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THE DECLARATIVE INTONATION OF DYIRBAL

AN ACOUSTIC ANALYSIS

HEATHER B. KING

A thesis submitted as partial requirement for the degree of Master of Arts of The Australian National University.

November 1994
Except where stated otherwise, the contents of this thesis are my own work.

Heather B. King
Hobart
November 1994
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Supreme Cognitive Principle
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CHAPTER 1

INTRODUCTION

Intonation in Australian Aboriginal languages has, to date, received scant attention. This thesis, which presents a quantified analysis of Dyirbal declarative intonation phrases, goes some way towards redressing the imbalance.

1.1 AIM

The aim of this thesis is to analyse and describe the intonation contours of declarative utterances in Dyirbal and then to establish the relationship between the intonation and the communicative structure. Spectrographically derived measurements have been obtained from 187 intonation phrases extracted from five texts of natural speech. The basic tenets of Pierrehumbert's intonation model [1987] have been applied to the data in order to ascertain the constructs required to describe the declarative intonation of Dyirbal.

Although this thesis is an instrumental analysis of intonation, I have attempted to present it in such a way as to be comprehensible where possible to those with an interest in Australian Aboriginal languages but who have little or no training in acoustic phonetics.
1.2 ORGANISATION OF THE THESIS

In this introductory chapter I discuss intonation in general and its relationship with stress. This is followed by a brief description of the Dyirbal language and of the texts and speakers involved in this study. Chapter 2 is devoted to a brief survey of past works on intonation, the paucity of studies in the prosody of Australian Aboriginal languages and a discussion of the model selected to describe the intonation of Dyirbal.

The methodology used in this study is documented in Chapter 3. Chapter 4 presents the results of the analysis and a detailed discussion of each aspect of Dyirbal declarative intonation. The relationship between the intonation and the communicative structure of Dyirbal is examined in Chapter 5. The final chapter summarises the findings.

1.3 INTONATION

The term intonation refers to the systematic rhythmical changes in pitch discernable in a speaker's utterance. Cruttenden [1986: 9] describes it as involving "... the occurrence of recurring pitch patterns, each of which is used with a set of relatively consistent meanings, either on single words or on groups of words of varying length". The following two examples of the utterance She only wants to help illustrate how the differing pitch patterns convey different meanings (the ' indicates accented syllables):

<table>
<thead>
<tr>
<th>She</th>
<th>ly</th>
<th>to</th>
</tr>
</thead>
<tbody>
<tr>
<td>ón</td>
<td>wânts</td>
<td>lp</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hé</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>She</th>
<th>ly</th>
<th>to</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ón</td>
<td>wânts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hé</td>
</tr>
</tbody>
</table>

"The reference line is the same in both: She -ly to. But the contrast in "mood" between the low-pitched accents and the high pitched ones is striking. The first might be used to soothe someone who has misunderstood the woman's motives. The
second, especially if accompanied by any trace of gruffness, is more like a reprimand or at least is "telling" rather than "persuading"" [Bolinger, 1986: 24].

All known languages employ intonation to some degree, however, its use is limited in tone languages and most pitch-accent languages. Intonation is perceived by a listener as an interplay between pitch, length and loudness. These features combine to make certain syllables more prominent than others in an utterance. A listener's perception of a particular intonation pattern is determined by which syllables receive prominence, how that prominence is achieved and the degree of prominence placed on those syllables. The manner in which there is movement from one prominent syllable to another is also important to a listener's perception.

1.3.1 Intonation and stress

Stress is a term which has been used in many, and often confusing, ways. In this thesis I follow Bolinger [1958, 1986] who claims that stress is a lexical abstraction which has no realisation in actual speech and that the term stress is useful only to describe the potential for accent within lexical items. The stressed syllable, then, is the one which can be made prominent whenever the word is emphasised and thus has the potential to be accented in an utterance. Stress, therefore, could be considered the abstract framework on which intonation is built, as accents are only assigned to those syllables which are considered to possess lexical stress.

1.3.2 Fundamental frequency

1.3.2.1 The production of fundamental frequency

What listeners perceive as a change in pitch is, in acoustic terms, a fluctuation in fundamental frequency brought about, principally, by a change in the rate of vibration of the vocal folds (also known as cords). This vibration results from the activity of the laryngeal musculature and in conjunction with the airflow from the lungs. When the vocal folds are approximated, they form a resistance to the flow of air from the lungs which
causes an increase in subglottal pressure. The vocal folds are forced apart when the subglottal pressure is high enough to overcome the muscular force holding them together. Once the glottal opening (and thus the airflow) has reached its maximum, it begins to narrow again causing an increase in the velocity of the airflow. The pressure between the vocal folds then drops due to the Bernoulli effect, creating a suction effect that snaps the vocal folds together. The vocal folds then return to their initial position before repeating the cycle [Ladefoged, 1967; Lehiste, 1970: 54; Sonesson, 1968; t'Hart, et.al., 1990: 12].

The primary cause of changes in the fundamental frequency has created some contention among theorists. Lieberman [1967, 1977] based his breath-group model of intonation on the theory that changes in fundamental frequency are due to fluctuations in the subglottal pressure of air from the lungs. However, Ohala [1978] cites many works by various researchers whose experimental work provides evidence for laryngeal activity being the primary influence on variations in fundamental frequency and this appears to be the majority opinion. The laryngeal activity involves the lengthening, thinning and stiffening of the vocal folds which causes an increase in their vibration during airflow. The vocal folds run between the cricoid cartilage and the arytenoid cartilage and their tensioning is achieved through a rotation movement of the cricothyroid joint in the larynx caused by the speaker's activation of the cricothyroid muscles. The strap muscles of the neck may be activated to produce very low rates of vibration. Variation in register is brought about by the thinning or thickening of the vocal folds and by the length of open and closed phases in the glottal aperture [Cooper & Sorensen, 1981: 7; Hollien, 1974; Ladefoged, 1967; Pickett, 1980: 91-93; Sonesson, 1968; Strik & Boves, 1992: 22; t'Hart, et.al, 1990: 13].

1.3.2.2 Fundamental frequency and pitch

"The acoustic correlate of vocal fold vibration is the fundamental frequency of the sound wave generated at the glottis" [Lehiste, 1970: 60]. Fundamental frequency (commonly referred to as Fo) is measured in Hertz (Hz) which is the rate of repetition of the complex periodic wave. One repetition of the complex periodic wave correlates to one cycle of the opening and closing of the glottis.

"While fundamental frequency involves acoustic measurement measured in Hz, ... pitch is used as a perceptual term, relating to
listeners' judgements as to whether a sound is 'high' or 'low', whether one sound is 'higher' or 'lower' than another and by how much, and whether the voice is going 'up' or 'down'" [Cruttenden, 1986: 4].

There is not, however, a one-to-one correspondence between frequency and pitch. There can be a change in Fo which does not cause a listener to perceive a change in pitch, and, likewise, a change in perceived pitch which is not associated with a change in the Fo. In terms of Fo, the difference between 200 and 100Hz is identical to the difference between 300 and 200Hz but, in terms of the listener's perception (ie. pitch), they are not. The difference between 200 and 100Hz is perceptually equivalent to that between 400 and 200Hz [Cruttenden, 1986: 4; Crystal, 1969a: 108; Crystal, 1971; Fry, 1968: 374; Lehiste, 1970: 65; Pickett, 1980: 81; Rose, 1989: 58].

Some linguists and phoneticians use the term *pitch* to refer to both fundamental frequency and to (perceptual) pitch. In this study however the above terminology is used; that is, *Fo* to refer to acoustic measurements and *pitch* to refer to its perceptual correlate.

1.3.2.3 **Intrinsic fundamental frequency**

"There is a connection between vowel quality and the relative height of the average fundamental frequency associated with it: other factors being kept constant, higher vowels have higher fundamental frequency" [Lehiste, 1970: 68].

This phenomenon, known as *intrinsic fundamental frequency* (or IFo), has been documented for many languages including English, German, Danish, Serbo-Croatian, Yoruba, Itsekiri, Shanghai Chinese and Thai [Lehiste, 1970: 68-71; Rose, 1989; Thorsen, 1984a; Zhu, 1992]. Lehiste and Peterson, in controlled experiments on English, found that there was a 20Hz difference between the average fundamental frequency of [i] at 183Hz and that of [a] at 163Hz [Lehiste, 1970: 68]. There are many different theories claiming to account for IFo (mostly articulatory) which will not be discussed here. There is also some contention as to whether listener's compensate for (ie. ignore) IFo in their perception of an utterance or whether IFo can serve as some form of perceptual cue [Lehiste, 1970; Rose, 1989; Zhu, 1992].

Preceding and following consonants are also known to influence the average fundamental frequency of a vowel. For example, a plosive such as [b] has a relatively low Fo during the pressure phase. After the release of the
plosive it takes some time for the Fo to reach the target value for the following vowel. [b] actually has a tendency to pull the Fo of the following vowel to a level slightly lower than the target value. The effect on the Fo is quite the opposite with a plosive such as a glottalised [p] for which the vocal folds are tense during the pressure phase. The Fo is relatively high when the voicing begins after the release and it takes some time for the Fo to fall to the target value of the following vowel. In fact the Fo of a vowel tends to be slightly higher than its target value when it is preceded by a [p] [Painter, 1979: 22]. Lehiste and Peterson found that

"higher fundamental frequencies occurred after a voiceless consonant and considerably lower fundamental frequencies occurred after a voiced consonant ... [T]he average peak fundamental frequency of words beginning with the sequence /ti/ was 191Hz, but of words beginning with /di/ it was 180Hz; for /tæ/ and /dæ/, the average values were 175Hz and 158Hz. The influence of an initial consonant could counterbalance the influence of intrinsic pitch" [Lehiste, 1970: 71].

1.3.2.4 Declination in Fo

Declination refers to the decrease in Fo values over the duration of an utterance [Cohen et.al, 1982; Ladd, 1983a, 1984, 1988; Kutik et.al., 1983; Umeda, 1982]. Some intonation models use such terms and/or concepts as downdrift, downstep and downtrend in place of, or in addition to, the term and/or concept of declination [Kohler, 1991a; Ladd, 1990; Pierrehumbert, 1987; Pierrehumbert & Beckman, 1988]. A downward trend in the Fo has been found to occur in so many languages that it has been considered by many linguists to be universal (or at the very least a near-universal) [Ladd, 1984].

There have been many conflicting hypotheses as to the physiological cause of declination which will not be covered here [Lieberman, 1967; Ohala, 1978; Pierrehumbert, 1987; t'Hart et.al., 1990]. Some theorists explain declination as being simply a product of physiological processes however others have attributed varying pragmatic, syntactic and semantic roles to this phenomenon. It has been suggested that declination clarifies the contrast in sentence modes, delineates major syntactic boundaries and allows for relative prominence of accents [Vaissiere, 1983: 57-58].

Experimental evidence suggests that listeners take declination into account when judging the relative accent peaks in an utterance. When
judging two peaks which have equal Fo values, listeners will rate the second peak as being higher [Gussenhoven & Rietveld, 1988; Ladd et.al, 1994; Pierrehumbert, 1979]. See Section 4.3 for further discussion of Fo declination.

1.3.3 Duration and length

It is common (but not essential) for accented syllables to be lengthened in relation to unaccented ones and for varying degrees of accent to involve varying degrees of length. In the following example taken from Bolinger [1986: 15] the first syllable of never is made to stand out by lengthening in addition to a jump in pitch:

```
  ne-e-e-ev
```

said
She she would er put up with anything like that

In some utterances length may be the only cue to what the speaker intends to stand out. For example in

```
I was so-o-o-o co-old
```

the length on cold indicates its importance in the context of the utterance while the length on so serves to emphasise the extreme degree of coldness implied by the speaker. The whole utterance is on a level pitch with only the length indicating the prominence of certain words. Duration is considered second in importance to Fo as an indicator of prominence in those languages which do not use length as a phonemic contrast for segmentals. The term duration refers to the absolute time over which a unit of speech, such as a syllable, is uttered by a speaker. Length, on the other hand, is a term used for how long that unit of speech is perceived to be by the listener. As with Fo and pitch, there is not a direct correlation between duration and length. The perceived length of a vowel may be affected by the influence of the adjacent consonants [Bolinger, 1986: 15-6, 22; Cruttenden, 1986: 2,16; Crystal, 1969a: 108; Lehiste, 1972; Pickett, 1980: 94].
1.3.4 Intensity and loudness

Intensity is the amount of energy present in a sound varied by the fluctuations in the pressure of air coming from the lungs. It is usually measured in decibels (dB) [Ladefoged, 1982: 169].

"If a particle (such as an air molecule) is set in vibratory motion, it oscillates back and forth between two positions that mark the extreme limits of its motion. The maximum displacement of the particle from its rest position is called the amplitude of the vibration" [Lehiste, 1970: 122].

If there is a doubling of the frequency of the particle's oscillation then the distance that the particle must travel is doubled. Thus the particle must travel twice as far in the same length of time and so its velocity is then twice as great.

"[S]ince the average kinetic energy varies with the average square of the velocity, energy will be four times as great. Similarly, if the amplitude of vibration is doubled, the particle must likewise travel twice the distance in the same time, its velocity will be doubled, and the kinetic energy will be four times as great. The intensity of a sound wave thus is proportional to the square of the amplitude times the square of the frequency" [Lehiste, 1970: 122].

"Loudness is 'that aspect of auditory sensation in terms of which sounds may be ordered on a scale running from "soft" to "loud"'" [Crystal, 1969a: 113]. In the following example taken from Bolinger [1986: 15] the first syllable of never is made to stand out by loudness as well as lengthening and a jump in pitch:
Loudness is a function of intensity, $F_o$, duration and the spectral characteristics of the sound.

"The relationship of absolute intensity to perceived loudness is by no means linear (a sound has to be much more than doubled in absolute intensity before it will be heard as twice as loud) and moreover the relationship is different at different frequencies" [Cruttenden, 1986: 3].

Those sounds which have most of their energy in the lower frequencies are perceived as increasing in loudness more rapidly than sounds with most of their energy in the higher frequencies. Moreover the loudness of a complex sound is equal to the sum of the loudnesses of its several components. Thus a sound with a large number of frequency components is perceived as being louder than sounds with fewer components. Also a sound with a short duration must have greater intensity than that of a longer sound for both sounds to be perceived as having equal loudness [Fry, 1968: 384; Ladefoged, 1982: 169; Lehiste, 1970: 112-115].

Intensity and loudness are not included in this analysis. The measurement of intensity presents many difficulties. According to Fry [1968: 385] it is difficult to determine just what ought to be measured.

"Since we are interested in intensity as the correlate of loudness ... we need to know the total amount of acoustic energy arriving at the listener's ear at a given moment, but the question immediately arises as to which moments, or more precisely, how long is the 'moment' to be".

Another problem is the weighting of all the frequencies of the continuously changing spectrum. Should all the frequencies be given equal treatment or should there be some form of normalisation to allow for perceptual factors? The intrinsic intensity of the segmentals also presents difficulties for measurement. For instance, close front vowels have more overall energy than close back vowels and open vowels have more energy still. Voiceless sounds have considerably less intensity than that of voiced sounds. In
addition, the intensity of a vowel varies throughout its duration. The intensity of the vowel is dependent on the formant structure however the initial and terminal frequencies of the formants are determined by the transitions to and from the adjacent consonants [Fry, 1968: 384-385; Lehiste, 1970: 123-124; Painter, 1979: 23]. All the above factors, along with the lack of native speaker judgements on loudness, made it impractical to include the analysis of intensity in a study of this type.

Loudness is considered to be the least important of the three features discussed above (pitch, length and loudness) in the perception of syllables prominence and may also be used for various linguistic purposes, such as shouting with anger. Bolinger [1978: 476] asserts that loudness is "overrated" as a cue to prominence. The results of experiments performed by Fry [1955, 1958] and Streeter [1978], briefly discussed below, support this view.

1.3.5 Fo, duration and intensity

Fry [1955, 1958] tested the three parameters of Fo, intensity and duration as cues for the perception of stress in English. Fry played synthesised tokens of English words such as *contract* which function as both verb and noun and which are differentiated only by the placement of stress. The listener's judgements indicate that duration is a much more effective cue to stress than intensity. These findings are supported by the results of Streeter's experiments.

Streeter [1978] performed perception experiments involving phrase boundaries in which listeners were required to parse controlled (but potentially ambiguous) utterances of English in order to determine the relative importance of the three variables of Fo, duration and intensity. She found that intensity, when used alone as a disambiguation cue, was wholly unreliable - only when combined with appropriate values of segmental duration did it tend towards a more effective cue. The Fo contour and the duration pattern, on the other hand, provided very reliable disambiguation cues but their affects were totally separate.

"In both experiments the effects of pitch (Fo) and duration did not interact, ... it is possible to predict their combined effect by merely adding their separate effects" [Streeter,1978:1588].
The dialects that were spoken in the Mourilyan and Ravenshoe areas are known only as P and A respectively [Dixon, 1991: 185, 188-9].
### TABLE 1.1

<table>
<thead>
<tr>
<th>CONSONANT</th>
<th>BILABIAL</th>
<th>ALVEOLAR</th>
<th>RETROFLEX</th>
<th>PALATO-ALVEOLAR</th>
<th>PALATAL</th>
<th>VELAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLOSIVE</td>
<td>b</td>
<td>d</td>
<td>d</td>
<td></td>
<td>g</td>
<td></td>
</tr>
<tr>
<td>NASAL</td>
<td>m</td>
<td>n</td>
<td>d</td>
<td></td>
<td>p</td>
<td>η</td>
</tr>
<tr>
<td>RHOTIC</td>
<td>r</td>
<td>(flap/trill)</td>
<td>r</td>
<td>(flap)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APPROXIMANT</td>
<td>w</td>
<td></td>
<td></td>
<td></td>
<td>j</td>
<td>(w)</td>
</tr>
<tr>
<td>LATERAL</td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The consonant phonemes of Dyirbal.

### TABLE 1.2

<table>
<thead>
<tr>
<th>PHONEME</th>
<th>ALLOPHONES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilabial plosive</td>
<td>b, p</td>
</tr>
<tr>
<td>Alveolar plosive</td>
<td>d, t</td>
</tr>
<tr>
<td>Palato-alveolar plosive</td>
<td>d, j</td>
</tr>
<tr>
<td>Velar plosive</td>
<td>g, y, g</td>
</tr>
<tr>
<td>Alveolar rhotic</td>
<td>r, r</td>
</tr>
</tbody>
</table>

The allophonic variations of consonant phonemes which occur in the corpus.

### TABLE 1.3

<table>
<thead>
<tr>
<th>PHONEME</th>
<th>i</th>
<th>a</th>
<th>u</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALLOPHONE(S)</td>
<td>i ε e</td>
<td>ʁ</td>
<td>Ω ʉ u o</td>
</tr>
</tbody>
</table>

The vowel phonemes of Dyirbal and the allophones which occur in the corpus.
1.4  DYIRBAL

1.4.1 The language

Dyirbal is an Australian Aboriginal language of North-East Queensland. R.M.W. Dixon published his grammar, *The Dyirbal language of North Queensland*, in 1972. Dixon estimates that Dyirbal was originally spoken by about 5000 people before the European invasion and, when he began to work on the language in 1963, "... there were several score fluent speakers, including a number of children. The language appeared to be in a reasonably healthy state" [Dixon, 1991: 183]. Over the intervening years the number of speakers has declined until, now, less than ten elderly speakers remain. There are also some who still speak a reduced version of the language which was documented in Schmidt's [1985] *Young people's Dyirbal: An example of language death from Australia*.

The Dyirbal language originally consisted of at least ten dialects, each of which had in common with its neighbours around 80-90 per cent of its vocabulary and the vast majority of its grammatical system (Figure 1.1). Each dialect consisted of an everyday style (Guwal) and an avoidance style (Dyalnguy). Dyalnguy was spoken in the presence of 'taboo' relatives [Dixon, 1972 & 1991]. The data for this thesis comes from speakers of the Jirrbal, Mamu and Girramay dialects speaking in the Guwal style.

"Dyirbal is a typical Australian language (of the Pama-Nyungan group). It is entirely suffixing, largely agglutinative, and has extraordinarily free word order" [Dixon, 1972: 22]. Its phonological system is quite simple and consists of the phonemes contained in Tables 1.1, 1.2 and 1.3. The consonant system consists of a four-way contrast among the plosives and the nasals, a two-way contrast among the rhotics plus two approximants and a single lateral [Dixon, 1972: 270-71]. Table 1.2 gives the consonants which have allophones occurring in the corpus of this study. Those allophones which are in bold print are the most common for each phoneme in the corpus. There are only three vowel phonemes in Dyirbal, two of which have several allophones occurring in the corpus (Table 1.3). They can loosely be grouped as front (/i/), back (/u/) and central (/a/).

Dixon [1972: 274] describes Dyirbal as having a 'preferred' stress pattern. "The ideal situation is for the first and all odd-numbered syllables to

---

1 All IPA symbols used here are taken from International Phonetic Association [1949 & 1989] except that of the palato-alveolar plosive which is taken from Ladefoged and Maddieson [1986].
be stressed, and for the second and all even-numbered syllables to lack stress. Final syllables are never stressed". For example,

\[
\begin{align*}
núd\text{in} & \quad núd\text{ilm}an & \quad bûj\text{bar}îm\text{ban} \\
* nudîn & \quad * núdilmân & \quad * bujbárimbán
\end{align*}
\]

This is a very brief description of aspects of Dyirbal which are relevant to this study. The phonotactics of Dyirbal are outlined in Chapter 4 and the syntax and communicative structure are discussed in Chapter 5. For a detailed grammar of the language see Dixon [1972].

1.4.2 The texts

Five texts of natural speech were analysed for this thesis. They are listed below and consist of three narratives and two conversations by one female speaker and four males. These texts were all recorded by Dixon in the course of his fieldwork:

<table>
<thead>
<tr>
<th>TEXT</th>
<th>SPEAKERS</th>
<th>TEXT TYPE</th>
<th>DIALECT</th>
<th>RECORDING DATE</th>
<th>TEXT DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CG37</td>
<td>Chloe Grant</td>
<td>autobiographical narrative</td>
<td>Jirrbal</td>
<td>20.8.64</td>
<td>3mins 45secs</td>
</tr>
<tr>
<td></td>
<td>(female)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CG16</td>
<td>Chloe Grant</td>
<td>mythical narrative</td>
<td>Jirrbal</td>
<td>13.5.64</td>
<td>2mins 30secs</td>
</tr>
<tr>
<td></td>
<td>(female)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW48</td>
<td>George Watson</td>
<td>autobiographical narrative</td>
<td>Mamu</td>
<td>12.5.82</td>
<td>5mins 25secs</td>
</tr>
<tr>
<td></td>
<td>(male)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW39 &amp;</td>
<td>George Watson</td>
<td>conversation</td>
<td>Mamu</td>
<td>31.3.67</td>
<td>4mins 45secs</td>
</tr>
<tr>
<td>JM39</td>
<td>Jimmy Murray</td>
<td></td>
<td>Girramay</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(males)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PB8 &amp;</td>
<td>Paddy Biran</td>
<td>conversation</td>
<td>Girramay</td>
<td>23.11.63</td>
<td>2mins 45secs</td>
</tr>
<tr>
<td>MD8</td>
<td>Mosely Digman</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(males)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The texts CG37, CG16 and PB8 & MD8 were recorded on 3\(\frac{3}{4}\) " BASF tape using a Butoba reel-to-reel recorder with a Beyer microphone. The other two texts (GW48 and GW39 & JM39) were recorded on BASF cassette tapes using a Uher tape recorder and a Beyer microphone.

