of Speech (agent, patient, verb) and word order pattern with random effects of speaker and word, using *lmer* and *step* in R [20]. Post-hoc Tukey tests using the R package *emmeans* were used to investigate any interactions more closely.

3. Results

3.1. Thematic role distribution

Table 1 summarizes the distribution of thematic role orders in the subset of data analyzed in this paper. In keeping with the results reported in [3] for the full corpus, Agent-initial word orders were the most common, followed by Patient-initial word orders. The full corpus contained all possible combinations of word orders except for VPA [3].

Table 1. *Word order distribution.*

Word Order	Number
AVP	306
APV	123
PVA	61
PAV	54
AV	33
PV	49
VAP	9
Total	637

3.2. Pitch range

Figures 4 and 5 plot the highest normalized f_0 target values associated with H* accents (i.e. HiF0) across each thematic component for the dominant utterance types: Agent – Verb – Patient (AVP) and Patient – Verb – Agent (PVA). For both thematic role orders, it is clear that the initial element, regardless of whether it is an Agent or Patient, contains the pitch accent with the highest f_0 value (HiF0) for the utterance. There is a statistically significant interaction between part of speech and participant order ($F=9.1423$; $p<0.0001$).

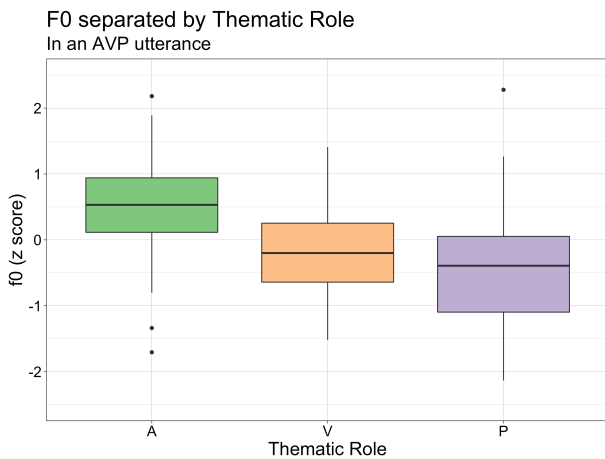


Figure 4 *Normalized f_0 values for the highest f_0 targets (H*) in Agent-Verb-Patient ordered utterances*

In general, utterance-final elements carry lower H* pitch accents than words that are either an initial Agent or Patient. However, the most significant downtrend is from the initial Noun (Agent) to the following Verb (AVP $t=5.378$). This is where most instances of downstep are observed in this frequent word order. The main driver of the interaction between word

order and thematic role appears to be driven by the location of the Verb: Verb-final utterances have lower H* pitch accents regardless of whether preceded by an Agent and/or Patient. In fact, the magnitude of utterance-level (i.e., global) downtrend tends to be greater in Verb-final utterances, as shown in Figure 6 for APV sequences, and a similar pattern is observed in PAV word order (APV $t=5.34$ $p<0.0001$; PAV $t=5.318$; $p<0.0001$). In PV and AV word orders, there are also trends in the same direction (e.g. PV $t=3.54$ $p<0.07$), but the differences are not statistically significant. This is probably because speakers often produce these utterances with a lot of intervening or following material, given the free nature of the speech task.

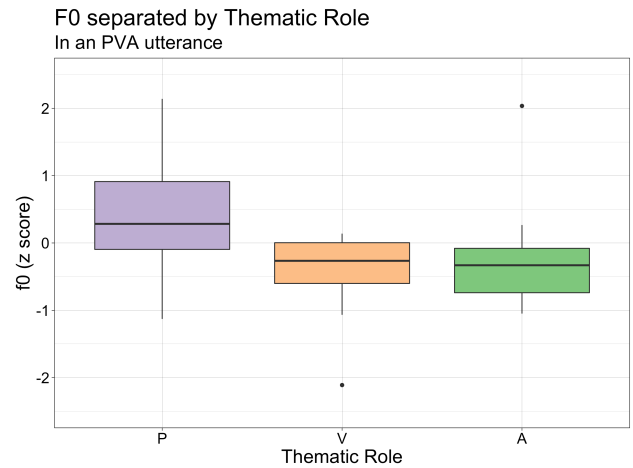


Figure 5 *Normalized f_0 values for the highest f_0 targets (H*) in Patient-Verb-Agent ordered utterances.*

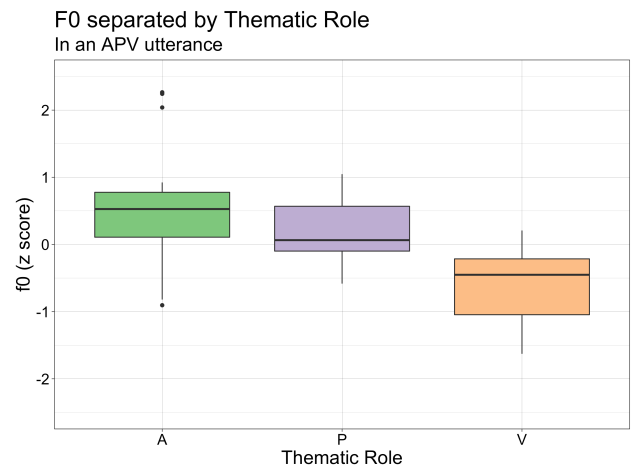


Figure 6. *Normalized f_0 values for the highest f_0 targets (H*) in Agent-Patient-Verb ordered utterances*

3.3 Intonational Phrasing

A complex picture emerges when intonational phrasing patterns are examined. Given the relatively free nature of the task, a range of different intonational phrasing patterns are observed as one would expect. Table 2 summarizes some key observations for a portion of the dataset for those utterances that have both Agents and/or Patients. Column 1 documents the proportion of

utterances where the final A, V, or P is realized as a separate major IP with final pitch reset, whereas column 2 shows the proportion of cases where the first two constituents are grouped into a major IP.