The texts were not recorded specifically for an intonation analysis, but rather for the documentation of the complete language. The three narratives and two conversations consist of natural speech recorded under non-laboratory conditions.

Most research on intonation has been based on laboratory recordings made under controlled conditions. The informant is often given linguistic samples to read which have no apparent context or are required to make judgements about such samples in perception tests. Rischel [1992] asserts that relying totally on controlled data may result in the researcher missing certain information that is present only in natural speech. He argues that "[d]escriptive linguistics-phonetics typically deals with language data that are more orderly than truly genuine specimens of human communication by means of language [p.382] ... After all, spontaneous speech, with its annoying multi-dimensional complexity, is the most basic type of communicative use of language [p.380] ... It is essential to change the research strategies both within linguistics and phonetics in the direction of more emphasis on the empirical analysis of natural speech" [p.391].

Since it is no longer possible to obtain controlled data from Dyirbal language consultants [Dixon, personal communication] it has been necessary to carry out this analysis without the aid of elicited utterances and perception tests. Whilst it would have been ideal to have augmented the natural speech with some controlled data, this study provides an opportunity to develop research strategies for the analysis of the intonation of a language which is close to extinction.

1.4.3 The speakers

CG (Chloe Grant) was a female speaker of the Jirrbal and Girramay dialects who died in 1974. She was born around 1903 to a Girramay-speaking (Girramaygan) mother and an Irish father, however she was brought up by a Jirrbal-speaking (Jirrbalngan) woman. CG was an extremely knowledgeable and enthusiastic informant and thus became Dixon's main teacher with whom he recorded a large number of texts. She was around sixty years old when the two texts analysed here were recorded [Dixon,
GW (George Watson) was born in about 1899 and was reared by his maternal aunt who was a speaker of the Mamu dialect. He was also taught many traditional legends and skills by his maternal grandfather. Dixon found him to be an invaluable source of information on the Mamu dialect. He was around sixty-eight years old when the conversation with Jimmy Murray was recorded and in his early eighties at the time the narrative was elicited [Dixon, ms.2].

JM (Jimmy Murray), PB (Paddy Biran) and MD (Mosely Digman) were all speakers of the Girramay dialect. At the time of recording JM was about sixty-eight years old and both PB and MD were in their early forties [Dixon, personal communication].
CHAPTER 2

PAST WORKS ON INTONATION

In this chapter I shall briefly discuss the development of two major approaches to English intonation and their relevance to this analysis before proceeding to a description of Pierrehumbert's model on which this study is based. This is followed by a summary of past works on intonation in Australian Aboriginal languages.

2.1 ENGLISH INTONATION - THE EARLY YEARS

The intonation of English has been studied for at least the past four hundred years and is the language for which there are the most published works. The earliest studies were concerned primarily with the development of punctuation marks while up until the beginning of this century descriptions of intonation were written for elocutionary purposes [Danielsson, 1963 (Hart 1551, 1569, 1570); Steele, 1775; Pike, 1945: 5; Sweet, 1892, 1898].

Many of the works on intonation from the first half of this century were pedagogical works designed for the instruction of "foreign students". Two major approaches emerged during this time - the prosodic approach and the phonemic approach. The prosodic approach regards the intonation contour as a unit whereas the phonemic approach describes intonation in terms of a series of pitch levels considered to be phonemes. Bolinger [1951] in his Intonation: Levels vs. configurations discussed the difficulties
presented to intonational analysis by both of these approaches.

2.2 THE PROSODIC APPROACH

The prosodic approach was developed in Europe and falls into two subcategories - the tonetic approach and the tune approach.

2.2.1 The tonetic approach

In his *English intonation* (1922) Harold Palmer presented his innovative intonation model for English. "Instead of dealing with either the pitch of single syllables, or with the pitch of a sentence as a whole, he discovered that the sentence could be broken into several parts of one or more syllables each, and that each part might have its own intonation contributing to the whole" [Pike, 1945: 6]. Palmer called these "parts" the *nucleus*, *head* and *tail*. Palmer's work was the precedent for the models of a number of intonationists; notably Kingdon (1939, 1958), Jassem (1952), Schubiger (1958), O'Connor and Arnold (1961) and Halliday (1967) [Crystal, 1969a: 36-8; Gibbon, 1976: 129-30,142-48; Halliday 1967; Jassem 1952; Kingdon 1939 & 1958a&b; Ladd, 1980: 10; Lindsey, 1981: 5, 17-18; Pike, 1945: 8-9]. The tonetic approach has become known as the British Tradition as the majority of its proponents are British.

An intonation phrase (often called a tone group or intonation-group) in the British Tradition contains a single nuclear tone. The *nucleus*, which is generally the final pitch accent, is the syllable on which there is a major pitch movement to or from the accent. Most intonationists belonging to the British Tradition regard the sequence of pitch accents preceding the nucleus as the *head* and any syllables before the first accent as the *prehead*. Any syllables following the nucleus are called the *tail* [Cruttenden, 1986; Nolan, ms.].

The method of broad transcription involves the use of 'tonetic-stress marks'.

"In a full system of tonetic stress marking, a mark is placed before each stressed syllable and the differences between the marks indicate the type of pitch movement beginning on that syllable" [Cruttenden, 1986: xiii].
FIGURE 2.1

The 'dog's / unfortunately es ' caped

---

Transcription of an utterance according to the British tradition. (After Cruttenden, 1986: 84).

FIGURE 2.2

The 31 dog's 2 un 1 fortunately es 4 caped 1

Transcription of an utterance according to the phonemic tradition.
For example in

The `dog's / unfortunately es`cape`d.

the / represents the boundary between the two intonation phrases of the sentence. dog's is the nucleus of the first intonation phrase and is preceded by ` to indicate that it has a fall-rise nuclear tone. The ` before caped of escaped represents an accent with a fall from high to low (known as a high-fall tone) [Cruttenden, 1986: xiv, 84].

The system of narrow transcription in the British Tradition is referred to as 'interlinear tonetic' and is illustrated in Figure 2.1. The horizontal lines represent the top and bottom of the speaker's range and each dot corresponds to a syllable. The larger dots correspond to accented syllables with the attached lines indicating the direction of the pitch movement. The unaccented syllables are represented by the smaller dots [Cruttenden, 1986: xiii; Nolan, ms.].

I attempted to transcribe the intonation of Dyirbal using this model however it was not flexible enough to accommodate the number of pitch movements in an intonation phrase [see Section 3.2].

2.2.2 The tune approach

In the tune approach stressed syllables were represented by dots above a baseline similar to the tonetic approach and the configuration of these syllables were considered to be a tune. Each tune was regarded as a functional unit and given a syntactic and/or attitudinal meaning. The major contributors to the tune approach were Klinghardt (French, English and German), Armstrong and Ward (English) and Jones (English) [Gibbon, 1976: 103-110; Jones, 1956]. Armstrong and Ward's [1926] A handbook of English intonation, in which they reduce English intonation to two basic tunes (differentiated only by the presence or absence of a terminal rise), had great influence on language teachers and some intonationists and was still in widespread use at least fifty years after it first appeared.
2.3 THE PHONEMIC APPROACH

In the same year that Palmer's study appeared (1922), Walter Ripman, who was also British, published a very different intonational analysis in which he posited three pitch levels regarded as phonemes. This led to the works of the American intonationists: Pike (1942, 1945), Harris (1944, 1951), Wells (1945, 1947) and Trager and Smith (1951, 1957). These American models had four phonemic pitch levels with which the intonation contour was described [Gibbon, 1976: 192-242; Pike, 1945].

Trager and Smith's model incorporated three hierarchies (phonological, morphological and syntactic) with the clause of each hierarchy having some form of equivalence to each other. The contour was considered to be an intonational morpheme and was described in terms of pitch levels, junctures (characterised by pitch movement) and various vocal qualifiers. The contour was deemed to have, minimally, a terminal juncture and at least two pitch phonemes. Each pitch phoneme was assumed to continue at that level until the next one occurred [Gibbon, 1976: 207, 242; Ladd, 1980: 3, 11; Lieberman, 1965: 41, 53].

The four pitch level phonemes in Trager and Smith's model were each further divided into four allophonic pitch levels. These were indicated by diacritics below the pitch number (low to high: \( \wedge \) \( \vee \) \( o \) ). Unlike the four prime perceptual levels which were considered to be relative in height, the sixteen allophonic levels were described as absolute. Lieberman [1965] however showed instrumentally that there was no phonetic basis for the levels and junctures in Trager and Smith's model.

Figure 2.2 shows a basic phonemic transcription of the same utterance as is in Figure 2.1. The dashes between the two horizontal lines show the level of the pitch for each syllable in the utterance. The relative pitch levels of the accented syllables are annotated within the text with numerals - 4 being the highest level and 1 the lowest. Thus \( 3^1 \text{dog's} 2 \) indicates the fall-rise accent represented by \( ^{v} \text{dog's} \) in the British Tradition.

2.4 PIERRERHUMBERT

The model which has been adapted to describe the data in this analysis was developed by Janet Pierrehumbert to give a phonological and phonetic description of English intonation. In this model Pierrehumbert
The dog's unfortunately escaped.

And remember to bring along your rain gear.

Transcriptions of two utterances according to Pierrehumbert's model.
constructs an underlying representation of intonation tunes and a set of rules which transmutes them into actual patterns of Fo [Pierrehumbert, 1987]. The framework of Pierrehumbert's model has been used to describe a number of languages other than English; for example Japanese [Pierrehumbert & Beckman, 1988] and Bengali [Hayes & Lahiri, to appear].

This model is based on the concepts of phonemic levels and on the autosegmental phonology principles contained in Goldsmith [1990]. Rather than having four levels as in the phonemic models, Pierrehumbert posits just two levels (tones), a high (H) and a low (L). The intonation phrase in this model is made up of one or more pitch accents followed by a phrase accent and a boundary tone. The pitch accent can either be a single tone (ie, L*, H*) or a pair of tones (eg. L-+H*, L*+H-, H-+H*). The starred tone represents the centre of the accent and the secondary tone (marked - ) denotes the 'leading' or 'trailing' tone. The bitonal form of the pitch accent is responsible for describing the local behaviour of the Fo around the stressed syllable. Pierrehumbert refers to the pitch accents as Fo targets which are crucial points in the contour that can be lined up with crucial points in the text. The overall shape of the intonation phrase is determined indirectly by the rules for implementing the pitch accents; that is, the phrase contour is only a "... by-product of the application of the local tonal implementation rules" [Pierrehumbert, 1987: 78].

The shape of the Fo contour following the pitch accents is accounted for by the phrase accent and the boundary tone. The phrase accent (H- or L-) accounts for the Fo from its position following the final pitch accent to the onset of the phrase-final boundary tone. The final boundary tone (H% or L%) occurs right at the phrase boundary regardless of the behaviour of the Fo immediately preceding or following it. Thus this model breaks up the nucleus of the British Tradition into three separate tones - the final pitch accent, the phrase accent and the final boundary tone. The Fo at the beginning of an intonation phrase can be accounted for in Pierrehumbert's model by the initial boundary tone which corresponds to the prehead in the British tradition.

Figure 2.3 shows two utterances analysed according to Pierrehumbert's model. Schematic diagrams of the Fo contours are labelled with the tones. Figure 2.3a is an example of the same utterance as in Figure 2.1. The tones associated with dog's are a high pitch accent (H*) on the Fo peak followed by a low phrase accent (L-) to account for the
lowering of the Fo before the high final boundary tone (H%) on the terminal Fo rise. These three tones account for the same intonation contour on dog's as V in the British tradition and 31 2 in the phonemic model. The accent on for of unfortunately is accounted for by a /L*:/ which is then followed by a /H*:/ on cap of escaped. The continual lowering of Fo values after the accent is accounted for by a low phrase accent (/L-:/) and a low boundary tone (/L%:/).

Figure 2.3b illustrates the bitonal accents of Pierrehumbert's model. The Fo peak of the accent on mem levels out for the duration of remember to. This is accounted for by the high accent with a high trailing tone (/H*+H-:/) followed by the high leading tone (/H*:/) of the low accent (/L*:/) on bring. The Fo then rises again to a high accent (/H*:/) on rain. This is followed by a low phrase accent (/L-:/) and a low final boundary tone (/L%:/) which account for the lowering Fo between the peak of the final accent and the end of the utterance.

Pierrehumbert appears to rely totally on Fo contours for her analysis without taking into account the auditory impression (i.e pitch). This approach ignores the importance of the listener's perception of pitch as there is no one-to-one correspondence with the Fo (see Section 1.3). For instance the Fo peak of a pitch accent does not necessarily occur in the syllable which sounds accented (see Section 4.1). In this analysis I have used auditory observations to ascertain the speaker's intended targets for the tones in conjunction with the spectrographic measurements for the Fo contours.

Pierrehumbert makes no attempt to define the pragmatic, syntactic and semantic determiners of intonation in her model. This study also does not analyse the meanings of the intonation contours, however Chapter 5 is devoted to the discussion of the relationship between the intonation and the communicative structure.

2.5 INTONATION IN AUSTRALIAN ABORIGINAL LANGUAGES

While the number of Australian Aboriginal languages that have been studied and documented has increased dramatically over the past twenty or so years, the intonation of these languages appears to have escaped any detailed observation and analysis.
I surveyed approximately 150 works concerning individual Australian Aboriginal languages and found that only 25 (17%) of these even mentioned intonation. All of these descriptions are derived from auditory impressions alone and most are quite brief and rudimentary. None of these works apply an intonational model to the data.

Some contained a brief description of a few lines without any analysis or examples:

- Austin [1978:91-2]
- Birk [1975:76]
- Blake [1979:26]
- Chadwick [1975:9]
- Dench [1987:105]
- Donaldson [1980:44]
- Hansen & Hansen [1978:42]
- Jagst [1975:44-5]
- Diyari
- Malakmalak
- Kalkatungu
- Djingili
- Martutunira
- Ngiyambaa
- Pintupi
- Ngardilpa

Three works identified several intonation patterns and described them in terms of punctuation:

- Wordick [1982:42-5]
- Pintupi
- Walmatjari
- Yinjibarndi

Curving or sloping lines above the text were used by some to indicate intonation contours:

- Hershberger & Pike [1970:802-5]
- Merlan [1982:199-203]
- Patz [1982:68-71]
- Sayers & Pym [1977:97-130]
- Gugu-Yalanji
- Mangarayi
- Kuku Yalanji
- Iwaidja

Three used symbols within the text:

- Kilham [1977:37-38]
- Marsh [1969:147-8]
- Gugu-Yalanji
- Wik-Munkan
- Mantjiltjara
Pitch levels, in the style of Trager and Smith, were applied to the description of intonation in three works:

Capell in Coate & Oates [1970:9-18]  
Douglas [1964:18-25]  
Sayers [1976a]  
Ngarinjin  
Western Desert  
Wik-Mungkan

Sayers' [1976b: 34-71] work on Wik-Mungkan contains a description of the intonation based on the principles of the tagmemic model and is related directly to the grammar. It is one of the lengthier descriptions of intonation in an Australian Aboriginal language. Nash [1986:100] states categorically that intonation is not included in his study.

Works containing an analysis of Aboriginal intonation which employ instrumental techniques appear to be very rare. Flint, in his comparison of Indindji, Aboriginal English and Standard Australian English, employs an auditory and acoustic analysis of syllable duration, intersyllable frequency changes and intersyllable intensity changes. However, he only relates this to grammatical and lexical features for the two dialects of English and does not discuss the overall implications for intonation [Flint, 1970: 717-740]. Sharpe, in her study of Alawa, identifies seven intonation patterns with variations using mingograph traces of the Fo and intensity [Sharpe, 1972: 34-40, 157-72].

Roberts [1988], in an assignment for a course at the Australian National University, wrote a brief spectrographic analysis of the declarative and interrogative intonation of Yidin, a neighbouring language of Dyirbal. He found that Yidin questions are marked by an Fo increase on the question word and that the statements "have one or more peaks of lower pitch generally at the periphery of the statement".

I presented preliminary results of my acoustic analysis at the Phonology Workshop at the inaugural Australian Linguistics Institute [King, 1992a] and the Fourth Australian International Conference on Speech Science and Technology [King, 1992b]; the latter were published in the conference proceedings [King, 1992c]. A description of the relationship between the intonation and the communicative structure of Dyirbal was presented at the 1994 Australian Linguistic Society Annual Conference [King, 1994]. King [in press] contains the preliminary results of an analysis of the interrogative intonation in Dyirbal.
CHAPTER 3

PROCEDURE

This chapter outlines the procedure used to prepare the corpus for analysis. It discusses the selection and transcription of the texts and intonation phrases which form the basis for this study. An explanation is also given of the methods used for making, segmenting and measuring spectrograms and for the preparation of fundamental frequency graphs for the intonation phrases in the corpus.

3.1 SELECTING TEXTS

The texts were selected from the collection of R.M.W. Dixon (see Section 1.4.2). Dixon’s collection is so large that it would be many years of work to analyse the intonation of every text. It was necessary, therefore, to narrow the corpus down although, at this stage, I still did not know how many texts I could conceivably analyse. My knowledge of the language was limited to what I had read and to my participation in a semester course devoted to the grammar of Dyirbal run by Dixon in the Linguistics Department at the Australian National University. This course did not include a study of the intonation. I was, therefore, forced to make a subjective judgement on the suitability of the texts for this analysis.

I listened to numerous texts in order to select those that were of the best quality in both the recording and the speech. I discarded those texts which sounded as if the speaker spoke fast, disinterestedly, not clearly
3.1a Two intonation groups showing reset and audible pause.

3.1b Reset and barely audible pause in the Fo between two intonation phrases.
enough or sounded uncertain, and those in which the recording was not
good quality. This left me with a selection of seven of the best recorded
texts with clear and confident speakers. My supervisor, Phil Rose, helped
me to select the final five texts from these seven texts.

My first criterion for the final selection of texts was that the texts
themselves should be of a manageable length. I originally thought that the
analysis of a total of around 20 minutes of speech spoken by five speakers
would be a manageable task. However, after spending around 95 hours
processing the first text to a stage where it was ready for analysis, I
concluded that a total of four minutes speech would have been ample for a
study of this type. I consequently used the one fully-processed text (3 mins
and 45 secs.) as the basis of the study and selected only parts of the other
four texts.

The selection process was also determined by the fact that I wanted at
least two texts which had the same speaker. This was to ensure that I had
not selected a text exhibiting intonation patterns that were not the usual ones
used by the speaker. I also wanted to have both narratives and conversations
to have a better idea of the range of intonation patterns.

Another important selection criterion was that the texts should have
intonation phrases which sounded clear and identifiable. The boundaries of
the intonation phrases were most often delineated by perceivable pauses but,
in several cases in which the pauses were so minimal that they were barely
audible, the boundaries were located by the reset in the Fo, as shown in
Figure 3.1.

In Figure 3.1a, there is a time-course for two adjacent intonation
phrases which have a clearly audible pause between them. There is a
cessation of the Fo for a duration of 40 centiseconds (csecs) between the
intonation phrases. There is also a reset of 23Hz in the Fo from 167Hz at the
offset of the first phrase to 190Hz at the onset of the following one. This
clearly delineates the intonation phrase boundary and is representative of
most of the boundaries in the corpus.

The pause between the intonation phrases in Figure 3.1b is barely
audible and so I needed to verify the existence of a boundary by looking at
the Fo course. There is a sharp increase in the Fo to 428Hz towards the end
of the first intonation phrase. Then, due to intrinsic aerodynamic factors
(discussed in Chapter 4), there is a 103Hz drop in the Fo to 325Hz. The Fo
ceases for 12 centiseconds between the two intonation phrases. The Fo at
the onset of the second intonation phrase is at 230Hz, 95Hz less than the
offset of the preceding intonation phrase. The Fo has reset to a lower value and there is a corresponding drop in pitch, both of which provide the clue to the intonation boundary in the absence of a clearly audible pause.

3.2 TRANSCRIBING THE TEXTS

Once the texts had been selected, I dubbed each text onto a cassette tape for transcribing purposes and onto a reel tape for instrumental analysis. Using the cassette tape and a tape player with a review facility, I first transcribed the segmentals of the texts phonetically. This was to make the segmentals more readily recognisable on the spectrograms in order to determine how they aligned with the Fo and to take into account their effects on the Fo (see Section 1.3). Full interlinear texts of the utterances were also done with the help of R.M.W. Dixon.

I then attempted to transcribe the pitch using the British Model of intonation by trying to identify the nucleus, head and prehead of each intonation phrase (see Section 2.1). I soon discovered that this model was totally unsuitable for the description of Dyirbal intonation. In the British Model an intonation group contains only one nucleus (a syllable carrying a pitch movement), however a Dyirbal intonation group can contain up to three pitch movements. Dyirbal required a more flexible intonation model in which the structure of the intonation phrase could be more variable.

Pierrehumbert's [1987] model, although also developed for English, afforded the much-needed flexibility (see Section 2.3). Once I had made the spectrograms, I recommenced transcription of the intonation contours, with much greater success, using Pierrehumbert's constructs of high and low accents, phrase accents and boundary tones. This is discussed in more detail in Chapter 4.

3.3 SELECTING INTONATION PHRASES

The five texts selected for analysis together contained a little over 19 minutes of speech. This, as already mentioned in Section 3.1, was an impractical amount of speech for a study of this type. It took at least one hour to process each intonation phrase from the making of the spectrograms, through the extraction of measurements to the stage of a segmented graph a
full transcription and interlinear text. The text CG37 contained 95 intonation phrases within its 3 minutes and 45 seconds of speech. It therefore took around 95 hours to process a little over 3 minutes of speech to the stage where it was ready for analysis. Clearly it would require an impractical amount of time to process the 19 minutes of the combined five texts. It was therefore necessary to make a selection of intonation phrases in the other four texts. Those intonation phrases which were grammatically *interrogative* were automatically rejected since this is a study of *declarative* intonation. Also rejected were those intonation phrases containing interruptions, hesitations or coughing and those which sounded too fast or indistinct. The Fo traces for these utterances would not be distinct and thus would not be suitable for inclusion in the analysis.

The different types of intonation phrases were chosen from each text proportional to their occurrence for each speaker to allow for statistical comparisons. Any intonation phrases that grammatically made a near-minimal pair were retained in order to ascertain any linguistic influences on the intonation patterns.

The selection criteria, then, resulted in a corpus of 187 grammatically declarative intonation phrases from the best quality recordings of Dyirbal which represented around 200 hours of pre-analysis processing. The intonation phrases in the corpus were selected from the texts in the following proportions:

<table>
<thead>
<tr>
<th>Text</th>
<th>Intonation Phrases</th>
</tr>
</thead>
<tbody>
<tr>
<td>CG37</td>
<td>93</td>
</tr>
<tr>
<td>CG16</td>
<td>18</td>
</tr>
<tr>
<td>GW48</td>
<td>24</td>
</tr>
<tr>
<td>GW&amp;JM39</td>
<td>43</td>
</tr>
<tr>
<td>PB&amp;MD08</td>
<td>9</td>
</tr>
</tbody>
</table>

3.4 MAKING SPECTROGRAMS

Due to the fact that the texts were not recorded in a laboratory there was inevitably some interference in the recordings. This can be manually factored out but if done on computer there is a risk that the interference will be included in the measurements of the sound wave. Thus the decision was made to work with manually made spectrograms. So, once the intonation phrases had been selected, I made two spectrograms of each one - a
FIGURE 3.2

Components of a wide band and a narrowband spectrogram.

10 csec calibration marks

lack of energy in these higher frequencies

3 kHz

2 kHz

1 kHz

baseline (0 Hz)

perturbation

1 kHz

harmonic

baseline (0 Hz)

WIDEBAND SPECTROGRAM

NARROWBAND SPECTROGRAM
FIGURE 3.3

Spectrograms marked with segmental boundaries.

(Spectrograms are reduced to 80% of their actual size).
narrowband and a wideband - combined on one sheet of spectrographic paper. These were done on the Voiceprint Laboratories Series 700 Sound Spectrograph in the Phonetics Laboratory of the Linguistics Department at the Australian National University. There was usually one intonation phrase per spectrographic sheet unless there were two adjacent short ones, in which case they were put on the same spectrographic sheet.

Figure 3.2 shows a part of two typical spectrograms from the corpus (it is a portion of the spectrograms in Figures 3.3 and 3.4). The marks along the top line are at 10 centisecond (csec) intervals showing the duration of the utterance. The upper portion of the diagram is a wideband spectrogram with a bandwidth of 300 Hz and a scale of 714 Hz per centimetre. The horizontal calibration lines are set at 1kHz (1000 Hz) intervals. This wideband spectrogram was included on the spectrogram because it provides a valuable aid in the identification of the segmentals. The lower portion is an expanded narrowband spectrogram with a bandwidth of 45 Hz, and a scale of 357 Hz per centimetre which means that the 1kHz line is twice the distance from the baseline than it is in the wideband spectrogram. The long wavy lines are the harmonics which show the energy present in whole number multiples of the fundamental frequency.

The boundaries of the segmentals were then marked on the spectrograms according to Painter's [1979: 11-24] guidelines. I encountered some difficulties in segmenting the spectrograms due to a lack of energy in the frequencies above 1.5kHz in the older recordings. This lack of energy was not due to a flat setting on the spectrograph. The perturbations in the narrowband spectrogram however were often sufficiently distinct to aid in the location of segment boundaries. Figure 3.3 shows two spectrograms (reduced to 80% of actual size) that have been segmented. Vertical lines are ruled along the segment boundaries in both spectrograms. Note that there is a 1mm delay in the onset of the narrowband spectrogram behind that of the wideband one. Each segment is labelled across the top of the spectrograms allowing the relationship between the Fo contour and the segmentals to be made clear.

Once the spectrograms had been segmented the sampling points with a sampling frequency of no more than 10 centiseconds were also marked on the spectrograms. The sampling frequency was much higher where there were dramatic changes in the Fo, particularly around the realisations of putative accents. To identify possible accents I transcribed them auditorily and then looked at the Fo course and sampled in greater detail around the
FIGURE 3.4

Segmented spectrograms marked with sampling points and measurements. (Spectrograms are reduced to 80% of their actual size).
area that I thought signalled the accent. The sampling points are illustrated in Figure 3.4. The two accented syllables show up on the lower (narrowband) spectrogram as the two major 'humps' (these are labelled as accent above the lower spectrogram). The vertical measurement lines ruled through these 'humps' are closer together than elsewhere in order to capture the shape of the Fo for the accented syllables. On the section between the 'humps' the sampling frequency is maintained at 10 csecs since there the only activity is a few perturbations caused by the segmentals and the gradual decline of the Fo.

The Fo and duration were then measured at each sampling point. The majority of the spectrograms were measured manually with calipers and a calculator. Some spectrograms, however, were measured using a digitising pad in conjunction with the "pitch" software developed by the Macquarie University Speech Hearing and Language Research Centre, modified to allow up to 100 Fo measurements per spectrogram. The Fo measurements were taken at each sampling point from the highest visible harmonic to the 1kHz line. The duration was measured from the first sampling point (0 csecs). The measurements were then written below the line of each sampling point.

3.5 MAKING GRAPHS

The measurements of Fo and duration, taken from the spectrograms, were then be plotted on graphs so that the Fo time-course was easier to see. Each duration measurement, in conjunction with its corresponding Fo value, was entered into a computer with Quattro Pro and Statview 512+ software. The tables of data were then printed out with the corresponding graph of each intonation phrase. Every graph was plotted on the same scale to allow for comparison between graphs. The segmentals were written on the graphs so that the location, in relation to the segmentals, of each part of the Fo contour could be identified. Both the phonetic and the phonological representations of the utterance as well as the English gloss were also written on the graph (as shown in Figure 3.5).

Figure 3.5 shows the graph plotted from the measurements of the spectrograms in Figures 3.3 and 3.4. The vertical axis of the graph is Fo, quantified in Hertz (Hz), whilst the duration of the intonation phrase, measured in centiseconds (csecs), runs along the horizontal axis. The
Graph of Fo contour marked with the segmentals.

[midangadilu nade wudinu bulganbinu/
"I grew up in that camp, got big there."]
realisation of the two accents in the intonation phrase in Figure 3.5 can plainly be seen as the Fo excursions peaking at around csec 22 and csec145. The graph also makes it easier to see the relationship between the segmentals and the Fo. It can be seen in this graph that the realisation of the accents differ in the two words. The Fo peak of the first accent occurs in the second syllable of the first word whereas that of the second accent occurs in the first syllable of the final word. The major perturbations resulting from the articulation of the segmentals, such as the release of plosives, can also be seen in the graph.

Graphs were also made of some of the individual accents to compare the onsets, offsets and peaks in the Fo. These are discussed in the following chapter.

3.6 SUMMARY

This chapter has described the procedure for preparing the corpus of data for analysis. Firstly the five texts were selected from the collection of R.M.W. Dixon's recordings. It was essential that the texts selected were of the best quality in both the recording and the speech. It was also most important that the intonation groups in the texts were clear and identifiable. Once the selection had been made the segmentals in the texts were transcribed phonetically using auditory impressions. Intonation phrases were then selected from the texts in order to compile a manageable-sized corpus.

A narrowband and a wideband spectrogram were made of each intonation phrase and were then marked with the segmental boundaries. Sampling points with a sampling frequency of no more than 10 csecs were also marked on the spectrograms. A higher sampling frequency was used where there were major excursions in the Fo. The Fo value and the duration were measured at each sampling point. This data was then entered into a computer to make graphs of the Fo time-course of each intonation phrase. These graphs were marked with the boundaries of the segmentals.

Once all this data had been gathered and extracted each of the 187 intonation phrases had its own file containing two spectrograms, a table of Fo measurements, an annotated graph, phonetic and phonological transcriptions, an interlinear text and its English gloss. The corpus was now ready for the analysis described in the following chapter.
CHAPTER 4

RESULTS AND DISCUSSION

This chapter discusses the findings of the investigation into Dyirbal declarative intonation\(^1\). The tones required to describe Dyirbal intonation are identified and discussed in Section 4.1 and the intonation contour types are listed in Section 4.2. Contour slope, the relative prominence of pitch accents and the role of syllable lengthening are discussed in Sections 4.3, 4.4 and 4.5 respectively. Section 4.6 summarises the results of this analysis.

4.1 TONES

As discussed in Chapter 3, once I had processed all of the intonation groups, I examined the spectrograms and graphs for major excursions in the Fo which were most likely to be due to a deliberate action by the speaker and not merely to the articulation of the segmentals. I also listened to the recordings for evidence of pitch movements which may or may not correspond to the changes in the Fo. These changes in the pitch were likely to be the most significant points in an intonation phrase where the speaker had invested meaning into the intonation of the utterance. Since the pitch is the clue to the listener's perception of an

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\(^1\) This analysis of the tones is a revision of the initial results contained in King [1992 a, b, c] in which were posited two types of pitch accent (H\(^*\) and L+H\(^*\)), a phrase accent (H-) and a boundary tone (H\(^\%\)). The former H\(^*\) accent and H- phrase accent can be accounted for phonetically and so are not considered to be phonological units. The analysis here is based on a greater corpus of data than the previous results.
FIGURE 4.1a

I knew nothing.

FIGURE 4.1b

I was picked up

Fo course of intonation phrase with a low offset.
utterance’s intonation, the auditory impressions were vital to distinguish which of the Fo excursions were likely to be significant.

It became evident from this examination of both the pitch and Fo of Dyirbal intonation phrases that there are pitch movements on certain syllables and that there are variations in pitch at the beginnings and ends of the phrases.

Once the pitch movements had been located, they were defined according to Pierrehumbert’s model; that is, in terms of pitch accents, phrase accents and boundary tones.

In most intonation phrases, the identification of the tone type was done by examining the spectrograms and graphs and then auditorily cross-checking them. The pitch accents were identifiable as the Fo excursions and jumps in pitch that occur on particular parts of an utterance. The initial boundary tone is, in Pierrehumbert’s model for English, always at the onset of the intonation phrase and the final boundary tone at the offset. The phrase accent is located between the final pitch accent and the final boundary tone.

The auditory impressions were vital to determine whether each of the tones in Dyirbal was H or L. For instance, I found that even when the Fo value in a contour increased it did not always indicate a high tone. An example of an increase in the Fo without a corresponding rise in pitch is illustrated in Figure 4.1 which consists of three graphs showing the Fo time-courses for three intonation phrases. The Fo time-course for the intonation phrase in Figure 4.1a shows a 50 Hz increase in the Fo in the last 11.2 centiseconds but, on listening to the tape of the intonation phrase, I could not detect a corresponding increase in pitch. This would therefore not be counted as a high boundary tone. The intonation phrase in Figure 4.1b also does not have an audible increase in pitch at the end, but in this case it is reflected in the Fo as a non-rising offset. Figure 4.1c, however, shows an increase in the Fo at the end of the intonation phrase similar to that in Figure 4.1a but this utterance also has a corresponding audible rise in pitch. If these utterances were transcribed from the Fo pattern alone, then the intonation phrase in Figure 4.1a would have been determined, along with that in Figure 4.1c, as having a rise at the end when in fact it is not an audible rise and can have no significance in the listener’s perception of the intonation.

Rose [1990b], in his study of Thai-Pake tones, measured airflow and found that it increased at the end of certain tones. He suggests that this is due to the widening of the glottal aperture towards the end of
Fo course of intonation phrase terminating in a boundary tone.
phonation. The wider glottis results in an increase in airflow thus causing the vocal folds to vibrate faster. This is then reflected in an increase in the Fo at the offset of phonation. This intrinsic perturbation in the Fo has no corresponding audible rise in pitch. Rose’s findings suggest a probable explanation for the perturbations in Fo towards the end of certain of the intonation phrases in this study, such as the Fo rise in Figure 4.1a.

Since there can be a rise or drop in Fo which is not reflected in the pitch, listening to the pitch provides an all important aid in identifying the tones in intonation. The variations in pitch are the means by which the listener interprets the meaning of the speaker’s intonation, and, unlike Pierrehumbert, I found it to be an absolutely essential part of intonation analysis.

4.1.2 Pitch accents

As explained in Chapter 2, in Pierrehumbert’s model the pitch accents, which are denoted by a star, can either be a single tone or a pair of tones (eg. H*, L*, L-+H*, H-+L*, H*+H-). The starred tone represents the centre of the accent and the secondary tone, marked by a hyphen, denotes the 'leading' or 'trailing' tone. The bitonal form of the pitch accent is responsible for describing the local behaviour of the Fo around the stressed syllable; either to the left or to the right but not both.

Pierrehumbert [1987: 78] assumes that the overall shape of the intonation phrase contour is determined indirectly by the rules for implementing the pitch accents; that is, the contour is only a "...by-product of the application of the local tonal implementation rules". She refers to the pitch accents as Fo targets which are crucial points in the contour that can be lined up with crucial points in the text, with the stretches in between then "being computed accordingly". Pierrehumbert [1987: 37] states that the high pitch accent typically shows up as a peak due to the dipping in the Fo between high pitch accents, and that the Fo falls after a high pitch accent until it is time to aim for the next high pitch accent target.

In Dyirbal, prominence is given to an accented syllable by raising the pitch of that syllable. Unlike English, there is no evidence in Dyirbal for an accent which entails a lowering of the pitch to give prominence to a syllable.
Fo course of intonation phrase with two pitch accents.
4.1.2.1 The pitch accent

Pierrehumbert [1987] found English to have seven types of pitch accent. There is, however, only one type of pitch accent in Dyirbal declarative intonation. The phonological representation of this pitch accent is *//. The pitch accent is manifested in the Fo time-course as an increase in Fo values which reach a peak and then begin a decline to the original course of the Fo. The pitch accent is realised as [LHL]. The deletion of [L] results in various other surface forms which are derived by rule. Further research will be required to determine the derivation rules.

The intonation phrase in Figure 4.2. has a pitch accent realised as [LHL] on the first word (mîqînâdîlu) and on the final word (bulganbînju). The Fo values for both pitch accents begin at a low level (L), and then rise to a peak (H) before falling again to a low level (L).

The following section examines the ways in which the pitch accents are aligned within a syllable.

4.1.2.2 Fo peak alignment with segmentals

The phonological structure of a word root in Dyirbal is as follows:

\[ C_1 \text{ V } C_2 \text{ V (C}_2 \text{ V)}^n \text{ (C}_3 \text{ ) } \text{ where } n \geq 0 \]

V is any vowel
\( C_1, C_3 \) are single consonants
\( C_2 \) can be any sequence of one, two or three consonants

Dixon [1972: 274] states that

"[i]t is not easy to formulate a criterion for dividing up Dyirbal words into syllables. A syllable is always centred on a vowel; plainly a \( C_1 \) consonant goes with the following vowel, and a \( C_3 \) segment with the preceding vowel. However, a three-segment \( C_2 \) cluster can be divided between syllables in several ways. Consider \( \text{galnbil} \) 'dance'; the first syllable involves \( \text{gal} \) and the second \( \text{bil} \), \( n \) could be assigned in either direction".

In this analysis I have considered \( C_1 \text{V} \) to be a definite part of a syllable. However, due to the difficulties described above in determining the
FIGURE 4.3

/butan nada gandang jidan nada/ When I saw it was cooked, I took it out.

Spectrograms of an intonation phrase with two pitch accents.
(The spectrograms are reduced to 80% their actual size).
syllable boundary in a C₂. I have simply regarded C₂ as *inter-vowel consonants* (i.e. ambi-syllabic). The V which follows a C₂ is considered to be the centre of a syllable. This approach to the phonotactics of Dyirbal appears to be adequate for the purposes of this study which is concerned with the *phonetic* realisation of the pitch accent since the location of the syllable boundary is a *phonological* problem.

Once this approach to the phonotactics of Dyirbal had been determined it was then possible to examine the location of Fo peaks in relation to the syllable structure. The Fo peak corresponding to the pitch accent does not always occur directly on the syllable which sounds prominent. For example Figure 4.3 shows the Fo time-course of an intonation phrase with two pitch accents. The first accent is on the word /buran/ ([poreñ]) and the second accent is on the word /gandañu/ ([yendañ]). The 'hump' in the harmonics towards the beginning of the utterance reflects the pitch accent on the word [poreñ]. The peak of the 'hump' occurs half way into the vowel of the second syllable ([ñ]) at csec 14. However, on listening to the utterance, it is the first syllable that sounds prominent. Thus phonetically the peak of the accent may occur within the second syllable of the accented word when phonologically the accent belongs to the first syllable. It may be the pitch movement, rather than the peak, which signals the accent to the listener. Thus, when I transcribed the intonation phrases phonologically, I used my auditory impressions of the pitch to locate the pitch accents in relation to the syllables.

The Fo in 88% of the pitch accents in the corpus (i.e. 173) peaks on the same syllable as the onset of the Fo rise to the peak. In most of the pitch accents, the Fo values begin to rise at the onset of the syllable but some may not rise until the beginning of the vowel. In the remaining 12% of the pitch accents in the corpus (i.e. 24) the Fo begins to rise on the first syllable but does not peak until the vowel of the following syllable. The intonation phrase in Figure 4.3 has both peak alignments in its accents. In the first pitch accent of the intonation phrase - on the word [poreñ] - the Fo begins to rise at the onset of the vowel [ñ] (as it follows a voiceless consonant) and continues to rise throughout the first syllable. The Fo peaks in the centre of the vowel of the following syllable [ù] at csec 14 before declining. The second accent in this intonation phrase, which occurs on the word [yendañ], also begins rising at the vowel onset at csec 59 but it peaks on the boundary between the vowel of the first syllable [ù] and the following consonant [n] at csec 72 before
beginning to decline.

In order to determine the distribution of Fo peak alignments in the corpus histograms were plotted of the peak locations of the three main speakers - CG, GW and JM. The histograms are shown in Figure 4.4. The horizontal axes give the location of the Fo peaks in relation to the segmentals. The duration of the vowels are subdivided into 10 percent second intervals (the numerals are explained in the legend). The vertical axes represent the number of pitch accents in the corpus that have their Fo peak at each of the segmental locations. Thus in Figure 4.4a, for instance, there were four Fo peaks on the first consonant and seven Fo peaks at the 21-30% interval (represented by the numeral 3) of the duration of the first vowel.

The following is an explanation of each peak location accompanied by a schematic diagram of an Fo peak occurring in that location.

1. The first C represents the first consonant on which the Fo movement of the pitch accents occurs (solid shading). This is an example of the Fo peak being realised on the consonant.

2. The first CV is the boundary between the first consonant and the first vowel (vertical shading).
Figure 4.4a. Timing of pitch accent peaks in relation to segmentals for speaker CG.

C = consonant  CV = boundary between consonant and following vowel  VC = boundary between vowel and following consonant

VOWEL - percentage of vowel duration:

1 = 1-10%  2 = 11-20%  3 = 21-30%  4 = 31-40%  5 = 41-50%
6 = 51-60%  7 = 61-70%  8 = 71-80%  9 = 81-90%  10 = 91-100%

Figure 4.4b. Timing of pitch accent peaks in relation to segmentals for speaker GW.
3. The first vowel after the onset of the Fo rise.

4. The vowel is followed by another vowel/consonant boundary (VC, vertical shading).

5. The possible inter-vowel consonant configurations are represented by the C (C) (C) (solid shading).
Figure 4.4c. Timing of pitch accent peaks in relation to segmentals for speaker JM.

C = consonant       CV = boundary between consonant and following vowel
VC = boundary between vowel and following consonant

VOWEL - percentage of vowel duration:

1 = 1-10%  2 = 11-20%  3 = 21-30%  4 = 31-40%  5 = 41-50%
6 = 51-60%  7 = 61-70%  8 = 71-80%  9 = 81-90%  10 = 91-100%

Figure 4.4d. Timing of pitch accent peaks in relation to segmentals for all three speakers CG, GW and JM.
6. The second CV represents the boundary between the inter-vowel consonant(s) and the following vowel (vertical shading).

7. The second vowel belongs to the second syllable after the onset of the Fo rise to the peak.

---

**Figure 4.4a** is a histogram of CG's accent peak locations. The Fo peaks of the pitch accents in the corpus for this speaker are distributed over most of the locations. However, there are three locations at which the majority of Fo peaks occurred - the first and second vowel/consonant boundaries (VC) and the mid portion of the duration of the first vowel (particularly at the 51-60% duration interval which is shaded with dots).

**Figure 4.4b** gives the distribution of Fo peaks for the speaker GW. Although this speaker's Fo peaks are not so widely distributed as those of CG, the majority of Fo peaks are concentrated in the same three locations, as are those of speaker JM in **Figure 4.4c**.

From these histograms it would appear that the speakers may align the peaks of their pitch accents with the first and second vowel/consonant boundaries and the central portion of the duration of the first vowel. **Figure 4.4d** shows the combined distribution of Fo peaks for all three speakers. Fifty-four Fo peaks (16% of the accents) occurred at the boundary between the first consonant and the first vowel. Sixty-six Fo
The location of pitch accent Fo peaks in the corpus for speakers CG, GW and JM.

<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th>GW</th>
<th>JM</th>
<th>OVERALL</th>
<th>OVERALL</th>
</tr>
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<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
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<td>TOTALS</td>
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<tr>
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<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>3</td>
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<td></td>
<td></td>
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</tr>
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<td>18</td>
<td>11</td>
<td>16</td>
<td>54</td>
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<td>4.5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>vowel - mid</td>
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<td>49</td>
<td>14</td>
<td>40</td>
<td>131</td>
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<td>(20,15)</td>
<td>(35,14)</td>
<td>(8,33)</td>
<td>(24,16)</td>
<td>(79,62)</td>
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<tr>
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<td>7</td>
<td>9</td>
<td>4</td>
<td>7</td>
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</tr>
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<td>21</td>
<td>11</td>
<td>26</td>
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<tr>
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<td>4</td>
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<td>consonant</td>
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<td>3</td>
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<td>vowel - mid</td>
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<td>-</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>vowel - late</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>191</strong></td>
<td><strong>66</strong></td>
<td><strong>70</strong></td>
<td></td>
<td><strong>327</strong></td>
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</tr>
</tbody>
</table>
peaks (20% of the accents) occurred at the 51-60% duration interval of the first vowel (dot shading). Sixty-six Fo peaks (20% of accents) occurred at the boundary between the first vowel and the following consonant.

Table 4.1 summarises the results of the histograms. All figures are percentages except the righthand column and the bottom row which have actual figures. The two rightmost columns contain the figures for the entire corpus. The leftmost column lists the Fo peak alignments with the segmentals. The vowels are divided into three temporal portions: between the vowel onset and the 30% point of vowel duration (early); the 31-70% portion of the duration of the vowel (mid); and the final portion of the vowel between 71% duration and the vowel offset (late).

It can be seen from the overall totals in Table 4.1 that the majority of pitch accent peaks for the three speakers (CG, GW and JM) occur before the inter-vowel consonant(s) (the overall totals for this section add up to 88%). Forty percent of the Fo peaks are in the mid portion of the first vowel. There appear to be two groups of peaks in the mid portion of the vowel - the figures for these are given in brackets in the table. The first are those peaks that are directly followed by a decline in Fo while those of the second group are followed by a relatively steady level of Fo that does not begin to decline until after the vowel offset. The three major Fo peak locations are illustrated in the schematic diagram below:
**Figure 4.5a**

Fo peaks in the centre of the vowel and then declines.

**Figure 4.5b**

Fo peaks in the centre of the vowel and continues at that level to the boundary between the vowel and the following consonant.

**Figure 4.5c**

Fo peaks at the boundary between the initial consonant and the vowel.

**Figure 4.5d**

Fo peaks at the boundary between the vowel and the following consonant.
(i) peak at boundary of first consonant and following vowel

![Graph showing pitch accent realization](image)

(ii) peak in mid portion of vowel; Fo either declines after peak or sustains its peak level until segment boundary

![Graph showing pitch accent realization](image)

(iii) peak at boundary of vowel and following consonant

![Graph showing pitch accent realization](image)

Figure 4.5 shows spectrograms of the four forms of pitch accent realisations described above. The spectrograms are of four pitch accents of speaker CG which are in almost identical segmental environments - that is, [ŋə] followed by [m] or [n]. Figure 4.5a shows the Fo begin its 125 Hz rise on the initial consonant [ŋ] and continue to a peak at csec 15, midway through the duration of the vowel [v]. The Fo then immediately begins to decline. In Figure 4.5b the Fo of the pitch accent begins its
rise of 71 Hz during the initial consonant [ŋ] at csec 38. The Fo peaks in the mid portion of the vowel on csec 57 and, rather than declining immediately as in Figure 4.5a, remains relatively steady with only a drop of 5 Hz between the peak and the offset of the vowel. In Figure 4.5c the Fo begins to rise at the onset of the [ŋ] (202 Hz) and peaks on the boundary between the [ŋ] and the following [u] at csec 8 (226 Hz). The Fo declines only 6 Hz throughout the duration of the [u] before the perturbation due to the articulation of the [ŋ]. The Fo in Figure 4.5d rises 125 Hz from the onset of the initial consonant [ŋ] to the peak at the boundary of the vowel [u] and the following consonant [m] at csec 127.