Table 2. *Intonational phrasing distribution and Thematic Role order for utterances including Agents and/or Patients*

Order	Final Pitch reset of A,P, or V – separate IP (%)	Grouping of first two constituents (%) into IP
PVA	40	75
AVP	66	77
APV	44	47
PAV	25	35
VAP	25	25
AV	7	26
PV	17	50

Verb-medial utterances (i.e., AVP or PVA) group the Verb with the initial Agent or initial Patient into a major intonational phrase (IP) in 77% and 75% of cases, respectively. In the remaining 23% or 25% of utterances, the A, V or P elements are realized as either separate IPs, or iPs within a single IP depending on the speaker. For the cases where either the A or P groups with the following V, the A and V or P and V are also sometimes realized as separate minor iPs within the major IP. Pre-boundary lengthening is usually observed in the IP-final syllable that marks the right edge of the Agent or Patient +Verb complex and there is also an optional pause in many cases (29% for AVP, 20% for PVA utterances). A local downtrend is often observed within the initial IP with Verbs that are part of the same major IP, typically bearing a downstepped !H* pitch target or showing a pitch downtrend (as reflected in the example in Figure 3, and shown in the overall f0 target plots in Figures 4 and 5). Thus, there appears to be a degree of prosodic cohesion, as evidenced by the downtrend patterns within the A+V or P+V IPs *regardless of thematic role* for AVP and PVA utterances.

In addition, the final element in verb-medial utterances (either a P or A) is often realized as a separate major intonational phrase in 40% and 66% of cases respectively (Table 2, column 1). This occurs regardless of whether there has been initial grouping of the AV or PV as discussed above. In these cases, the pitch topline (HiF0) of the final IP is marginally lower or at the *same level* as the HiF0 of the initial major intonational phrase of the utterance, i.e. where the typical global declination pattern is disrupted. An example of this is the contour illustrated in Figure 3, where the speaker has emphasized the final noun and produced the utterance-final Patient in an expanded pitch range that results in a HiF0 (H*) value that is equivalent to the HiF0 value on the initial Agent. The rest of the cases analyzed in this subset of data follow predictable global downtrend patterns, i.e., there is declination across the entire utterance.

For less frequent utterance types that include both thematic roles, more variation is observed with a range of different phrasing patterns produced. Interestingly, in 47% and 35% of PAV and APV utterances, final verbs are grouped together with the preceding thematic role (Agent or Patient) into a single intonational phrase, with the A or P realized in a separate initial IP. Pre-boundary lengthening of IP final syllables and pausing between major phrases are observed in many cases but the A

and P often have a similar HiF0 value and we do not observe a strong pitch downtrend across the two. By contrast, final Verbs are often realized with a significantly lower HiF0 than preceding constituents (as shown in Figure 6 and as confirmed statistically). In the relatively rare VAP pattern (9 in this subsection of the original corpus), speakers tend to produce all three constituents as three separate major or minor intonational phrases. This is also more likely to be the case in PAV utterances. For utterance-types that consist of an Agent-Verb (AV) or Patient-Verb (PV) sequence, there are also a variety of intonational patterns as speakers often inserted a degree of extraneous material in their utterances, giving rise to multiple phrasing patterns. In PV and AV utterances, for example, 26% and 50% are produced as a single IP (Table 2, column 2) with the rest produced as separate IPs. In the shorter PV and AV utterances final verbs are usually produced in a lower overall pitch range similar to other verb-final word orders.

4. Discussion

The Murrinhpatha speakers analysed in this preliminary study produce a variety of intonational phrasing patterns regardless of thematic word order, showing that in the same way as there is no underlying default word order in Murrinhpatha [3], there is no predictable intonational phrasing pattern that reflects one thematic order rather than other. Our results also support the claim that syntax and prosody are largely independent in Murrinhpatha [15]. Speakers produce a wide range of intonational phrasing patterns for each participant order type, although the most common thematic orders analysed in this study also show a similar intonational profile in that initial agents or patients are grouped with following verb complexes into major intonational phrases with final patients or agents realised as separate IPs.

Pitch downtrends are largely similar across the corpus regardless of thematic role order. Speakers tend to expand their pitch range for the initial intonational phrase of the utterance regardless of whether the utterance begins with an Agent or Patient. Notably, the lowest HiF0 values are typically registered on Verbs across the dataset, and are clearest when Verbs are utterance-final. Intonational phrases tend to show typical downtrends, particularly in APV word order with final Verbs realised with lower HiF0 targets than final Patients in AVP order, for example. Conversely, in AVP and PVA utterances, there are clear downtrends between the Agent or Patient to the Verb, but these are often disrupted when there is a following Patient or Agent. It should be noted, however, that all types of Verb-initial utterances analysed in [3] (i.e. VA or VP orders) were not included in the intonational analysis reported here and should be analysed in any future work.

This quantitative investigation of Murrinhpatha confirms that the language has phrasal prosody with demarcative right-edge pitch movements that are largely falling, as suggested in [15], although we also observe mid-level tunes in utterance medial contexts. Like many other Australian languages whose intonation systems have been quantitatively analyzed so far, Murrinhpatha prosody is indeed “positional” in that utterance-initial IPs typically utilise the widest pitch range of an utterance. Speakers can elect to manipulate both phrasing and pitch range downtrends when there are final nominals, but this appears to be largely independent of participant role.

5. References

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