Researchers with the Kiel Intonation Project (which includes microprosodic research) have discovered, through controlled perception tests in German, that the accent peak alignment within a syllable influences the perceived prominence of a pitch accent and also the meaning of the utterance. A medial peak which occurs around the centre of the syllable is perceived as being more prominent than early or late peaks [Gartenberg & Panzlaff-Reuter 1991; Hertrich, 1991; Kohler, 1991b,c; Kohler & Gartenburg, 1991]. In a controlled experiment on a particular German utterance, it was found that changes in the accent peak position resulted in “corresponding changes of meaning from ‘established’ for the early to ‘new’ for the central to ‘emphatic’ for the late Fo peak” [Kohler, 1990: 115].

Without controlled data such as in the Kiel Project, it is impossible to determine the significance, if any, of the variation of accent peak positions in Dyirbal. However, since there appears to be at least three distinct accent peak positions in the corpus, there is a possibility that this has some significant intonational function. Those peaks which occur on the first and second vowel/consonant boundaries (VC) can be regarded as early and late peaks respectively and those which occur in the central portion of the first vowel as mid peaks. These peak positions may carry some salient information as is the case in German but perception tests with native speakers of Dyirbal would be required to determine this.

The three Fo peak locations could be due to variation in the tempo of utterances in the corpus. Slow tempo may result in an early peak around the first consonant/vowel boundary, 'normal' tempo may have a peak occurring in the central portion of the vowel duration while the peak in fast tempo may be delayed to the following vowel/consonant boundary. The effects of tempo on peak location could be determined from the duration of the segmentals in the spectrograms, however the
measurements would need to be normalised for the intrinsic duration of segmentals [Silverman & Pierrehumbert, 1990].

Bruce [1990: 107] lists
"a number of factors that may determine the timing of tonal peaks (or any other points in the tonal structure) relative to segmental references as part of the rhythmical make up of an utterance ...

1. Tonal composition (phonological analysis of pitch accents - whether analyzed as mono- or bitonal, linked or unlinked tones, targets or gestures - can influence the results of a phonetic analysis).

2. Prosodic context
   a. Boundaries (word, phrase, utterance, etc.)
   b. Rhythmical organization (rhythmical grouping, eg. stress clash)
   c. Focus (prefocal, focal, postfocal position)
   d. Tonal environment (tonal interaction within and between successive pitch accents, eg. tonal crowding)
   e. Pitch range (local or global, eg. differences in degree of overall emphasis due to the degree of involvement)
   f. Global intonation (eg. absence/presence of downdrift due to interrogative/declarative structure)

3. Segmental context (eg. differences in intrinsic vowel length)

4. Speaking rate (fast, normal, slow tempo)"

The rhythmical organisation (2b) is unlikely to be a major contributing factor to Fo peak alignment in Dyirbal as it is not a stress-timed language like English, Russian and Arabic [Roach, 1982: 73]. Tonal crowding (2d) is not likely to be a major factor in Dyirbal either since the accents in the majority of utterances occur on the first and final word and are very rarely adjacent. It is difficult at this stage however to say what other influences successive accents have on each other. The difference between the interrogative and declarative structure (2f) is not relevant to this study as it is confined to declarative utterances. Further research will be required to determine the influence of the other factors in Fo alignment in Dyirbal, particularly focal position as little is known about the pragmatic structure of Dyirbal.

Silverman and Pierrehumbert [1990], from their tests on the timing of prenuclear high accents in English, developed a model of peak placement. They applied Multiple Regression to the results of their tests and then divided the peak delay by the duration of the associated syllable rhyme. This procedure was designed to predict the Fo peak alignments in English. They
FIGURE 4.6

Fo course of an intonation phrase with the peak of the pitch accent at the onset of phonation.
found that "... it was the proportional alignment of Fo peaks with their associated syllables, rather than the absolute distance in time, that exhibited rule-governed behaviour" [p. 88].

It is beyond the scope of this study to identify the determinants in Fo peak placement in Dyirbal. This will be a topic of future investigation.

4.1.2.3 Prominence of pitch accents

The prominence of pitch accents is determined by the degree of prominence the speaker wishes to give particular syllables within an utterance. The relative prominence of pitch accents is discussed in Section 4.4.

4.1.3 Boundary tones

Variations in pitch can occur at the beginning and end of phonation in an intonation phrase. Pierrehumbert refers to these pitch variations in English as initial and final boundary tones and they can be either low (L%) or high (H%).

4.1.3.1 Initial boundary tones

Six per cent of the intonation phrases in the corpus have the Fo peak of an accent at the onset of phonation, as is illustrated in Figure 4.6. In the remaining 94% of the intonation phrases the pitch is lower at the onset than at the peak of the following accent, as in Figure 4.2. Such a low occurrence (6%) of intonation phrases which begin with the Fo peak suggests that these onsets are just a phonetic variation of the significant majority which do not begin with the Fo peak. Strong support is given to this hypothesises by the fact that all occurrences of the Fo peak at the beginning of phonation came from only one of the five speakers in this study. A phonetic rule such as the deletion of the initial [L] in the surface form of the [LHL] of the pitch accent would account for this phonetic variation. Thus a phonological initial boundary tone is not needed in Dyirbal declarative intonation.
4.1.3.2 Final boundary tones

Pierrehumbert's model for English also has two final boundary tones (H% and L%) to account for the variations in Fo at the offset of phonation of the intonation phrase, and two phrase accents (H- and L-) to describe the behaviour of Fo between the final pitch accent and the boundary tone. The results of this study indicate that Dyirbal has just one final boundary tone. Due to the aerodynamic effects on the Fo described in Section 4.1, and to the importance of the auditory impression in ascertaining perceptual differences between intonation phrases, the final determination of the type of offset of each intonation phrase was dependent on how it sounded.

Twenty-six per cent of the intonation phrases in the corpus have an audible rise in pitch towards the point of phonation offset. These would be regarded, in terms of Pierrehumbert's model of English, as having a high final boundary tone (H%). The 74% with no final rise would be regarded as having as having a low final boundary tone (L%). Twenty percent of the intonation phrases with final Fo rises (5% of the corpus) also have rising Fo between the final pitch accent and the final boundary tone. In Pierrehumbert's model of English this rising Fo pattern would be analysed as a high phrase accent (H-) and non-rising Fo in this position as a low phrase accent (L-). The following schematic diagrams show Pierrehumbert's [1987:286-287] analysis for these three types of Fo contour:

(i) low phrase accent /L-/ plus low boundary tone /L%/

```
   H*  
  /   
 /     
+------
   L-  
   L-+  
   L%  
```

(ii) low phrase accent /L-/ plus high boundary tone /H%/

```
   H*  
  /   
 /     
+------
   L-  
   L-+  
  H%   
```
(iii) high phrase accent /H-/ plus high boundary tone /H%/

I will argue below that the Fo behaviour described by Pierrehumbert's final boundary tones (L%, H%) and phrase accents (L-, H-) can, in the analysis of Dyirbal declarative intonation, be accounted for by one boundary tone. Phonologically the boundary tone is /H%/ and phonetically it is [H].

The Fo courses in Figures 4.7, 4.8 and 4.9 illustrate the three variations of intonation on the final word of a Dyirbal declarative utterance. In Figure 4.7, the Fo declines after the peak of the final accent and continues at a lower value than the accent peak throughout the final two words [ben weyiban] to the offset of phonation. This pattern is also audible in the pitch of the intonation phrase and occurs in 74% of intonation phrases in the corpus. In Pierrehumbert's [1987] model of English, the declining Fo after the peak of the pitch accent would be allocated a low phrase accent (L-) and, for the low offset, a low boundary tone (L%). These two tones appear to be redundant in an analysis of Dyirbal intonation as low Fo after the final pitch accent is predictable where there is no following boundary tone.

The contour in Figure 4.8 also has a decline in Fo after the peak of the pitch accent. However, there is a sharp rise in the Fo on the final segment [u] of the utterance from 226 Hz to 428 Hz which is also audible as a large rise in pitch. This contour contrasts with that in Figure 4.9 which also has a high offset. In the intonation phrase in Figure 4.9 there is a gradual increase in the Fo on the first syllable of the final word in the intonation phrase [weyiban] starting at csec 162. The Fo continues to increase over the following two syllables before terminating with a high offset. The pitch accent is audible as a prominent-sounding rise in pitch on the first syllable of [weyiban] followed by a continued rise until the end of the word. Whereas the pitch rise in Figure 4.8 occurs on the final segment of the final syllable, the rise in Figure 4.9 takes place over the entire last two syllables of the phrase-final word.
FIGURE 4.7

Fo course of an intonation phrase with a low offset.

FIGURE 4.8

Fo course of intonation phrase terminating in a boundary tone (%).
In Pierrehumbert’s [1987] model for English intonation the decline in Fo after the final pitch accent in Figure 4.8 would be analysed as a low phrase accent (L-), and the final rise as a high final boundary tone (H%). In this analysis of Dyirbal, however, the low phrase accent is redundant as stated above but the construct of the high boundary tone must be retained to describe a final rise in Fo which is also audible as a rise in pitch. The contour in Figure 4.8 is then described in this analysis as having one pitch accent (*) and a high boundary tone (%).

Pierrehumbert’s [1987] model for English would account for the high Fo following the final pitch accent in contours such as that in Figure 4.9 with a high phrase accent (H-) followed by a high boundary tone (H%). However, in Dyirbal intonation phrases, a continued rise after the final pitch accent always terminates in a high offset. In this analysis, therefore, rather than proposing a high phrase accent (H-) obligatorily followed by a high boundary tone (H%) for such a small number of contours in the corpus, I regard this as a phonetic variation of the contour type illustrated in Figure 4.8. In other words, phonologically the contour is comprised of a pitch accent (*) followed by a boundary tone (%). Phonetic rules deleting the final [L] of the [LHL] of the final pitch accent would account for the fact that there is no decline in the Fo between the pitch accent and the boundary tone. Further research will be required to determine this.

Dyirbal declarative intonation phrases, then, have three different Fo patterns between the final pitch accent and the offset of phonation. Seventy-four percent of the corpus has a declining pitch after the final pitch accent which terminates in a non-high offset. This is the unmarked ending of an intonation phrase which has no tone and is shown in Figure 4.7. Twenty-one percent of the intonation phrases in the corpus have an audible ‘dip’ in the pitch between the final pitch accent and a final rise in the last syllable to a boundary tone /%/ as demonstrated in Figure 4.8. The remaining 5% of the intonation contours in the corpus have a continued Fo rise from the final accent peak to the boundary tone, as in Figure 4.9, which is accounted for by phonetic implementation rules. Further research will be required to determine these rules.

The possible linguistic functions of the boundary tones are discussed in Chapter 5.
Figure 4.9

/jalajalabajda daligiñundinda/
She worked down here at Dallachy's.

Fo course of intonation phrase with a boundary tone (%) preceded by a
Fo rise from the peak of the final accent.
4.1.4 Summary

It has been demonstrated that just two tones are required to describe Dyirbal declarative intonation contours. One pitch accent (*) that indicates which particular syllables are made prominent within an utterance. The pitch accent is realised as [LHL] and other surface forms which are derived by phonetic rules (further research will be required to determine these rules). There appears to be at least three major positions of pitch accent peaks within the syllable but it is not clear whether the different locations have any linguistic significance. The boundary tone (%) indicates a high offset to an intonation phrase in contrast to the unmarked non-high offset.

Dyirbal does not appear to have a low pitch accent (L*) as Pierrehumbert [1987] posits for English in which prominence is given to a syllable by the lowering of the pitch. Pierrehumbert’s low final boundary tone (L%) and low phrase accent (L-) are redundant for Dyirbal as low pitch in these positions is the unmarked form and therefore does not receive a tone. The high phrase accent (H-) is not needed for Dyirbal as the continuous rise in Fo from the accent peak to the offset of phonation is accounted for as phonetic variation. There is no need at all for an initial boundary tone as all Dyirbal declarative intonation phrases have a phonologically low onset.

Having established the basic tonal units, the following section describes how these tones are concatenated into intonation contours.

4.2 CONTOURS

After identifying and labelling the individual tones I looked at the way in which the tones are combined in an intonation phrase. The combination of tones and the prominence that they are given by the speaker creates an intonation contour which conveys a particular meaning to the listener. This section discusses the tones in the context of the intonation phrase. Further research will be required to determine the phonetic rules for the derivations of Dyirbal contours. The following sections discuss contour slope and the relative prominence of pitch accents in Dyirbal intonation.
Figure 4.10a. Duration in centiseconds of intonation phrases in the corpus.

Figure 4.10b. Number of syllables in the intonation phrases in the corpus.
4.2.1 The intonation phrases

A Dyirbal declarative intonation phrase contains at least one, and no more than three, pitch accents. An intonation phrase also may or may not have a boundary tone (%).

The number of pitch accents in an intonation phrase is determined by syntactic and pragmatic factors, discussed in the following chapter, and by the duration of the utterance. Figure 4.10 contains two histograms showing the duration in centiseconds and the length in syllables of the single-accent, two-accent and three-accent intonation phrases in the corpus. Figure 4.10a gives the duration of intonation phrases. The horizontal axis is divided into 20 centisecond intervals. The vertical axis gives the number of intonation phrases in the corpus which fall into each duration interval. The bars on the chart are shaded to distinguish between the intonation phrases which have one, two and three pitch accents (see legend in figure). So, for instance, the first bar (horizontal shading) shows that there were 5 intonation phrases in the corpus with one pitch accent and which had a duration between 20 and 40 centiseconds.

The histogram in Figure 4.10a shows that there is a correlation between the duration of intonation phrases and the number of pitch accents they contain. Those intonation phrases with three pitch accents tend to have a greater duration than those with two accents which in turn tend to be longer than single-accent intonation phrases. The greatest number of single-accent intonation phrases have a duration between 61 and 100 csecs. whereas the majority of two-accent phrases have a duration between 101 and 140 csecs. Most of the three-accent intonation phrases have a duration between 141 and 220 csecs. There is however considerable overlap between the 81 and 160 csecs. duration intervals for which there are occurrences of intonation phrases with one, two and three pitch accents.

Figure 4.10b shows the length of the intonation phrases in the corpus in terms of syllables. The histogram illustrates the tendency for those intonation phrases with the greater number of syllables to have the greater number of pitch accents. The overlap of all three types of intonation phrases occurs at the 7 and 8 syllable lengths.

Table 4.2 summarises the results contained in the histograms in Figure 4.10. It gives the percentages within the corpus of single-accent, two-accent and three-accent intonation phrases. It also gives the
### TABLE 4.2

<table>
<thead>
<tr>
<th>No. of pitch accent</th>
<th>Percentage of corpus</th>
<th>Duration - syllables</th>
<th>Duration - csecs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>1</td>
<td>40</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>42</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>7</td>
<td>20</td>
</tr>
</tbody>
</table>

Intonation phrases: Number of pitch accents, frequency of occurrence in corpus and durations.
minimum, maximum and range of intonation phrase duration in syllables and in centiseconds. It tends to suggest that the longer an intonation phrase is, the more pitch accents a speaker will include in it. The table also suggests that speakers of Dyirbal tend to use more single-accent and two-accent intonation phrases in their speech than the longer three-accent ones.

4.2.2 The contours

There are six declarative intonation contours in the corpus which can be divided into two groups: those with only pitch accent(s), and those which also have a boundary tone. Sections 4.2.2.1 and 4.2.2.2 list each of the six underlying contours with the percentage of the corpus occupied by each one.

4.2.2.1 Pitch-accent-only contours

Seventy-four percent of the contours in the corpus contain no tone other than pitch accents. There are three such contours in the corpus.

1 (a).

/ * / 28%

one pitch accent; no boundary tone.

1 (b).

/ * * / 32%

two pitch accents; no boundary tone.
1 (c).

/ * * * /

14%
3 pitch accents; no boundary tone.

4.2.2.2 Contours with a boundary tone.

Twenty-six percent of the intonation phrases in the corpus contain a boundary tone. There are three contours in the corpus which have a boundary tone.

2 (a).

/ * % /

12%
one pitch accent; plus a boundary tone.

2 (b).

/ * * % /

10%
two pitch accents; plus a boundary tone.
Sampling points and regression lines for eight two-accent Fo contours from the speaker CG.
FIGURE 4.12

An Fo course showing declination between the pitch accents.
CHAPTER 4 Results and discussion

2 (c).

/ * * * % / 4%

3 pitch accents; plus a boundary tone.

4.3 CONTOUR SLOPE

This section looks at downward trend in the intonation contours in terms of declination, downstep and downdrift. Fo upstep, which occurred in a small number of intonation phrases, is also discussed.

4.3.1 Declination

"It is common wisdom among phoneticians and phonologists that fundamental frequency tends to decrease over the course of an utterance" [Pierrehumbert and Beckman, 1988: 57]. This Fo decline was introduced and discussed in Chapter 1 of this thesis. Eighty-two percent of the intonation contours in the corpus have Fo declination in those stretches where there are no excursions for pitch accents or boundary tones. Figure 4.11 shows the sampling points and regression lines (calculated over all points) for eight two-accent Fo contours of the speaker CG. The graph clearly shows a downward trend in the Fo over the duration of the utterances.

Figure 4.12 is an example of the decrease in Fo over the course of an utterance. In this intonation phrase, the Fo between the first two pitch accents declines for 63 csecs at the rate of 0.6 Hz/csec. From the offset of the accented syllable of the second pitch accent at csec 127, the Fo declines at the rate of 2.6 Hz/csec over 46 csecs to the onset of the third pitch accent at csec 173. After the third accent, the Fo value drops to a level below that preceding the pitch accent then rises to the boundary tone. Although there are considerable rises in the Fo for the pitch accents and the boundary tone, with the third accent being higher than that of the
FIGURE 4.13

Single accent contour with Fo declination and boundary tone from the speaker CG.

TABLE 4.3

<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th>GW</th>
<th>JM</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>0.7</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>max</td>
<td>2.8</td>
<td>1.2</td>
<td>2.1</td>
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<tr>
<td>range</td>
<td>2.1</td>
<td>0.8</td>
<td>1.8</td>
</tr>
<tr>
<td>mean</td>
<td>1.4</td>
<td>0.7</td>
<td>1</td>
</tr>
<tr>
<td>SD</td>
<td>0.64</td>
<td>0.26</td>
<td>0.62</td>
</tr>
</tbody>
</table>

The rate of declination of F0 in intonation contours of the speakers CG, GW and JM, expressed in terms of Hz/csec.
second accent, there is a general downward trend over the duration of the utterance. The Fo value immediately preceding that of the rise to the boundary tone is 95Hz lower than that of the onset of the intonation phrase.

Declination is not confined to contours with three accents. There is even declination evident in the Fo of single accent contours as in Figure 4.13. The Fo of this contour has an onset at 255Hz followed by a rise to a pitch accent peak at 309Hz before dropping to 280Hz at csec 30 at the end of the accented syllables. The Fo then begins a steady decline over the next 46 csecs at the rate of 1.2 Hz/csecs and begins the rise to the boundary tone at csec 78.

Pierrehumbert and Beckman (1988: 70) suggest that declination "seems to be extremely variable from speaker to speaker". This appears to be borne out by the Dyirbal data. Table 4.3 gives the minimum and maximum rates of Fo declination in Hertz per centisecond (Hz/csec) for the speakers CG, GW and JMI. The table also includes the range (max. minus min.) and the mean and standard deviation for the rates of Fo decline of each of the three speakers. These measurements are of the Fo stretches between the tones. Table 4.3 shows that CG has the greatest range and mean values of declination rate of the three speakers whilst GW has the smallest. The between-speaker variation in the maximum rates, wherein CG's rate is 1.6 Hz/csec greater than that of GW, is larger than that in the minimum rates where there is only 0.4 Hz/csec difference between the highest and the lowest. The range of declination rate of CG is 1.3 Hz/csec greater than that of GW, whilst CG's mean rate is double that of GW. JM has the lowest minimum declination rate of the three speakers but his maximum rate, mean rate and range are around midway between those of CG and GW.

In general, the rate of declination in the contours of the corpus tends to be lower in utterances of longer duration. However, even within intonation contours that are of similar duration, there is variation in the rate of declination. Figure 4.14 shows two such contours of the speaker CG in which there is Fo declination between the two pitch accents. The two contours have been plotted so that the timing of the onset of their second pitch accents are aligned (at csec 59). Contour 1 is, therefore,

---

1 The measurements in Table 4.3 are the result of the number of centiseconds of the Fo stretch being divided into the number of Hz and do not imply that I can measure in fractions of centiseconds.
Two Fo contours with different rates of Fo declination.
plotted 6 csecs ahead of Contour 2. The Fo duration between the two pitch accents is 38 csecs in both contours. The rate of declination of the two contours is quite different, however. The difference in absolute Fo values between the two contours at csec 21 is 47 Hz but at csec 59, at the onset of the second pitch accents, the difference is only 29 Hz. Contour 1, with a declination rate of 1 Hz/csec has, therefore, a steeper Fo slope between the pitch accents than that of Contour 2, which has a declination rate of 0.6 Hz/csec.

### 4.3.2 Downstep

Some intonationists analyse the downward trend of Fo in intonation contours as a form of downstep which Pierrehumbert and Beckman refer to as 'catathesis' [Berg et al., 1982; Gussenhoven & Rietveld, 1988; Kohler, 1991 b&c; Ladd, 1990 & 1992; Liberman and Pierrehumbert, 1984; Pierrehumbert, 1987; Pierrehumbert and Beckman, 1988]. The models are, however, very complex and are beyond the scope of this thesis. I shall use a simplified description, based on the models of Ladd and Berg et al., in order to show how the concept of downstep may be useful in accounting for downward trends in Dyirbal declarative intonation phrases.

Ladd [1992: 119] points out that the "particular value of the parameter that is input to a given application of downstep depends on a number of factors, including the long-term characteristics of the individual speaker's voice, the speaker's emotional state, and of course the pattern of previous register shifts in the utterance."

In the absence of data which has been controlled for these effects, I have attempted to factor out as much of these effects as possible by analysing the downstep as a percentage of the Fo range (minus the rise to a boundary tone) of each individual intonation phrase, calculated in Hertz. In this discussion I am assuming the validity of the assumption of Berg, Gussenhoven and Rietveld [to appear] that

"accentual downstep can be modelled with a single downstep factor, which is independent of prominence and the number of downstepped accents".

Berg et al. consider the Association Domain of the pitch accent (AD) to be the domain for accentual downstep and regard downstep as a morpheme affixed to the AD. The AD is the part of an utterance which is dominated by a particular pitch accent.
FIGURE 4.15

Fo contour showing downstepped Association Domains (ADs).
**Figure 4.15**, which is the Fo course of the same intonation phrase as in **Figure 4.12**, has three Association Domains with sequentially lowered onsets. The tones are indicated on the graph as are the ADs. The thick black lines passing through the contour indicate the downstepping of the AD onsets. The Fo range of the contour is 238Hz. Boundary tones are excluded from the calculation of the Fo range of the intonation phrase as they have no direct bearing on the downward levelling of the pitch accent onsets. The onset value of the AD1 is 268Hz while that of AD2 is 202Hz. The difference between these two onsets is 66Hz and signifies a downstep of AD2 of 28% of the Fo range of the intonation phrase. The onset of AD3 is 179Hz which is 23Hz lower than that of AD2. AD3 is, therefore, downstepped by 10% of the utterance's Fo range. The Fo value at the onset of the boundary tone is an insignificant 6Hz lower than that of AD3, indicating that the downstepping is levelled off following the final pitch accent. The degree of downstep of AD2 is almost three times that of AD3. This may be due to the fact that AD3 has a higher peak than AD2 and thus is more prominent. If downstep is a deliberate action of the speaker then a smaller downstep would ensure an even greater degree of prominence for AD3. (Accent prominence is discussed in more detail in Section 4.4).

To determine the ADs in the corpus I took the Fo value of the onset of each pitch accent in an intonation phrase as the reference points since they are easily identifiable and signify the boundary between the ADs. **Table 4.4** gives the minimum, maximum, mean and standard deviation of the downstep values of the intonation phrases in the corpus for the speakers CG, GW and JM. The difference between the Fo onset values of two adjacent pitch accents in an intonation phrase is expressed as a percentage of that utterance's Fo range.

Downstep and declination can be considered as separate features of a contour that can co-occur. The first and second ADs in **Figure 4.15** have Fo declination following the accented syllables. Downstep then could be analysed as occurring **between** the ADs of a contour, as Berg et al. do, and declination as being a factor **within** the AD itself. Single accent contours, such as that in **Figure 4.13**, lend some credence to the concept of an AD in Dyirbal. The shape of the contour (without the boundary tone) in **Figure 4.13** is very similar to that of the first AD in **Figure 4.15**.
TABLE 4.4

<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th>GW</th>
<th>JM</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>10</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>max</td>
<td>53</td>
<td>42</td>
<td>57</td>
</tr>
<tr>
<td>range</td>
<td>43</td>
<td>30</td>
<td>41</td>
</tr>
<tr>
<td>mean</td>
<td>26</td>
<td>48</td>
<td>33</td>
</tr>
<tr>
<td>SD</td>
<td>14</td>
<td>27</td>
<td>15</td>
</tr>
</tbody>
</table>

Downstep values expressed as the percentage of the Fo range of the intonation contour.

FIGURE 4.16

Fo contour with upstep and downdrift.
FIGURE 4.17

Fo contour of declarative intonation phrase showing upstep and declination.

FIGURE 4.18

Declarative intonation contour with continuous upstep.
4.3.3 Downdrift

Seven percent of the contours in the corpus have a 'terracing' effect which Katamba [1990: 206] attributes to downdrift in which a L automatically lowers a following H. In Figure 4.16, the third pitch accent has a terrace-like appearance. The Fo falls from the peak of the second accent and then levels out at around 250Hz for 30 csec before falling again.

4.3.4 Upstep

The Fo in 6% of the declarative intonation contours in the corpus has no downward trend at all. These contours have an upward trend in which the Fo values of the pitch accent onsets become progressively higher throughout an utterance. This effect is known as "upstep" or "reset" [van den Berg, et.al., to appear; Katamba, 1990: 207].

Figure 4.17 is an example of upstep in an utterance. It is the Fo contour of a single word (njabajdara) which is a reply to a question within a conversation. It has a pitch accent on the first syllable [ni] and on the third syllable [bej]. The contour has an onset of 179 Hz. The Fo increases by 21 Hz over the duration of the first syllable [ni] which is accentuated and ends at csec 10. The Fo continues to rise throughout the second syllable [ne]. There is also a Fo perturbation in the second syllable due to the articulation of [n]. The third syllable [bej], which is also accentuated, begins at csec 22 and the Fo rises 10 Hz over the duration of the syllable. The Fo then begins to decline at the onset of the fourth syllable [de] (csec 46). Phonation ceases at csec 75 with the Fo at 177Hz which is the same level as the contour onset. There is however declination of the Fo between the pitch accent peaks as in the intonation phrase in Figure 4.15. There is however declination in the Fo from the peak of the final pitch accent to the end of the utterance.

There is no Fo declination at all in Figure 4.18 which shows a declarative contour of the speaker JM with continuous upstep. The onset of the contour, which is also the onset of the first accent, is 199Hz. The Fo continues to rise throughout the first word with a perturbation at csec 30 due to the articulation of [y]. During the second word the Fo levels off with a slight decline towards the [b]. The onset of the second accent at csec 82 is 230Hz, which is 31Hz (36% of the Fo range of the intonation
FIGURE 4.19

Interrogative Fo contour with upstep.

FIGURE 4.20

Imperative Fo contour with upstep.
phrase) higher than that of the first accent. The Fo then continues to rise to the offset of phonation. Figures 4.19 and 4.20 show contours which also have the upward trend in Fo that is evident in Figure 4.18. Figure 4.19 is a syntactically interrogative intonation phrase from the same conversation as the contour in Figure 4.18 but is from the other speaker, GW. The second pitch accent of this contour has an onset at csec 57 which is 11Hz, or 17% of the contour Fo range, higher than that of the first pitch accent. Figure 4.20 is an Fo contour of a syntactically imperative intonation phrase of the speaker CG. The Fo on the first word, which is unaccented, remains relatively level except for the perturbation on the initial [ŋ]. The onset of the first pitch accent is at csec 16 and is 187Hz. The second pitch accent has an onset of 193Hz at csec 65. There is a difference of 6Hz or 11% of the contour Fo range between the onsets of the two pitch accents. The syntactically declarative intonation phrases with the continuous upstep, as in Figure 4.18, are derived in the same way as the interrogative contour in Figure 4.19 and the imperative contour in Figure 4.20. Auditorily, the pitch of all three intonation phrases sounds equivalent. Thus a small number of contours in the corpus of syntactically declarative contours have the same shape as some contours which are not declarative.

Table 4.5 gives the minimum, maximum, range and mean and standard deviation for upstepped accents of speakers CG, GW and JM. The values in the table are the difference between the onset of the upstepped AD and that of the preceding AD, expressed as a percentage of the Fo range of the intonation contour. For example, in Figure 4.17 the onset of the second AD (256 Hz) is upstepped from that of the first AD (232 Hz). The 24 Hz difference between these two values is 12 % of the Fo range of the intonation contour (193 Hz).

4.3.5 Contour onsets and offsets

It has been found by many researchers of intonation (eg. of Dutch and English) that a given speaker's lowest utterance-final Fo values are almost constant and can, therefore, provide a fixed end-point from which other parts of the contour can be referenced [Liberman & Pierrehumbert, 1984: 159, 181; Menn and Boyce, 1982: 345; t’Hart et al., 1990: 128]. Ladd [1984:57] considers this to be a "generally accepted and well-grounded fact".
TABLE 4.5

<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th>GW</th>
<th>JM</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>11</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>max</td>
<td>76</td>
<td>66</td>
<td>72</td>
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<tr>
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<td>mean</td>
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</tr>
<tr>
<td>SD</td>
<td>18</td>
<td>23</td>
<td>16</td>
</tr>
</tbody>
</table>

Upstep values expressed as the percentage of the Fo range of the intonation contour.
TABLE 4.6

<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th>GW</th>
<th>JM</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<tr>
<td>mean</td>
<td>206</td>
<td>114</td>
<td>197</td>
</tr>
<tr>
<td>SD</td>
<td>23</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td><strong>OFFSET (no boundary tone)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>169</td>
<td>91</td>
<td>155</td>
</tr>
<tr>
<td>SD</td>
<td>35</td>
<td>23</td>
<td>28</td>
</tr>
<tr>
<td><strong>BOUNDARY TONE (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>271</td>
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<tr>
<td>SD</td>
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<td>&lt; .0001</td>
<td>&lt; .0001</td>
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<tr>
<td>OFFSET / %</td>
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<td>.0043</td>
<td>&lt; .0001</td>
</tr>
</tbody>
</table>

Mean and standard deviation values in Hertz for the onsets, offsets and boundary tones of the speakers CG, GW and JM plus t-test results.

FIGURE 4.21

Mean and standard deviation values for the onsets, offsets and boundary tones of the speakers CG, GW and JM.
I analysed the data to ascertain whether there is a fixed end-point in Dyirbal declarative intonation. Table 4.6 gives the mean and standard deviation Fo values for the onsets and offsets of the intonation phrases in the corpus for the speakers CG, GW and JM. These values are also illustrated in the graph in Figure 4.21. All three speakers have a mean Fo value for the offset (without a boundary tone) that is lower than that of the onset. All three speakers also have the mean value for the boundary tone (which is a high tone) higher than that for the onset and for the offset. As would be expected, the female speaker (CG) has the highest Fo values although the second male speaker (JM) has mean values almost as high. GW, however, has a much smaller difference between the onset and offset values than those of CG and JM.

T-tests were carried out on the Fo values of the onsets, offsets and boundary tones to ascertain whether there was a statistically significant difference in their Fo standard ranges (i.e. the difference between the minimum and maximum values). The probability results of the t-tests are included in the bottom part of Table 4.6. The probability values for CG and JM indicate that their offsets and boundary tones have a statistically significant wider range than that of their onsets - their boundary tones having the widest range. GW's boundary tones, however, have a much narrower range which is not statistically different from that of his onsets. GW's offsets have a significantly wider range than that of his onsets and boundary tones. This result may be due to the fact that there were only three tokens of GW's boundary tone in the corpus.

It can be seen therefore that the wide range of Fo values for the three speakers' offsets contrasts with the well-attested constant end-points found in English and Dutch declarative intonation.

4.3.6 Fo reset at intonation phrase boundaries

The Fo level is usually reset at each intonation phrase boundary. As the previous section shows, where the Fo has declined to a low contour offset, the mean onset of the following intonation phrase is between 22 and 27 percent higher than that of the preceding offset. Following a boundary tone, however, the mean onset is between 24 and 29 percent lower. Table 4.7 gives the Fo reset percentages of the mean onsets for the speakers CG, GW and JM.
No, you disowned him a long time ago.

Fo course showing reset at the onset of the third intonation phrase.
FIGURE 4.23

Fo course of two intonation phrases with reset from a boundary tone to a following onset.

She was my mother’s sister.

[balanbawal majo daraga]

[balanbawal majo daraga] [dureyta]
### Table 4.7

<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th>GW</th>
<th>JM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>offset - onset</strong></td>
<td>22%</td>
<td>25%</td>
<td>27%</td>
</tr>
<tr>
<td><strong>boundary tone - onset</strong></td>
<td>-24%</td>
<td>-29%</td>
<td>-24%</td>
</tr>
</tbody>
</table>

Fo reset values of mean intonation phrase boundaries for the speakers CG, GW and JM.

Figure 4.22 shows the Fo courses of three intonation phrases of speaker GW. The offset of the second intonation phrase occurs at csec 159 and is 83 Hz. The onset of the following intonation phrase is 113 Hz and occurs at csec 174, after a pause of 15 csecs. The onset is 30 Hz higher than the preceding offset which is a reset in the Fo 36% higher than the offset value. There is no reset between the first and second intonation phrases, just a pause of 12 csecs duration. Figure 4.23, on the other hand, has a lowering of the Fo in the reset of the second intonation phrase. The first intonation phrase terminates in a high boundary tone of 428 Hz at csec 94. This is followed by an inaudible Fo perturbation of the type discussed in Section 3.7. The onset of the second intonation phrase is 232 Hz at csec 118. This represents a reset in the Fo of 196 Hz so that the onset is 46% lower than the preceding offset.

The presence and the magnitude of reset between intonation phrases can signal major syntactic boundaries. This is discussed in Chapter 5.

### 4.4 Fo AND PITCH ACCENT PROMINENCE

"Prominence is the property by which linguistic units are perceived as standing out from their environment...Prosodic prominence is associated with suprasegmental characteristics of speech, primarily frequency, duration, and amplitude" [Terken, 1991: 1768].

Experimental research has shown that the accented words of an utterance are generally manifested by a Fo change, longer duration and higher amplitude than their unaccented counterparts. Of these, Fo change has been found to be the most important cue to prosodic prominence [Fry, 1958; Lehiste, 1970: 125-132]. "In a general way, it is known that the perceived prominence of an unaccented syllable is affected
FIGURE 4.24

Fo of six accents with different prominence on the syllable [ŋɛ]- from speaker CG.

FIGURE 4.25

Five Fo contours with different prominence on the word [belen] of speaker CG. The small stroke on each contour marks the centre of the inter-vowel consonant [l].
by pitch range: the greater the pitch range, the more prominent the accent. Unfortunately, "pitch range" is not a well-defined concept. Specifically with respect to accented words and syllables, it can be defined in at least two ways: as the size of the Fo excursion that accompanies the accent, or as the relative height of the Fo peak. Opinions differ about the appropriateness of these two definitions" [Ladd et.al., 1994: 88].

This section looks at the role played by Fo and downstep in the relative prominence of pitch accents in Dyirbal declarative intonation. The lengthening of accented syllables is discussed in Section 4.5.

4.4.1 Degrees of prominence

It is generally assumed that the magnitude of an Fo change signals to the listener the degree of emphasis that the speaker wishes to give particular syllables of an utterance. A greater degree of emphasis results in higher Fo values for the peaks of H* pitch accents [Liberman & Pierrehumbert, 1984: 161].

In Dyirbal declarative intonation the Fo always increases to signal prominence. Figure 4.24 illustrates the varying prominence on identical segments. The graph contains six Fo time-courses of the syllable [ŋe-] for speaker CG. There is a 105 Hz difference between the peaks of Contour 2 (333 Hz) and Contour 6 (228 Hz). Contour 6 is also 14 csecs shorter than, and less than half the duration of, Contour 2. Contour 2 sounds the most prominent of the six accents and Contour 6 sounds the least prominent. The rest of the accents range in prominence between these two extremes. However, without the intuition of native speakers, it is not possible to determine how many different degrees of prominence are represented by these six accents.

Figures 4.25 and 4.26 illustrate the degrees of pitch accent prominence on two disyllabic words. Figure 4.25 shows the Fo contours of five tokens of the noun marker [bələn], in which Contours 1 and 2 have much higher Fo peak values than the other three contours. I am not a native speaker of Dyirbal however these two contours sound to me to be considerably more prominent than the other three contours. The rise from Fo onset to peak of Contours 1 and 2 is at least 150 Hz greater than that of Contours 3, 4 and 5. The Fo peaks in Contours 1 and 2 occur well into the second syllable, considerably later than those of the other
FIGURE 4.26

Four Fo contours of accents on the word [bilən] of the speaker CG. The small stroke on each contour marks the centre of the inter-vowel consonant [l].
contours. The Fo contours in Figure 4.26 are four tokens of the verb [bılən]. Contour 1 has a much greater rise in Fo from onset to peak (337 Hz) than the other three contours, which gives it considerably more prominence. Contour 4 has an Fo rise of only 41 Hz, however, the accented syllable is lengthened to 52 csecs which is 30 csecs longer than that of Contour 1. This syllable lengthening in Contour 4 may add prominence to the pitch accent as, to my non-native speaker's ears, it sounds closer to the degree of prominence of Contour 1 than to the other two contours even though they have higher Fo peaks.

The Fo values of accented syllables in Dyirbal declarative intonation may, therefore, vary considerably according to the emphasis applied to them by the speaker. As I am not a native speaker, my perceptions cannot in any way be considered as conclusive evidence of the role of accent prominence in Dyirbal intonation.

### 4.4.2 Relative prominence

Two accent peaks in an intonation phrase may have the same absolute Fo values but a listener may judge them to have perceptually different degrees of prominence. Pierrehumbert [1979], in her perception experiments on English intonation, found that, where there is an intonation phrase that has two peaks with equivalent absolute Fo values, the second accent will be judged by a listener to be more prominent than the first. The listener makes an allowance for Fo declination between the accents in an utterance and normalises the heights of the accents accordingly. Gussenhoven and Rietveld [1988] verified Pierrehumbert's results in their experiments on Dutch intonation. So, for two accents to be perceived as having equivalent prominence, the absolute Fo value of the second peak actually has to be lower than that of the first peak.

There are many conflicting theories to account for pitch accent prominence, particularly in the treatment of the effects of declination [Cohen, et al., 1982; Gussenhoven & Rietveld, 1988, 1989; Ladd, ms; Liberman and Pierrehumbert, 1984; Pierrehumbert, 1979, 1987; Terken, 1989, 1991]. The two main theories of prosodic prominence are the MAX hypothesis and the CHANGE hypothesis [Terken, 1991]. Section 4.4.2.1 discusses the pitch accents in the corpus according to the MAX hypothesis while Section 4.4.2.2 looks at relative accent prominence in Dyirbal intonation in terms of the CHANGE hypothesis.
<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th></th>
<th></th>
<th></th>
<th>GW</th>
<th></th>
<th></th>
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<th>JM</th>
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</thead>
<tbody>
<tr>
<td></td>
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<tr>
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<td>0.73</td>
<td>1.03</td>
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<td>1.02</td>
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<td>3 2</td>
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<td>(1.30)</td>
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<tr>
<td>1 3</td>
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</tbody>
</table>

Minimum, maximum and range of relative absolute Fo peak values for speakers CG, GW and JM.
FIGURE 4.27

Fo contour of intonation phrase with two tokens of accented [bilàn] and with the second pitch accent more prominent than the first.

FIGURE 4.28

Fo contour of intonation phrase with two accent peaks of equal absolute Fo value.
4.4.2.1 Relative Fo peak values

The MAX hypothesis determines relative prominence by scaling the Fo maxima within the speaker's range. Perception tests are used to determine the extent of influence that declination has on the perceived prominence of pitch accents [Gussenhoven and Rietveld, 1988; Ladd, ms.; Terken, 1991]. Table 4.8 contains the data on relative maxima for speakers CG, GW and JM. The left hand column indicates the relationship between adjacent pairs of accent peaks wherein 1 has the highest absolute Fo value. 2 has the lowest Fo value in a two-accent intonation phrase but 3 is the lowest in a phrase with three accents. Thus '2 1' indicates that the first accent peak has a lower absolute Fo value than that of the second accent peak. The figures in brackets are where there is only one occurrence in the data.

The values in Table 4.8 are calculated as the ratio of the absolute Fo value of the second peak in relation to that of the first peak. For example, in Figure 4.27 the absolute Fo value of the first peak is 244 Hz and that of the second peak is 95 Hz higher at 339 Hz. The second peak, then, is calculated as being 1.39 times as high as the first peak (that is, 39% higher). There is, therefore, a '2 1' relationship between the two accents. The minimum, maximum and range ratios are also given in Table 4.8 to demonstrate the variability of absolute Fo peak values. Therefore, for CG's '2 1' peak relationship, the minimum ratio of the second peak in relation to the first is 1.02. The lowest second peak has an absolute Fo value just 2% higher than that of the preceding peak. CG's maximum ratio for '2 1' peaks is 1.75 which indicates that the second peak can have an absolute Fo value that is 75% higher than that of the first peak. The difference between the minimum and maximum ratios is a range of 0.73.

The perception tests carried out by Gussenhoven and Rietveld [1988:358] indicate that, in Dutch, the second peak must be "on average 3.7%, or 6.5 Hz, lower than the first" for the two peaks to have perceived equal prominence due to the "declination effect". So, in Dutch, of two peaks which have a peak height ratio higher than 0.963, the second peak is perceived as being more prominent than the first peak. Without the prominence judgements of native speakers, however, it is not possible to conclusively determine the relative prominence of the Fo peak ratios for Dyirbal according to the MAX hypothesis. It can be suggested, however, that, of two peaks in Dyirbal that have a height ratio of 1 or greater, the
TABLE 4.9

<table>
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<th>GW</th>
<th>JM</th>
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</thead>
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<td>1 2</td>
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<td>41</td>
<td>30</td>
</tr>
<tr>
<td>2 1</td>
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<td>3 2 1</td>
<td>14</td>
<td>9</td>
<td>9</td>
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</tbody>
</table>

The ordering and percentages of occurrence of absolute Fo peak ratios in the corpus.

FIGURE 4.29

Onset-to-peak measurement of the Fo course of an accent.
second accent will be perceived as being more prominent than the first. The ratio of 1 indicates that the two peaks have equivalent absolute Fo peak values which, due to the listener's normalisation for the declination effect, means the second accent will be perceived to be more prominent, such as in Figures 4.27 and 4.28. Both peaks in Figure 4.28 have an absolute Fo value of 303 Hz but, due to the downward trend in the Fo between the accents, the second peak is likely to be perceived as being more prominent than the first accent. The relationship between the two accents, then, is '2 1' (The second accent also has syllable lengthening which most likely adds to its prominence).

Table 4.9 gives the ordering of absolute Fo peak values and the percentages of their occurrences within two- and three-accent intonation phrases for speakers CG, GW and JM. Two-accent phrases of both the '1 2' and '2 1' types have the greatest occurrence of those intonation phrases with more than one pitch accent.

### 4.4.2.2 Relative Fo rise values

In the CHANGE hypothesis, the "[p]erceived prominence is a function of the extent of Fo change: Greater changes result in more prominence, regardless of how these changes are scaled in the speaker's range" [Terken, 1991: 1768]. The extent of the Fo change is measured from a reference point to the accent peak to account for the listener's normalisation of the declination effect. t'Hart and his colleagues, in their analysis of Dutch intonation, measure the Fo excursions from a declination line fitted to the valleys of the contour. Ladd argues against the use of the declination line as a reference line from which to measure Fo peaks.

"Along with the global downward trend of contours, there is a gradual downward modification of the frame of reference for interpreting the local Fo events that make up the contour ... [T]his gradual downward modification of the frame of reference can be present without being directly manifested as gradually declining Fo. Clarifying the close interrelationship between actual downward pitch trends and perceived linguistic equivalence of pitch range is thus central to an understanding of how declination works" [Ladd, ms.].

In this analysis, downstep levels are used as the reference point
FIGURE 4.30

Fo contour of intonation phrase with two tokens of accented [bilən] with downstep line fitted.

FIGURE 4.31

Fo contour of intonation phrase with two accent peaks of equal absolute Fo value and downstep line fitted.
rather than a declination line. As described in Section 4.3, the downstep levels were calculated at the onset of the Fo rise. The Fo change signalling an accent was calculated as the difference in Fo values between the onset and the peak, measured in Hertz, as shown in Figure 4.29. To establish the relative prominence of two pitch accents, the onset-to-peak measurement of the second accent was calculated as a ratio of that of the first accent. For example, the contour in Figure 4.27 is fitted with a downstep line in Figure 4.30. The onset value for the first accent is 214 Hz whereas that of the second accent is 179 Hz, a downstep of 35 Hz. The first accent has an onset-to-peak measurement of 30 Hz while that of the second accent is 160 Hz. The rise from the downstep line to the second peak, therefore, is 5.33 times that of the first accent (that is, 533% greater).

The Fo course in Figure 4.28 has also been fitted with a downstep line in Figure 4.31. Although both peaks of the accents have the same absolute Fo value, the onsets do not; that is, they are downstepped. The first accent has an onset of 262 Hz while that of the second accent has been downstepped by 60 Hz to 202 Hz. The onset-to-peak measurement for the first accent is 41 Hz and that of the second accent is 95 Hz. The rise of the second accent, then, is 2.32 times that of the first accent (i.e. 232% greater). The contours in both Figure 4.30 and 4.31, thus, have considerably more prominent second accents in relation to the first.

Table 4.10 contains the data on relative Fo rises for speakers CG, GW and JM. The lefthand column indicates the relationship between the onset-to-peak measurements of adjacent accents wherein 1 has the highest Fo value. 2 has the lowest onset-to-peak Fo value in a two-accent intonation phrase but 3 is the lowest in a phrase with three accents. Thus '2 1' indicates that the onset-to-peak measurement of the first accent has a lower Fo value than that of the second peak. The ratios in the table are of the onset-to-peak measurement of the second accent in relation to that of the first accent. The minimum, maximum and range of the ratios are given to demonstrate the variability of the onset-to-peak measurements of the accents. Thus, for CG’s '2 1’ accent relationship, the minimum ratio of the onset-to-peak measurement of the second accent in relation to that of the first accent is 1.26. CG’s maximum ratio for ‘2 1’ onset-to-peak measurements is 5.07 which indicates that the second peak can have an onset-to-peak value that is around five times greater than that of the first peak. This would suggest, then, that the second accent can be considerably more prominent than the first accent. The difference between the
### TABLE 4.10

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th>GW</th>
<th></th>
<th></th>
<th>JM</th>
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<tbody>
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</table>

Minimum, maximum and range of relative Fo accent rise values for speakers CG, GW and JM.

### TABLE 4.11

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</tr>
</tbody>
</table>

The ordering and percentages of occurrence of Fo accent rise ratios in the corpus.
minimum and maximum ratios is a range of 3.81.

Table 4.11 gives the ordering of relative Fo rise values within utterances and the percentages of their occurrence within two- and three-accent intonation phrases for speakers CG, GW and JM.

### 4.4.2.3 Summary

As can be seen from the data in Tables 4.9 and 4.11, the two approaches to relative prominence produce quite different results. The data in Table 4.9 has not been normalised for the declination effect whereas those of 4.11 have had the downstep factored out. Obviously, this is by no means a conclusive analysis of relative pitch accent prominence in Dyirbal intonation. The prominence judgements of native speakers are necessary to have any definitive description of pitch accent relationships. The frame-of-reference for relative pitch accent prominence is very difficult to determine and is a matter of contention between intonation researchers.

"(W)e must acknowledge that what we are looking for is some sort of abstract reference value in a comprehensive model of pitch range. We must keep in mind that "the baseline" drawn through Fo valleys *is a theoretical construct* ...we must always keep in mind that more appropriate constructs may be found" [Ladd, ms.].

In the absence of a 'more appropriate abstract reference value', it is still possible, however, to determine a certain relationship between the pitch accents in many intonation phrases in the corpus. Pairs of adjacent accents, of which the second accent has a higher absolute Fo value than the first, occur in the following proportions for each of the three main speakers:

- CG 42%
- GW 55%
- JM 68%

If it is assumed that speakers of Dyirbal normalise for declination, as was found in English by Pierrehumbert [1979] and in Dutch by Gussenhoven and Rietveld [1988], then it can be extrapolated that the corpus contains a greater number than the above percentages suggest of second accents which are perceived as being more prominent than the first.

The perceived prominence of pitch accents is an area of intonation that is not as yet fully understood. "The most that can be said with
Percentage of lengthened syllables which are accented or phrase-final.

<table>
<thead>
<tr>
<th>SPEAKER</th>
<th>PITCH ACCENT</th>
<th>PHRASE-FINAL SYLLABLE</th>
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</thead>
<tbody>
<tr>
<td>CG</td>
<td>86%</td>
<td>81%</td>
</tr>
<tr>
<td>GW</td>
<td>44%</td>
<td>35%</td>
</tr>
<tr>
<td>JM</td>
<td>46%</td>
<td>63%</td>
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certainty at this point in the development of our understanding is that there is some relationship between perceived prominence and pitch range, but that further empirical data and further attempts at modeling the overall use of the voice pitch range in ordinary speech will be required before the relationship becomes completely clear" [Ladd, et.al., 1994: 88].

4.5 SYLLABLE LENGTHENING

As was discussed in the introduction, length is one of the three main features of intonation, along with pitch and loudness. Changes in the duration of a segment can provide the listener with various cues as to the speaker's intended meaning of an utterance. Length can be used to give emphasis to accented words and on utterance-final words can be used to indicate syntactic boundaries. This section discusses the length of segments which occur with a pitch accent or a utterance-final syllable.

4.5.1 Syllable lengthening in Dyirbal

The data for the speakers CG, GW and JM were examined in regard to syllable lengthening (there was insufficient data for MD and PB). Vowels in the corpus were divided into three groups - those belonging to accented syllables, those occurring utterance-finally and those which do not occur in either of these positions. The durations of these vowels were measured and compared. The same was done with the consonants in the corpus. Those segmentals which were unaccented and which were not utterance-final formed the control group against which the other two groups were measured for lengthening. The mean was calculated for the measurements of each group. It was found that not all syllables occurring with pitch accents, or that are utterance-final, are subject to lengthening and that this phenomenon varied between speakers. Table 4.12 shows the percentages of pitch accents and utterance-final syllables, for each speaker, which have syllable lengthening. CG employed syllable lengthening to a far greater degree than the other two speakers. GW and JM both lengthened their syllables with pitch accents in just under half of the cases but varied considerably in their rate of lengthening on the phrase-final syllables.
Mean and standard deviation values for the durations of unlengthened vowels, plus accented lengthened vowels and lengthened vowels in phrase-final syllables, for the speakers CG, GW and JM.
4.5.2 Vowel Lengthening

In all but six cases the syllable lengthening fell on the vowel. Table 4.13 shows the mean durations in centiseconds of vowel phonemes which are unlengthened (/a i u/), those which are accented and lengthened (/a* i* u*), and those which occur utterance-finally and are lengthened (/a_i u_i/). The standard deviations (SD) for these values are also given. The difference (diff) between the mean durations of corresponding unlengthened and lengthened vowels is given in centiseconds and in ratio form. The figures in brackets are those where only one case of that phoneme appears in that position in the data. The intrinsic duration of the segmentals is averaged out by taking the mean and standard deviation values.

Table 4.13 shows that, when a vowel is lengthened in an accented or phrase-final syllable, the length is increased by a minimum of 50%. This result is comparable with those of some other languages. Lehiste [1970: 36] states that, in English, the accented vowels tend to be approximately 50% longer than unaccented vowels while Fry [1968: 370] found that in "German, stressed syllables regularly contain vowels of greater length than the corresponding unstressed syllables".

4.5.3 Consonant Lengthening

The vast majority of intonation-phrase-final segments in the data are vowels. CG's data, shown in Table 4.14, however, has six instances of a final [n], all of which are lengthened by an average of 173%. In only one of the intonation phrases with final [n] lengthening is the vowel preceding the [n] also lengthened (by 60%). In two cases the preceding vowel is reduced to [ə] while in the remaining three instances the vowel retains normal length. In most cases where the final syllable of an intonation phrase ended in a consonant, there was no syllable lengthening.
Mean and standard deviation values for the durations of unlengthened /n/, and phrase-final lengthened /n/, for speaker CG.

<table>
<thead>
<tr>
<th></th>
<th>non-phrase-final /n/</th>
<th>phrase-final /n/</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean</td>
<td>7.06</td>
<td>19.26</td>
</tr>
<tr>
<td>SD</td>
<td>1.71</td>
<td>4.46</td>
</tr>
<tr>
<td>DIFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>csecs</td>
<td></td>
<td>12.2</td>
</tr>
<tr>
<td>ratio</td>
<td></td>
<td>2.73</td>
</tr>
</tbody>
</table>
4.5.4 Perception of Lengthening

Perception tests on segmental length have shown that just-noticeable differences (JND) in duration are between 1 and 4 centiseconds. Although frequency has no influence on the magnitude of JNDs, intensity does; the greater the intensity, the smaller the JND [Lehiste, 1970: 13, 17].

The hearer, then, can detect quite small differences in length and interpret their relevance accordingly. The lengthening which occurs in the Dyirbal data, with two exceptions, is well above the maximum JND (ie. 4 csecs) whilst GW's /a*/ is well above the minimum JND of 1 csec. This would suggest that the lengthening would be quite perceivable to Dyirbal speakers and may have significance in an utterance. It is impossible to determine the definite significance of the lengthening in Dyirbal intonation, assuming in fact there is one, without recourse to the help of native speakers. However it may be that in Dyirbal, as in some other languages, lengthening with an accent is for added emphasis and, in a phrase-final syllable, indicates major syntactic boundaries. The possible significance of the lengthening of utterance-final syllables is in Chapter 5.

4.6 SUMMARY OF RESULTS AND DISCUSSION

Dyirbal declarative intonation has two tones - a pitch accent (/*/) and a boundary tone (/%/). The pitch accent is signalled by a rise in pitch is phonetically realised as [LHL]. The accent peak can occur anywhere within the same syllable as the accent onset or within the following syllable. The boundary tone is manifested as a rise in pitch on the final syllable of the intonation phrase and its phonetic realisation is [H].

The tones are concatenated into intonation contours which must have one, two or three pitch accents and which may or may not have a boundary tone. The contour offsets without a boundary tone tend to have lower Fo values than those of the onsets while those of the boundary tones are higher. The majority of intonation phrases have a downward trend in the Fo between the accents and this can be accounted for by declination within the Association Domains of the pitch accents and as downstep from one Association Domain to the next. A small
number of intonation phrases display a form of upstep similar to that of some interrogative and imperative contours in Dyirbal intonation.

The pitch accents receive a wide variation of prominence according to the amount of emphasis a speaker wishes to give a syllable. It is difficult to determine the relative prominence of the pitch accents within an intonation phrase without the judgements of native speakers, but it appears that an accent can be endowed with the most prominence regardless of whether it is the first, second or third accent in the intonation phrase. There is also evidence of syllable-lengthening associated with the pitch accents and boundary tones in which the vowels are lengthened by over 50%.
"What should be established first are the prosodic categories and subcategories that are involved (peaks vs. valleys, syllable alignment, etc.), then the phonetic variation should be established within these formal elements, finally the question should be asked as to how the different phonological categories are related to syntactic structures and further semantic differentiation" [Kohler, 1991c: 17 (my emphasis)].

The constructs with which to describe Dyirbal declarative intonation were determined in Chapter 4, so it is now possible to investigate their relationship to syntactic and pragmatic structure.

This chapter first provides a brief outline of pragmatic structure in Section 5.1 and of the syntax of Dyirbal in Section 5.2. Sections 5.3, 5.4 and 5.5 discuss the relationship of the intonation with, respectively, the syntactic phrases, the syntactic clauses and the topic chains in Dyirbal declarative utterances. In Section 5.6 the relationship between the intonation, word order and word classes is explored. Section 5.7 discusses the significance of the boundary tone and Section 5.8 summarises the chapter.

5.1 PRAGMATIC STRUCTURE

"In any sequence of sentences, it is essential to mark elements as being more or less important or essential. Speakers and writers
are responsible for highlighting certain elements and backgrounding other elements, exactly as a painter highlights particular details and de-emphasises others with a judicious use of colour, shape and position" [Finegan, et.al., 1992: 175].

Some words are considered to be [+focus] and it is these words that are generally expected to be assigned a pitch accent to make them more prominent than those which are [-focus] (Faber, 1987; Gussenhoven, 1984: 14-15; Lindsey, 1981; Pierrehumbert & Beckman, 1988: 93-99). The languages in which accenting of [+focus] words has been documented instrumentally include English, Swedish, Dutch, Danish, Mandarin and Hausa.

"The concept of focus has been discussed in the literature as focus ..., comment ..., rHEME ..., new (information) ... while their counterparts are called, respectively, presupposition ... or deaccenting ..., theme and given or old (information)" [Gussenhoven, 1984: 14].

The two major categories of communicative structure which are most relevant to this analysis are the distinctions between given and new information and between topic and comment. The following two sections give a brief outline of these two categories.

5.1.1 Given and new

*Given information* is information which the speaker assumes is known by the addressee from preceding discourse and/or from the context of the situation. Given information typically includes pronouns and unstressed noun phrases or it may be simply omitted from a sentence. *New information*, on the other hand, is information which is newly introduced into the discourse and which the speaker assumes is unknown to the addressee [Finegan et.al., 1992: 176-177].

The following example illustrates the distinction between given and new information in English:

Simon: What would have made those tracks?
Emily: A goanna would have made those tracks.
Emily's answer to Simon's question contains both new and given information. A *goanna* is the freshly introduced information and is thus new information. The given information *would have made those tracks* is recoverable from Simon's question and could have been left out altogether without affecting Simon's understanding of Emily's reply.

Pronouns can also be used to represent given information. For example,

> I wanted to show Ernie those photos last night. He wasn't home so I left them with George.

*Ernie* and *photos* are both given information in the second sentence. The speaker assumes that the addressee knows that *he* refers to *Ernie* and that *them* is the pronoun representing *photos*.

The following is an example of given and new information in two utterances of Dyirbal taken from the corpus of data for this study. In (1a) both *ŋa đa* 'I' and *wubu* 'orphan' are new information. However in the following sentence (1b) *ŋa num* 'didn't know' is the new information and *ŋa đa* is old information since it was already mentioned in the previous utterance. In (1b) *ŋa đa* has been placed at the end of the utterance whereas in (1a), where it is new information, it occurs at the beginning of the utterance.

\[(1a)\]

\[
\begin{align*}
\text{ŋa đa} & \quad \text{wubu} \\
I & \quad \text{orphan}
\end{align*}
\]

'I (was an) orphan'.

\[(1b)\]

\[
\begin{align*}
\text{ŋa num} & \quad \text{ŋa đa} \\
\text{didn't know} & \quad I
\end{align*}
\]

'I knew nothing'.

Whilst the corpus does contain utterances which have given information at the beginning, there are many more cases of the given information
being placed in a position other than utterance-initial.

The following two Dyirbal utterances taken from the corpus illustrate how given information can be left out altogether. bangun 'she' and najguna 'me' are the subject and the object respectively of both utterances. These two words are also given information in both utterances. In (2a) both words precede the verb gulgan 'breastfed' however in (2b) they are left out altogether and only the new information is overt.

(2a)

\[
\text{bangun najguna gulgan}
\]

\[
\text{she me breastfed}
\]

'She breastfed me'

(2b)

\[
\text{bulganman dan\text{\'}a}
\]

\[
\text{made big now}
\]

'(She) made (me) big now'

('now' refers to time within the story)

It appears from the corpus that given information is most likely to be left out in a discourse and only repeated occasionally where clarity is required.

5.1.2 Topic and comment

"The topic of a sentence is what the sentence is about, its point of departure. The notion of topic is opposed to the notion of comment, the part of the sentence that says something about the topic" [Finegan et.al., 1992: 178].

The topic is often represented by given information and comment by new information. However, this is not always the case as there is no one-to-one correspondence between the given/new contrast and the topic/comment contrast, as shown in the following examples [taken from Finegan, et.al., 1992: 178]:
(i) Topic as given information and comment as new information:

Speaking of Mary, she ate the custard.

*Speaking of* indicates that the NP *Mary* is given information although it is also the topic. The comment *she ate the custard* is also the new information.

(ii) Topic as new information:

Mary ate the custard. As for her little sister, she drank the cod-liver oil.

The NP *her little sister* is both the topic and new information.

(iii) Comment as given information:

Jack believed everything the charlatan said, and Jill did too.

The underlined element is given information which is also serving as the comment.

In the following Dyirbal sentence taken from the corpus the topic is the NP *balan ŋamun* 'her breasts' and the remainder is the comment. The topic NP in this sentence is also new information and it has been positioned at the beginning of the utterances as is the majority of cases in the corpus [see Sections 5.2.6 and 5.5 for further discussion of topic NPs].

```
balanŋamun ɗubiŋu ɗuŋaŋu ŋamun majili
her breasts rubbed water weed milk make flow
```

'(She) rubbed her breasts with water weed to make the milk flow'.

It will be shown in Section 5.6 how these categories of pragmatic structure along with the syntax are determining factors in the intonation of Dyirbal.
5.2 DYIRBAL SYNTAX

The following is a brief summary of those parts of Dyirbal syntax which are relevant to the discussion of the declarative intonation with examples extracted from the corpus. For a fully detailed description of the grammar of Dyirbal, see Dixon [1972].

5.2.1 Nominals

5.2.1.1 Nouns and adjectives

Nouns and adjectives inflect for case in a nominative - ergative (NOM-ERG) system in which the intransitive subject (S) and the transitive object (O) take the same inflection while the transitive subject (A) takes a different one [Dixon, 1972:42]. There are nine cases for Dyirbal nominals, of which four occur much more frequently in the corpus than the others. These are:

- NOMINATIVE (NOM) marks the intransitive subject and the transitive object; has zero case-marking. (Note that Dixon's use of the term NOMINATIVE to include the transitive object differs from the widely accepted use of NOMINATIVE).

- ERGATIVE (ERG) marks the transitive subject; has the following four allomorphs: -ŋu / -gu / -tu / homorganic stop plus -u

- DATIVE (DAT) affix -gu added to word stem

- LOCATIVE (LOC) affixes identical to those of ERG except they have a final -a rather than -u

The first three cases - NOM, ERG and DAT - mark syntactic relations while LOC gives information about location. The following table gives examples of the case inflections on nouns:
5.2.1.2 Noun markers (NM)

Each noun in Dyirbal belongs to one of four noun classes but the class is not overtly marked on the noun itself. The "noun is normally accompanied by a 'noun marker' (NM) that shows its class, agrees with it in case, and also yields information on the location of the referent of that occurrence of the noun." [Dixon, 1972:44].

Noun markers can occur without their corresponding noun and serve a similar role to that of a pronoun.

5.2.2 Pronouns

Dyirbal has the following pronouns:
(i) first person singular (1sg)
(ii) first person dual (1dl)
(iii) first person plural (1pl)
(iv) second person singular (2sg)
(v) second person dual exclusive (2dl.excl.)
(vi) second person plural exclusive (2pl.excl.)

The Mamu dialect also has a 1dl pronoun for speaker and spouse.

Dyirbal does not have any third person pronouns. Noun markers are used to fulfil that role [Dixon, 1972: 49-51].

"Superficially, pronouns in (the Jirrbal and Mamu dialects) follow a 'nominative-accusative' (NOM-ACC) pattern, with one pronominal form functioning as transitive (A) or intransitive subject (S), and another as transitive object (O). There is, however, a great deal of syntactic evidence for the view that both nouns and pronouns follow an underlying nominative-ergative pattern" [Dixon, 1972: 50].

Thus, although S and O pronouns have different forms while S and O nouns have the same form, S and O in both nouns and pronouns are syntactically identified [Dixon, 1972: 132]. Dyirbal pronouns also inflect for the DATIVE and SIMPLE GENITIVE cases.

5.2.3 Noun phrases (NP)

5.2.3.1 Non-pronominal noun phrases

A non-pronominal noun phrase most often consists of a head noun accompanied by a noun marker, for example

\[ \text{[balan jabujabu]}_{NP0} \]

she - NOM mothers - NOM

noun marker class II head noun

However, the following forms are also quite acceptable in Dyirbal:
(i) head noun only
e.g. [jabungu] \text{NPA} \quad \text{mother-ERG}

(ii) noun marker only
e.g. [balan] \text{NPO} \quad \text{she-NOM}

(iii) adjective only
e.g. [talma] \text{NPs} \quad \text{on my own-NOM}

(iv) head noun with adjective(s)
e.g. [muraj dudu] \text{NPs}
\quad \text{hair-NOM bushy-NOM}

\quad \text{head noun adjective}
\quad \text{'bushy hair'}

(v) noun marker with adjective(s)
e.g. [baji manqaj] \text{NPs}
\quad \text{he-NOM full up with food-NOM}

\quad \text{noun marker adjective}
\quad \text{'He (was) full up with food'.}

(vi) head noun with noun marker and adjective(s)
e.g. [nogi namuj bajji] \text{NPO}
\quad \text{mother's left all he-NOM}

\quad \text{father-NOM alone-NOM}

\quad \text{head noun adjective noun marker}
\quad \text{'(My) grandfather (was) left all alone'.}

A non-pronominal noun phrase can also contain a second, 'modifier', noun which cannot be accompanied by a corresponding noun marker [Dixon, 1972: 60-62].

5.2.3.2 Pronominal noun phrase

"An NP (noun phrase) can contain a pronoun, instead of noun-plus-marker, as head; the rest of the phrase can then be as described above" [Dixon, 1972: 63].

Thus a pronominal NP can take the following forms:

(i) pronoun only
e.g. [nada] \text{NPs} \quad 1sg-NOM
(ii) pronoun with noun
eg. [ŋajgu ɲuma] NPs
   1sg-GEN grandfather-NOM
   pronoun noun
   'my grandfather'

(iii) pronoun with noun marker
eg. [baji ŋajgu] NPo
   he-NOM 1sg-GEN
   noun marker pronoun
   'he (is) mine'

(iv) pronoun with adjective(s)
eg. [ŋalma ɲaŋa] NPs
   on my own-NOM 1sg-NOM
   adjective pronoun
   'I (was) on my own'

(v) pronoun with noun and noun marker
eg. [ŋajgu bagun wujgigu] NPs
   1sg-GEN she-DAT old person-DAT
   pronoun noun marker noun
   'my old lady'

5.2.4 Verbal complexes (VC)

A verbal complex (VC) can contain any number of verbs and adverbals which agree in both surface transitivity and tense or other inflection. VCs can also include verb markers (VM) - which provide locational qualification for the verb - and/or locational nominals [Dixon, 1972: 64]. The following are three examples of verbal complexes:

[wugal - ɗaj - ɗu] vc
give - all of object - PURP
verb + aspectual affix + inflection
'to give it all away'

[wuga - li ɗidi - ma - li] vc
give - PURP food - transitive - PURP
verbaliser
verb + inflection noun + verbaliser + inflection
'so as to be able to feed (me)'
5.2.5 Copular complements (CC)

A copular complement (CC) occurs in those clauses that do not contain a verbal complex and thus forms the predicate to the topic NP which must be in NOM case [Dixon, 1972: 70]. For example:

\[[nadə dana] NPs \{ban wubu\} CC\]

\(1sg\)-NOM this one pronoun there noun marker orphan-NOM noun

'I was an orphan girl'

5.2.6 Clauses and topic chains

Each clause in Dyirbal normally contains a verbal complex plus at least one noun phrase or an intransitive subject noun phrase and a copular complement. The clauses, which can be regarded as simple sentences, then form into topic chains. A topic chain is a sequence of clauses which have a common noun phrase with a common referent. The topic NP, which must be in nominative case, "may only be stated once, at the beginning of the topic chain; optionally all or part of it may be repeated later in the chain (commonly, just the noun marker may be repeated)" [Dixon, 1972: 71]. This is probably the case because, once the topic NP has been stated at the beginning of the topic chain, it then becomes given information. Verb complexes which occur subsequent to the first VC in the topic chain are normally marked as 'implicated' VCs. In an implicated VC the tense inflection is replaced by the \textit{purposive} inflection [Dixon, 1972: 67-8].
5.2.7 Word order

Word order is employed by many languages to mark differences in communicative structure. In English the word order also has to mark grammatical relations such as subject and object. For instance when the two NPs in

The cat is chasing the dog.

are reversed, the meaning of the sentence is changed.

The dog is chasing the cat.

*The dog* has become the agent and *the cat* is now the patient [Finegan, et.al., 1992: 185].

In Russian, however, the NP for *the cat* does not have to precede the NP for *the dog*. The subject is marked by the suffix -a and the direct object by - u. These inflections make it clear to the addressee who is chasing whom. Thus any of the following sentences can be used to convey the same meaning:

koška presleduet sobaku

*cat is chasing dog*

sobaku presleduet koška

presleduet koška sobaku

presleduet sobaku koška

koška sobaku presleduet

sobaku koška presleduet

[Finegan, et.al., 1992: 185].

"The differences among these versions of the same sentence reside in their communicative structure. Among other things, in Russian word order marks given and new information. The *wh*-question Što Koška presleduet? 'What is the cat chasing?' can only be answered as follows:

koška presleduet sobaku

*cat is chasing dog*

'The cat is chasing the dog'" [Finegan, et.al., 1992: 185].
The answer to the question Što presleduet sobaku? 'What is chasing the dog?' must be

sobaku presleduet koška

dog is chasing cat

'The cat is chasing the dog'

Thus in a Russian sentence the given information (rather than the subject as in English) comes first and the new information last [Finegan, et.al., 1992: 185].

Dyirbal, like Russian, has been considered to be a language in which the speaker has virtually free choice over the ordering of words in an utterance due to the inflectional system [Comrie, 181:82; Dixon, 1972].

"Dyirbal is an example of a living language with an order that is totally free, with the exception of certain particles and cases of multiple embedding. That is, any order of words CAN occur (although, of course, every possible order does not occur with equal frequency). But despite this, speakers are definitely aware of a norm word order, to which they will more closely adhere in elicitation than in conversation" [Dixon, 1972: 148].

The 'preferred' word order for Dyirbal is set out below, however, a speaker may choose to ignore these preferences at any time. [Dixon, 1972:.291]:

- time qualifiers before all other words
- some particles prefer to precede all but time qualifiers
- a [+actor] pronominal NP tends to precede any other NP
- NOMINATIVE noun phrases (NPs and NPo) precede ERGATIVE (NPA) and DATIVE (NPDAT) noun phrases
- ERGATIVE noun phrases (NPA) precede the verb
- DATIVE noun phrases (NPDAT) follow the verb
- some particles prefer to immediately precede the verb
- certain particles must precede the verb
- verb markers & locational nominals follow the verb
- a noun marker precedes its noun
<table>
<thead>
<tr>
<th></th>
<th>INITIAL WORD</th>
<th>FINAL WORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP A</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>NP S</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>NP O</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>VC</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>NP LOC</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>NP DAT</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CC</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>TIME QUALIFIER</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>OTHER</td>
<td>17</td>
<td>8</td>
</tr>
</tbody>
</table>

Percentages of grammatical structures which occurred as the first word and the final word of the intonation phrases within the corpus.
• an adjective follows a noun, noun marker or pronoun  
• an adverbial precedes a verb  
• a relative clause follows the noun it qualifies  
• a possessive phrase precedes the noun it qualifies  
• a demonstrative noun marker precedes all else in a NP

In Section 5.6.3 I shall present prosodic evidence which suggests that, although the word order in Dyirbal is free in that it is not determined by syntactic functions, there are certain pragmatic constraints which determine the word order in certain parts of a declarative utterance. It will be demonstrated how pragmatic rules dictate that the most salient constituents in an utterance must occur at the beginning and the end of the utterance and that this is reflected in the placement of pitch accents. The majority of the intonation phrases in the corpus have a pitch accent on the first word, and where there is more than one accent, another on the final word.

5.3 SYNTACTIC PHRASES AND INTONATION

Crystal [1969: 262] found for English that "[f]orty-six per cent of all (grammatical) structures after the beginning-point (of the intonation phrase) were Subjects ... but the highest percentage for structures preceding the end-point was only 36 per cent (for Complements) ... In other words, the beginning point of the tone-unit (intonation phrase) is clearly more predictable than the end."

The situation appears to be the reverse in Dyirbal. The grammatical form of the final word of an intonation phrase is more predictable than that of the first word.

Table 5.1 gives the percentages of the grammatical structures for the first and the final word of the intonation phrases in the Dyirbal corpus which contain more than one word. The subject NPs (NP_A and NP_S) together are the predominant structure (37%) at the beginning of an intonation phrase whereas the verbal complex (VC) is the most common (50%) in the final position.
TABLE 5.2

<table>
<thead>
<tr>
<th></th>
<th>ACCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPA</td>
<td>8</td>
</tr>
<tr>
<td>NPS</td>
<td>8</td>
</tr>
<tr>
<td>NPO</td>
<td>12</td>
</tr>
<tr>
<td>VC</td>
<td>41</td>
</tr>
<tr>
<td>NPLoc</td>
<td>5</td>
</tr>
<tr>
<td>NPDat</td>
<td>7</td>
</tr>
<tr>
<td>CC</td>
<td>4</td>
</tr>
<tr>
<td>TIME QUALIFIER</td>
<td>7</td>
</tr>
<tr>
<td>OTHER</td>
<td>8</td>
</tr>
</tbody>
</table>

Percentages of syntactic constituents which received the accent in the single-accent intonation phrases in the corpus.

TABLE 5.3

<table>
<thead>
<tr>
<th></th>
<th>ACCENT 1</th>
<th>ACCENT 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPA</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>NPS</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>NPO</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>VC</td>
<td>18</td>
<td>50</td>
</tr>
<tr>
<td>NPLoc</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>NPDat</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CC</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>TIME QUALIFIER</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>OTHER</td>
<td>10</td>
<td>6</td>
</tr>
</tbody>
</table>

Percentages of syntactic constituents which received the first and the second accents in the two-accent intonation phrases in the corpus.
5.3.1 Accent assignment in syntactic phrases

A syntactic phrase in Dyirbal can have up to two pitch accents assigned to it, although, if the phrase does not carry any salient information, it can be totally unaccented. Thirty-three percent of the intonation phrases in the corpus contain a syntactic phrase with two accents.

Tables 5.2, 5.3 and 5.4 give the percentages of accent assignment for the main syntactic constituents in the corpus. As can be seen from these tables the verbal complex (VC) is the constituent that was assigned the most accents in the corpus. In intonation phrases with two accents (Table 5.3) almost three times as many accented VCs were assigned the second accent than received the first accent. In the three-accent intonation phrases (Table 5.4) the majority of accented VCs took the second or third accent in the intonation phrase. Accented subject NPs (NP_A and NP_S) tended to be assigned the first accent in a two-accent intonation phrase. In three-accent intonation phrases the accented NPs took the majority of the first accents (34%) and a reasonable number of second accents (15%). The accenting of NP_A in three-accent intonation phrases was, however, quite minimal. The object NPs (NP_O) had the second highest number of accents in the single accent intonation phrases (12%). Accented NP_O were evenly distributed between the first and second accent assignments in three-accent intonation phrases.

The low incidence of NP accenting compared to that of VCs is in part due to the fact that some NPs can be deleted from an utterance whereas a VC must remain overt. Seventy-two percent of the intonation phrases in the corpus had at least one NP (46% had one NP, 24% had 2 NPs and 2% had 3 NPs). The accenting of the constituents also shows a pattern that is consistent with the preferred word order listed in Section 5.2.7. The NPs tended to take the accents which were earlier in the utterance than did the VCs. This suggests that there was a tendency for NPs to precede VCs within the intonation phrases.

5.3.1 Boundary cues of syntactic phrases

Intonation has been shown to play a role in the perception of syntactic phrases in English. Listeners use declination as well as a fall-rise
TABLE 5.4

<table>
<thead>
<tr>
<th></th>
<th>ACCENT 1</th>
<th>ACCENT 2</th>
<th>ACCENT 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPA</td>
<td>9</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>NPs</td>
<td>34</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>NPo</td>
<td>20</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>VC</td>
<td>9</td>
<td>49</td>
<td>60</td>
</tr>
<tr>
<td>NPLoc</td>
<td>9</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>NDPat</td>
<td>3</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>CC</td>
<td>3</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>TIME QUALIFIER</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>OTHER</td>
<td>8</td>
<td>-</td>
<td>2</td>
</tr>
</tbody>
</table>

Percentages of syntactic constituents which received the first, second and third accents in the three-accent intonation phrases in the corpus.

FIGURE 5.1

'I knew nothing (about) her.'

The Fo course of an intonation phrase which has the two words of a copular complement (CC) separated by another syntactic constituent (NPs). (The dotted lines indicate the word boundaries).
pattern in the Fo and phrase-final segmental lengthening as cues to phrase boundaries in English [Cooper & Sorensen, 1981: 117-134; O'Shaughnessy and Allen, 1983: 1156; Pierrehumbert, 1979; Scott, 1982; Streeter, 1982].

Phrases in Dyirbal, however, do not appear to be delineated by the intonation as they are in English. The freer word order in Dyirbal means that the words of a phrase can be split up within an utterance; that is, the words belonging to a particular phrase do not have to occur consecutively as they do in English. The listener knows which words belong to a phrase by the inflection or other affixation attached to the stem of the words. Figure 5.1 illustrates an utterance with a discontinuous constituent. The two words belonging to the copular complement (CC) - the noun marker ban and the adjective ɲanumbila - are separated by ɲada, the nominative subject noun phrase (NPs). The cues for phrasing in English do not appear to operate in a language like Dyirbal in which the word order is much freer.

5.4 SYNTACTIC CLAUSES AND INTONATION

5.4.1 Accent assignment in syntactic clauses

The syntactic clauses in the corpus have between one and six pitch accents depending on the amount of salient information they are carrying.

5.4.2 Boundary cues of syntactic clauses

Crystal [1969: 258], in his analysis of English intonation, examined the correlation between the intonation phrase (which he calls a tone-unit) and the syntactic clause. He found that "[f]rom the grammatical point of view, the proportion of clauses co-extensive with one tone-unit as, compared with the total number of clauses in the data, is only 46 per cent ... From the intonational point of view, only about 28 per cent of all tone-units are co-extensive with a clause" (my emphasis).

Despite this minority (28%) the clause is still the structure that is the most co-extensive with intonation phrases in English.
TABLE 5.5

<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th>GW</th>
<th>JM</th>
</tr>
</thead>
<tbody>
<tr>
<td>single complete clause</td>
<td>66</td>
<td>64</td>
<td>74</td>
</tr>
<tr>
<td>two complete clauses</td>
<td>7</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>one complete clause plus part of another clause</td>
<td>27</td>
<td>36</td>
<td>21</td>
</tr>
</tbody>
</table>

The percentage in the corpus of syntactic clauses (and/or part thereof) which constituted a single complete intonation phrase for the speakers CG, GW and JM.

TABLE 5.6

<table>
<thead>
<tr>
<th></th>
<th>CG</th>
<th>GW</th>
<th>JM</th>
</tr>
</thead>
<tbody>
<tr>
<td>single complete IP</td>
<td>67</td>
<td>78</td>
<td>76</td>
</tr>
<tr>
<td>two complete IPs</td>
<td>15</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td>three complete IPs</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>part of an IP</td>
<td>15</td>
<td>-</td>
<td>14</td>
</tr>
<tr>
<td>one complete IP plus part of another IP</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
</tbody>
</table>

The percentage in the corpus of intonation phrases (and/or part thereof) which constituted a single complete syntactic clause for the speakers CG, GW and JM.
"I worked on my own and always returned to see my old lady."

The Fo course of an intonation phrase consisting of two complete syntactic clauses (the clause boundary is marked by the dashed line; the dotted lines indicate the word boundaries)
The case of Dyirbal, however, is quite different. In the majority of cases the boundaries of the syntactic clauses in the corpus coincide with an intonation phrase boundary. Table 5.5 shows the percentages, for the three main speakers, of single complete syntactic clauses which are co-extensive with a single complete intonation phrase (64-74%). This is around 50% more than English clauses. Some Dyirbal clauses (8-22%) contain two complete intonation phrases while those that contain three are very rare. There are even some clauses which contain part of an intonation phrase.

Table 5.6 gives the percentages of single complete intonation phrases which are co-extensive with a single complete clause (67-78%). These percentages are more than double that for English. In those cases where the clause and the intonation phrase are co-extensive the clause boundaries have definite prosodic cues. There is a pause between the two clauses and, in most cases, a reset in the Fo level at the beginning of the second clause as discussed in Section 4.3. However, a small number of intonation phrases contain two complete clauses while 21-36% contain one complete clause plus a portion of another clause. In other words, these intonation phrases have a syntactic clause boundary within their own boundaries. It is much more difficult to find prosodic evidence of these syntactic clause boundaries than for those that coincide with an intonation phrase boundary.

Figure 5.2 illustrates an intonation phrase which contains a clause boundary (marked by the vertical dashed line; the vertical dotted lines indicate the word boundaries). The Fo course of this intonation phrase does not behave any differently to one that is co-extensive with a clause. The Fo declines from the offset of the first accent to the onset of the second one, as it does in other three-accent contours, despite the clause boundary between the two accents. Clause boundaries in English are usually marked by a fall-rise in the Fo pattern on the clause-final constituent followed by a reset in the speaker's Fo declination [Cooper & Sorensen, 1977, 1981: 103-117; Kutik, et.al., 1983; O'Shaughnessy & Allen, 1983: 1156; Sorensen & Cooper, 1980: 421-423]. There is no evidence of such activity in the Fo course at clause boundaries within Dyirbal intonation phrases. On the other hand, in Figure 5.3 the intonation phrase boundary within the clause is clearly marked. The first two contours are two intonation phrases making up a main clause. There is a pause between the offset of the first intonation phrase and the onset of
FIGURE 5.3

No, you disowned him a long time ago

A reset in the Fo indicates the boundary between a main clause (the first two contours) and a relative clause (the third contour).
the second intonation phrase but the Fo level remains the same at both points. The third contour is an intonation phrase that is coextensive with a complete relative clause. Here there is a pause of approximately the same duration, however the onset of the third contour is 30 Hz higher than the offset of the preceding one. There is, then, a reset of the Fo at the boundary between the main clause and the relative clause.

The majority of clauses in Dyirbal, then, are co-extensive with an intonation phrase. Whereas, according to Crystal [1969:258], it is "rare to find a sequence of clauses co-extensive in a one-to-one way with a sequence of tone units [intonation phrases]" in English, in Dyirbal the case is quite the reverse. It is rare to find a sequence of clauses which are not co-extensive in a one-to-one way with intonation phrases.

5.5 TOPIC CHAINS AND INTONATION

Sentences in Dyirbal are defined in terms of topic chains [Dixon: personal communication]. Topic chains in the corpus contain from one to seven intonation phrases. As discussed in Section 5.2.6, the clauses in a topic chain share a common NP with a common referent. The topic NP is not, however, always overt in every clause.

There are 64 intonation phrases with an overt topic NP within CG's main text (CG37). Table 5.7 shows the positioning and accenting of these topic NPs. Thirteen of the topic NPs occurred at the beginning of an intonation phrase - 11 were accented while 2 were not. A further 16 topic NPs were the first phrase in a topic chain - only one was not accented. Twenty-two topic NPs occurred in the first intonation phrase of a topic chain but were not in the initial position - 7 were accented while 15 were not. Thirteen topic NPs were non-initial in topic chains and intonation phrases - none of these were accented. These figures suggest a strong tendency for topic NPs to be accented when occurring in the initial position of an intonation phrase or topic chain (Topic NPs tend to occur utterance-initially when they are in the first intonation phrase of a topic chain). However, those topic NPs occurring in a position other than at the beginning of an intonation phrase are unlikely to receive an accent unless the intonation phrase is the first in a topic chain. In the small number of cases that a topic NP occurs at the end of an intonation phrase, it does not receive an accent as do the majority of other words in that position. This
### TABLE 5.7

<table>
<thead>
<tr>
<th>Position</th>
<th>ACCENTED</th>
<th>UNACCENTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>initial position in topic chain</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>initial position in IP</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>non-initial position in first IP of topic chain</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>non-initial position in IP</td>
<td>-</td>
<td>13</td>
</tr>
</tbody>
</table>

The positioning and accenting of topic noun phrases: the actual numbers which occurred in text CG37.
suggests that an element may be ‘fronted’ to give it the status of topic as in English [Finegan, et.al., 1992: 186]. Once the topic NP has been fronted and accented at the beginning of the topic chain it then becomes given information in subsequent intonation phrases and is usually not accented.

5.6 PITCH ACCENT PLACEMENT

Those parts of speech which are [+focus] are much more likely to be assigned a pitch accent than those which are [-focus] (see Section 5.1 for discussion of pragmatic structure).

"According to (Halliday's) classification the speaker must include in every tone group a chunk of new information, which will be phonologically marked by the tonic pitch movement. The speaker may optionally include one or more chunks of new information, which will be phonologically marked by pitch prominence" [Brown, 1983: 67].

In this section, word class and word order are discussed in relation to accent placement. It will be shown that both have a role in determining the assignment of pitch accents in the declarative intonation of Dyirbal.

5.6.1 Accentuation versus deaccentuation

Stress in Dyirbal falls on the first and every second syllable of a word except the final syllable [Dixon, 1972: 274]. In King [1992: 598] the rule which associated pitch accents with syllables was one of stress placement and deaccentuation:

*(a)* The underlying form of the declarative intonation phrase has stress on the first syllable and every second syllable of a word except the final syllable.

(eg.)

\[
\text{midangadilu} \quad \text{nda} \quad \text{wudingu} \quad \text{bulganbu} \\
\]  

*(b)* To derive the unmarked surface form delete all stress except on the first syllable of the phrase-initial word and the first syllable of the phrase-final word.
(eg.) 

\[ \text{mi\text{\textasciitilde}dangadilu na\text{\textasciitilde}da wudin\text{\textasciitilde}gu bulganbih\text{\textasciitilde}u} \]

(c) The location of the pitch accents in the marked surface form is determined by pragmatic rules [ie. those which are not formed as in (b)]."

However, in the current work it has been considered that a rule of accentuation more readily accounts for pitch accents occurring on unstressed syllables, such as in the intonation phrase discussed in Section 5.6.3.3.3. In this intonation phrase the final syllable of /\text{\textasciitilde}wubu/ (as well as the first syllable) is accentuated which cannot be accommodated by the stress placement.

5.6.2 Word class and accent placement

It has been claimed that English has a part-of-speech hierarchy that determines which words in an utterance will most likely receive emphasis, as well as the type and the prominence of the accents [Akers & Lennig, 1985; Allerton and Cruttenden, 1974, 1976; Sorensen & Cooper, 1980: 417; Crystal, 1969: 274; O'Shaughnessy & Allen, 1983]. O'Shaughnessy and Allen [1983] conducted controlled experiments to determine which word classes in English were most likely to receive emphasis. They posit the following hierarchy in which the "inherently contrastive word classes at the top of the list are likely to receive strong emphasis, whereas those at the bottom are likely to be completely de-emphasised" [1983: 1162-3]:

1. sentential adverbs
2. negatives
3. dummy auxiliaries in positive sentences
4. quantifiers
5. certain modals
6. adjectives
7. regular adverbs
8. nouns
9. negative contractions
10. verbs
11. demonstrative pronouns
### Table 5.8

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage of Total Accents in Corpus</th>
<th>Actual Number of Accents in Corpus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbs</td>
<td>34</td>
<td>112</td>
</tr>
<tr>
<td>Nouns</td>
<td>27</td>
<td>88</td>
</tr>
<tr>
<td>Noun Markers (NM)</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>Personal Pronouns</td>
<td>9</td>
<td>28</td>
</tr>
<tr>
<td>Adjectives</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Time Qualifiers</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Verb Markers (VM)</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Particles</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Adverbals</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Interjections</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Demonstrative Pronouns</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>[blank]</td>
<td><strong>327</strong></td>
</tr>
</tbody>
</table>

The percentages and the actual numbers of accents for each of the word classes occurring in the corpus.
### TABLE 5.9

<table>
<thead>
<tr>
<th>Word Class</th>
<th>Percentage Accented in Corpus</th>
<th>Total Number in Corpus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adverbals</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>Verb Markers (VM)</td>
<td>92</td>
<td>13</td>
</tr>
<tr>
<td>Adjectives</td>
<td>89</td>
<td>19</td>
</tr>
<tr>
<td>NOUNS</td>
<td>86</td>
<td>101</td>
</tr>
<tr>
<td>VERBS</td>
<td>82</td>
<td>138</td>
</tr>
<tr>
<td>Demonstrative Pronouns</td>
<td>67</td>
<td>6</td>
</tr>
<tr>
<td>Interjections</td>
<td>63</td>
<td>8</td>
</tr>
<tr>
<td>Time Qualifiers</td>
<td>57</td>
<td>23</td>
</tr>
<tr>
<td>Noun Markers (NM)</td>
<td>53</td>
<td>58</td>
</tr>
<tr>
<td>Particles</td>
<td>47</td>
<td>19</td>
</tr>
<tr>
<td>Personal Pronouns</td>
<td>31</td>
<td>91</td>
</tr>
</tbody>
</table>

## ACCENT ASSIGNMENT HIERARCHY

The percentage accented of the total number of tokens in the corpus of each word class. The word classes are ranked from most likely to be accented at the top to the least likely to be accented at the bottom.
12. prepositions  
13. auxiliaries  
14. articles  

O'Shaughnessy and Allen [1983: 1163] suggest that the emphasis priority ordering in English is due to speakers emphasising the less predictable parts of an utterance. The modality operators are given greater emphasis since they serve to qualify the more predictable words - namely nouns and verbs - which make up the nucleus of a proposition.

"Adjectives and adverbs are higher on the list than nouns because the former function as delimiters of the latter in the proposition; thus the nouns and verbs, as basic elements of the proposition, are the lowest content words on the list" [O'Shaughnessy & Allen, 1983: 1163].

Table 5.8 gives the percentages and actual numbers of accents in the Dyirbal corpus which were located on each word class. The first column of figures gives the percentages of the total number of accents in the corpus which is constituted by each word class. The second column of figures gives the actual number of tokens that were accented in each word class. So, for example, the 112 accented verbs constitute 34% of all accents in the corpus.

Verbs and nouns were assigned most of the accents in the corpus but this is presumably partly because they have a higher frequency of occurrence than most of the other word classes. Table 5.9 gives the percentage of all tokens in the corpus belonging to each word class which were accented. It also gives the total actual number of tokens in the corpus for each word class. As the table shows, of the eight adverbals which occurred in the corpus, every one of them was assigned an accent. Eighty-nine percent of the 19 adjectives in the corpus received an accent. The noun and verb classes had the largest number of the accents in the corpus due to their high frequency of occurrence. However, when the accenting is calculated as the percentage of words in each class that were accented (as opposed to the percentage which were not) the nouns and verbs have a lower accenting rate than adverbals, verb markers and adjectives. This would be expected as the modifying roles of the latter word classes would most often constitute new information. Table 5.9 can be regarded as a tentative accent assignment hierarchy which states that adverbals are the word class most likely to receive accenting when they occur in an utterance. Personal pronouns, on the other hand, are the
FIGURE 5.4

Fo course of intonation phrase which is syntactically a minimal pair with Figure 5.5.

FIGURE 5.5

Fo course of intonation phrase which is syntactically a minimal pair with Figure 5.4.
least likely of these word classes to be assigned an accent as they generally represent given information. This hierarchy appears to affect accent placement both across and within syntactic phrase boundaries. For example, in a single accent NP containing a noun marker, a noun and an adjective, it is invariably the adjective which is assigned the accent.

In Section 5.6.3 I will show how word class, in combination with the preferred word order (Section 5.2.7) and accent assignment, has a role to play in the determination of the word order in an utterance.

5.6.3 Word order and accent placement

Eighty-five percent of the intonation phrases in the corpus have an accent on the first syllable of the first word. Of the intonation phrases that have more than one accent, eighty-three percent (49% of the corpus) have an accent on the first syllable of both the first and the final word. If the word order (including the salient words which take the accents) is totally free then one would expect the pitch accents to be randomly sprinkled throughout Dyirbal speech. This obviously is not the case. The accent location has a definite pattern. Is there a rule in Dyirbal intonation, then, which states that accents must occur in the initial and final positions of an intonation phrase and which determines the word order? That is, do the accents have a fixed position so that the word ordering is 'shunted around' to fit the salient words into those positions. This would conceivably be possible in a language with virtually free word order. Although this scenario would seem unlikely since 17% or so of the intonation phrases in the corpus do not have the accents in the initial/final configuration, the proportion that do are a significant enough majority to warrant testing the hypothesis.

Since there is no possibility of testing synthesised utterances with native speakers, I scanned the corpus for utterances which are syntactically minimal or near-minimal pairs. Figures 5.4 and 5.5 have identical words but in a different order. The two utterances have the same meaning of she reared me. They are from the same text (48) of the same speaker (GW) but there are eight other intonation phrases between these two utterances. In Figure 5.4 the pronoun ŋajguna 'me' is positioned first in the utterance and is followed by the verbal complex (VC) wudiman 'grow up + transitiviser + non-future tense'. The noun
FIGURE 5.6

Fo course of intonation phrase which is syntactically a near-minimal pair with Figure 5.7.

FIGURE 5.7

Fo course of intonation phrase which is syntactically a minimal pair with Figure 5.6.
marker bəŋgun 'she' takes final position in the utterance. Each word in the utterance of Figure 5.4 is accented and thus receives prominence. This is not the case for the utterance in Figure 5.5 in which only two words have pitch accents. In this utterance it is the noun marker (bəŋgun) which is in the initial position. The verbal complex (wudiman) is again second with the pronoun (ŋajgunə) utterance-final. In this utterance ŋajgunə, which is now the final word, does not have a pitch accent and is therefore not made prominent. The lack of an accent on ŋajgunə in the second utterance suggests that the words are not positioned within an utterance to receive an accent but that the accents are located according to the position of the target word. In other words, just because bəŋgun received an accent in utterance-final position, it does not necessarily mean that ŋajgunə will do so in the same position.

The utterances in Figures 5.6 and 5.7 are syntactically near-minimal pairs both with each other and with those in Figures 5.4 and 5.5. The utterance in Figure 5.6 simply has the masculine noun marker bəŋgo1 rather than the feminine one that is in Figures 5.4 and 5.5. This changes the meaning to he reared me. In this utterance (Figure 5.6) the noun marker comes first, then the pronoun followed by the VC. The VC retains its pitch accent despite being moved to the end of the utterance, however ŋajgunə, which is now in the central position, still does not receive an accent due to it being given information. The utterance in Figure 5.7 has the same noun marker as those of Figures 5.4 and 5.5, however the VC is different. The VC is munumadan 'say doesn't want + non-future tense inflection' which gives the utterance the meaning she rejected me. The word order is the same as that in Figure 5.6 and so is the accent assignment. Both the noun marker and the VC are accented whereas the pronoun is not. Thus for these utterances we have:

\[
\begin{array}{c|c|c}
\text{ŋajgunə} & \text{wudiman} & \text{bəŋgun} \\
\text{NPO} & \text{VC} & \text{NPA}
\end{array}
\]
"I worked on my own and always returned to see the old lady".

Fo course of an intonation phrase which consists of two complete syntactic clauses and which is syntactically a near-minimal pair with that in Figure 5.9 (the clause boundary is marked by the dashed line; the dotted lines indicate word boundaries).
CHAPTER 5  Intonation and communicative structure

The pronoun ńajguna, then, only receives a pitch accent when it is in the utterance-initial position. ńajguna is the topic NP (and given information) in all four of these intonation phrases. As discussed in Section 5.5, the topic NP is unlikely to be accented unless it is at the beginning of the utterance. The verbal complex and the noun marker both receive a pitch accent regardless of their position within the utterance. These two points suggest that it is the salient words that determine the location of accents rather than the accents having a fixed position to which the salient words are fitted.

The corpus contains another two intonation phrases which further support this hypothesis. The utterances in Figures 5.8 and 5.9 are syntactically near-minimal pairs of the speaker CG. The utterances are single intonation phrases consisting of two syntactic clauses (the clause boundaries are marked by the vertical dashed lines). The two utterances are adjacent in the text. Each of the two clauses in Figure 5.8 begins with a NPs followed by a VC. The second clause also contains a NPDAT. Only the NPs in the second clause of this intonation phrase contains a pronoun (ńaďa). In Figure 5.9 the pronoun ńaďa has been moved to the NPs in the first clause while the genitive pronoun ńajgu has been added to the NPDAT in the second clause. Thus the second clause no longer has a NPs and so the VC is in initial position. This change in word order has not affected the placement of the pitch accents - they have remained on the same words. The only change in the accents is that in the second
"I worked on my own and always returned to see my old lady."

Fo course of an intonation phrase which consists of two complete syntactic clauses and which is syntactically a near-minimal pair with that in Figure 5.9 (the clause boundary is marked by the dashed line; the dotted lines indicate word boundaries).
utterance (Figure 5.9) an extra accent has been added and is placed on the final word, presumably for added emphasis. Thus for the two utterances we have:

(Fig. 5.8)

*  
\[ \eta_{\text{alma}} \ wa_{\text{gibin}} / \eta_{\text{ada}} \ ban_{\text{agananju}} \ ban \ wu_{\text{jigigu}} \]

\[
\text{NPs} \quad \text{VC} \quad \text{NPs} \quad \text{VC} \quad \text{NP}_{\text{DAT}}
\]

(Fig. 5.9)

*  
\[ \eta_{\text{alma}} \ \eta_{\text{ada}} \ wa_{\text{gibin}} / \ \text{ban}_{\text{agananju}} \ \eta_{\text{ajgu}} \ \text{ban} \ wu_{\text{jigigu}} \]

\[
\text{1sg-NOM} \quad \text{NPs} \quad \text{VC} \quad \text{VC} \quad \text{1sg-GEN} \quad \text{NP}_{\text{DAT}}
\]

Again the accent moved with the word and when an additional accent was added to the second utterance it was located on the final word. This suggests that wujjigigu is a salient part of the utterance and thus it is placed in utterance-final position. When the speaker corrected herself with the second utterance she gave wujjigigu the accent she had intended for it. These minimal and near-minimal pairs of utterances refute the hypothesis of a phonological rule fixing the accent positions at the beginning and end of an utterance with the salient words then being positioned accordingly.

If the word order is free from a syntactic viewpoint [Dixon, 1972] and the fixed-accent-position phonological rule hypothesis has been rejected, then the regular positioning of accents is most likely to be due to pragmatic rules determining where the salient words of an utterance must go.

In the following sections I will demonstrate that, although the word order in Dyirbal is free in that it is not determined by syntactic functions, there are certain pragmatic constraints on the ordering of the words and
"Now (he) drank a lot."

Fo course of a single-accent intonation phrase with the accent on the first syllable of the first word (dotted lines indicate word boundaries).
syntactic constituents within a Dyirbal declarative utterance which is evidenced by the regular positioning of accents within utterances. It would appear from the corpus that there is a very strong tendency (83%) for salient information to be positioned at the beginning and the end of an intonation phrase; that is, the first and final words of the majority of intonation phrases carry the most salient information. The following sections describe these intonation phrases. The remaining 17% of the intonation phrases are also described and reasons why they do not have the pitch accents on the first and final words are explored. Each accent placement is discussed for each of the single-accent, two-accent and three-accent intonation phrase types.

5.6.3.1 Single-accent intonation phrases

Contours with just a single pitch accent constitute 40% of the contours in the corpus.

5.6.3.1.1 First word

In 83% of the single-accent contours (33% of the total corpus), the pitch accent occurs on the first syllable of the first (and sometimes only) word of the intonation phrase, as in Figure 5.10. In this intonation phrase, the Fo begins to rise at the onset of the first syllable of the first word ɲaŋɲa and peaks at the boundary between the / a / and the / n / of the first syllable. The Fo then begins to decline and continues to do so throughout the following verb complex (ɲaŋɲaŋɲaŋaŋɛ ```drin3 a lot + REFLEXIVE + ANTI-PASSIVE + NON-FUTURE TENSE```) to the end of the intonation phrase. Thus the pitch accent is located on the time qualifier ɲaŋɲa 'now'. According to the preferred word order in Dyirbal (Section 5.2.7), time qualifiers tend to occur utterance-initially and so, since the speaker wishes to give ɲaŋɲa prominence, the accent occurs on the first word of the intonation phrase.
"(We'll) go walkabout after dinner tomorrow."

Fo course of a single-accent intonation phrase with the accent on the first syllable of the second word and a boundary tone (dotted lines indicate word boundaries).
5.6.3.1.2 Second word

The remaining 17% of the single-accent contours have the pitch accent occurring on the first syllable of the second, rather than the first, word in the utterance. An example of this is shown in Figure 5.11. The Fo declines slightly throughout the duration of the first word of the intonation phrase (ŋul̂ga). At the onset of the second word the Fo begins to rise, peaking towards the end of the second syllable before declining again until the rise to the high boundary tone at the offset of the utterance. The accent, then, is on dinajunu 'dinner + ablative' rather than ŋul̂ga 'tomorrow'. ŋul̂ga 'tomorrow' is a time qualifier and thus is the first word in the utterance due to the preferred word order (Section 5.2.7). ŋul̂ga has, however, been mentioned in the previous clause and so it is old information, as is wajmbugu 'walkabout + purposive', and is therefore less likely to be given prominence. (In fact, most of the text to which this intonation phrase belongs is a discussion between two speakers about going walkabout tomorrow). Dinajunu, on the other hand, is new information modifying the time qualifier ŋul̂ga - it is specifying what time tomorrow they will be going walkabout (ie. after dinner). The speaker, MD, is looking for agreement from the other speaker, PB, regarding the time that they will go walkabout tomorrow and so has emphasised 'after dinner' rather than 'tomorrow'. Thus, because there is a strong tendency for time qualifiers to occur at the beginning of an utterance (see Section 5.2.7), the accent is positioned on the second word in this intonation phrase.

There are ten single-accent intonation phrases in the corpus which have the pitch accent on the second word of the utterance. The following are the first (and unaccented) words of those intonation phrases and their proportion of occurrence:

<table>
<thead>
<tr>
<th>Word Class</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>personal pronoun</td>
<td>3</td>
</tr>
<tr>
<td>time qualifier</td>
<td>3</td>
</tr>
<tr>
<td>interjection</td>
<td>3</td>
</tr>
<tr>
<td>particle</td>
<td>1</td>
</tr>
</tbody>
</table>

These words were not assigned the pitch accent despite being in the utterance-initial position. Each of the pronouns and the time qualifiers were given information. All of these word classes are low on the accent assignment hierarchy and are less likely to receive an accent than those
"...to cook properly."

Fo course of a single word single-accent intonation phrase with the accent on the first syllable (dotted lines indicate word boundaries).
words which follow them in the utterance. The time qualifiers, interjections and particles have a strong tendency to occur utterance-initially and the pronouns belong to NPs which prefer to precede the verb that, in these intonation phrases, was the second word (see Section 5.2.7). Thus these words, although utterance-initial, were unaccented. The second (and accented) words in these intonation phrases and their proportions are:

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>verb</td>
<td>5</td>
</tr>
<tr>
<td>negative particle</td>
<td>2</td>
</tr>
<tr>
<td>adjective</td>
<td>1</td>
</tr>
<tr>
<td>time qualifier</td>
<td>1</td>
</tr>
<tr>
<td>noun</td>
<td>1</td>
</tr>
</tbody>
</table>

Each of these words added new information to their utterances and so were made prominent by the speaker through the assignment of a pitch accent.

5.6.3.1.3 Single word

The intonation phrases of 52% of the single-accent contours consist of just one word and all except one have the accent on the first syllable. Figure 5.12 shows an intonation phrase of the single word mundanbili 'properly cook + INTRANSITIVISER + PURPOSE'. The Fo rises from the onset of the word and peaks in the second half of the vowel of the first syllable (/u/). The Fo levels out during the articulation of the /n/ and /d/ and then declines steadily to the end of the utterance. The Fo contour has the same basic shape as that of the longer intonation phrase in Figure 5.10.

Thus all but ten of the single-accent intonation phrases have the accent on the first syllable of the first word. The ten which had the accent on the second word had the accent positioning affected by the preferred word order and the accent assignment hierarchy.

5.6.3.2 Two-accent intonation phrases.

Forty-three per cent of the intonation phrases in the corpus contain two pitch accents.
FIGURE 5.13

Schematic Fo course of a two-accent intonation phrase with an accent on the first word and an accent on the final word.

FIGURE 5.14

"I grew up right in that camp, got big there".

Fo course of a two-accent intonation phrase with an accent on the first syllable of the first word and an accent on the first syllable of the final word (dotted lines indicate word boundaries).
5.6.3.2.1 First and final words

The Fo in 73% of the two-accent phrases (31% of the corpus) takes the basic form of the schematic diagram in Figure 5.13. In this contour the Fo rises to a peak from an initial low onset and signals a pitch accent. It then declines until the point where it begins to rise to the peak of the second pitch accent before declining again to a low offset. (The behaviour of the Fo following the peak of the second accent is more variable than is shown in this diagram as it may also rise to a boundary tone. However, it will suffice for the illustration of accent placement). The first pitch accent, therefore, occurs on the first syllable of the first word and the second accent occurs on the first syllable of the final word of the intonation phrase.

Figure 5.14 contains an intonation phrase which illustrates this type of contour. The Fo rises from the onset of the first word, miđanŋaŋbilu 'camp + LOCATIVE + EMPHATIC AFFIX', to a peak on the vowel of the second syllable (/dɑ/). The Fo then falls sharply to the onset of the vowel of the third syllable (/ŋɑ/) before steadying to a less steep decline which continues over the duration of the next two words. (The perturbations in the period of declination are due to the articulation of the segmentals). At the onset of the final word, bulganbiŋŋu 'big + VERBALISER + RELATIVE CLAUSE AFFIX', the Fo again begins to rise. It peaks at the boundary between the first and second syllables before beginning its descent towards the end of the utterance. This intonation phrase thus has an accent on the first syllable of the first word and on the first syllable of the final word.

The intonation phrase in Figure 5.14 is a complete relative clause and is the last intonation phrase in a topic chain. The pronoun ŋaŋ is the topic NP of the utterance and, as such, is given information (see Section 5.5). wudĩŋu, the first of two words in the verbal complex (VC), has also been mentioned in the previous clause. Thus neither of these is accented. bulganbiŋŋu 'big + VERBALISER + RELATIVE CLAUSE AFFIX' qualifies the verb wudĩŋu 'grow up + RELATIVE CLAUSE AFFIX' and so carries some new information which causes it to be accented.
"(he) sent money"

Fo course of a two-accent intonation phrase with an accent on the first syllable of the second word and an accent on the first syllable of the final word (dotted lines indicate word boundaries).
Second and final word

Not all two-accents intonation phrases in the corpus, however, conform to the above pattern. Ten per cent of the two-accents intonation phrases (4% of the corpus) have the second pitch accent on the first syllable of the final word (as above), however the first pitch accent is located on the first syllable of the second, rather than the first, word.

The following are the first (and unaccented) words of those intonation phrases and their number of occurrences:
- noun marker: 4
- personal pronoun: 2
- particle: 2

Although these words were located in the utterance-initial position they were not assigned pitch accents. Each of these word classes occupy a low position on the accent assignment hierarchy. The two particles were of the type that must occur utterance-initially. The pronouns and two of the noun markers represented given information and were placed at the start of the utterance due to the preference within Dyirbal for nominative NPs to precede ergative NPs. The other two noun markers occurred in phrases with words of a class higher in the hierarchy which thus received the accents. The second (and accented) words in these intonation phrases and their number of occurrences are:
- verb: 4
- noun: 1
- adverbal: 1
- personal pronoun: 1
- demonstrative pronoun: 1

Each of these words added new information to their utterances and so were made prominent by the speaker through the assignment of a pitch accent. Apart from the personal pronoun, all of these words are higher on the accent assignment hierarchy than those which preceded them at the beginning of the intonation phrase.

The intonation phrase in Figure 5.15 has its two accents on the second and the final word. The Fo declines from the onset of the utterance to the end of the first word (bạ̈ji). The Fo level rises at the onset of the second word (māni ‘money’), peaks in the middle of the vowel of the first syllable and then declines until the onset of the third word (bilon ‘send - NON-FUTURE TENSE’). The Fo again rises, peaks in the centre of /i/ before falling and then rising to a boundary tone. The second accent is considerably more prominent than the first, not just
through the increased Fo level, but also the lengthening of the vowels. The first word of the intonation phrase, which in this case is not accented, is a noun marker (NM) in a NP with its noun. The noun marker precedes the noun according to the preferred word order (see Section 5.2.7) but does not receive the accent since the noun ranks higher in the accent assignment hierarchy (see Section 5.6.2). The NP is the topic NP in the first intonation phrase of the following topic chain and so occurs in the preferred utterance-initial position (see Section 5.5):

He sent money for the white women to buy a little bit of milk and clothes for me, and for them to buy blankets for me.

(24a) 

\[ \text{baji} \quad \text{*} \quad \text{mani} \quad \text{bilan} \]

NM-NOM-Class 1 money send-NF

sent money

(24b)

\[ \text{*} \]

bàngul

NM-ERG-Class 1

he

(25)

\[ \text{*} \quad \text{ηάιγ} \quad \text{mάδιναямбάλ} \]

1sg-GEN buy-AFFIX-VBLSR-PURP

buy for me

---

1 The numerals in brackets are the identification numbers of the intonation phrases within the text.
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(26)
*\
mi\`idim\`idig\`u  milg\`i\`u  midigu
white women-ERG  milk-DAT  small-DAT
the white women, a little milk

(27)
*\
g\`am\`ig\`u
clothes-DAT
and clothes

(28)
*\
bilaja\`ngir\`u  \`naj\`u  m\`andi\`naj\`mbali
blankets-DAT  1sg-GEN  buy-AFFIX-VBLSR-PURP
and to buy blankets for me.

5.6.3.2.3  First and non-final word

In 12% of the two-accent intonation phrases (5% of the corpus), the second pitch accent does not fall on the final word although the first pitch accent does occur on the first syllable of the utterance-initial word. Of these seven cases, four have the second pitch accent on the antepenultimate word and three on the penultimate word.

The following are the final (and unaccented) constituents of those intonation phrases and their number of occurrences:

| NP\DAT | 3  |
| NP\Po  | 2  |
| VC     | 2  |

Although these constituents were located in the utterance-final position they were not assigned a pitch accent. The dative NPs followed the verb as in the preferred word order (Section 5.2.7) but it was the verb which was accented. The VCs were preceded by accented NPs also according to the preferred word order. The two NP\Po were topic NPs
"I worked on my own and always returned to see the old lady".

Fo course of a two-accent intonation phrase with an accent on the first syllable of the first word and an accent on the first syllable of the penultimate word. The intonation phrase consists of two complete syntactic clauses (clause boundary is marked by dashed line; dotted lines indicate word boundaries).
placed at the end of the utterance and were given information. These were unaccented (see Section 5.5). The second accent of these intonation phrases fell on the following words:

antepenultimate word -

- verb 2
- noun 1
- noun marker 1

penultimate word -

- verb 1
- noun 1

**Figure 5.16** illustrates an intonation phrase with an accent on the first word and on the antepenultimate word. It is an intonation phrase made up of two complete syntactic clauses (the vertical dashed line shows the clause boundary). The Fo rises throughout the duration of the first syllable of the first word, nasalma 'on my own', and peaks at the boundary between the first and second syllables. The Fo then declines (with several perturbations) to the onset of the antepenultimate word, banagangani 'return-frequently + non-future tense'. The Fo again rises and, after peaking at the onset of the vowel of the second syllable, falls steeply to the end of the word. The Fo then has a slight decline throughout the duration of the final two words. This intonation phrase belongs to the following topic chain:

(58)

*  

\[
\text{mimagugu} \quad \etaajguna \quad \text{budin}
\]

white woman me take-NF

The white woman took me

(59)

*  

\[
\text{nalma} \quad \text{wagibili}
\]

on my own to work

for me to work on my own

---

1 The numerals in brackets are the identification numbers of the intonation phrases within the text.
As can be seen from this topic chain the intonation phrase (60) in Figure 5.16 is basically repeated (with two word changes) in the following intonation phrase (61). In (61) the final word, wujigigu, is accented and banaganganiŋŋu is moved to the beginning of the second clause. Thus both clauses have an accent on their first word and the second clause also has an accent on the final word. (61) appears be a correction of (60) on the part of the speaker (These two intonation phrases were discussed in Section 5.6.3). ŋalma is fronted and accented in three successive intonation phrases (59, 60, and 61). This is most likely because the speaker wanted to emphasise just how alone she was, having left her people to work amongst the whites. In most cases once ŋalma had first been introduced into the topic chain it would be unaccented in any subsequent intonation phrases as it would then be given information. Therefore it can be suggested that fronting and accenting given information is a method of emphasis in Dyirbal.

In a further 2% of the two-accent utterances (1% of the corpus), neither the first nor the final word are accented.
FIGURE 5.17

Fo course of a single-word two-accent intonation phrase with an accent on both syllables.
5.6.3.2.4 Single word

Another 4% of two-accent phrases (2% of the corpus) consist of a single word in which the first accent is assigned to the first syllable and another syllable receives a second accent. There are only three cases of this in the corpus. The speaker appears to be giving a particular word the most emphasis possible. An intonation phrase with a single word bearing two accents is shown in Figure 5.17. This is the second (and last) intonation phrase of the following clause/topic chain:

\[
\begin{align*}
\text{jabuŋgu} & \quad \text{ŋajguna} & \quad \text{gålgan} & \quad \text{ŋaŋa} \\
\text{mother-ERG} & \quad \text{me} & \quad \text{leave-NF} & \quad \text{baby-NOM}
\end{align*}
\]

(My) mother left me (as a) baby.

The accenting on \(ŋaŋa\) 'baby' is significant for four reasons:

(i) final syllables are not normally stressed;
(ii) on the rare occasions that a word has two accents, the second is usually attached to an affix rather than the word root itself;
(iii) the accents are on adjacent syllables; and
(iv) the second accent is considerably more prominent than the first (evident in the greater excursion in the Fo and in the longer duration of the second syllable).

The extra emphasis on \(ŋaŋa\) 'baby' may be to convey how young the speaker was when her mother left her. There is presumably some attitudinal information conveyed by the accenting but it is impossible to determine this without recourse to native speakers. The two accents on \(ŋaŋa\) 'baby' contrast with the options for emphasis on a word such as baby in English. An accent on the second syllable would be unacceptable in English so the major evidence of extra emphasis would be a greater excursion in the Fo, and an increase in duration, of the first syllable.
"A long while later they told me"

Fo course of a three-accent intonation phrase with an accent on the first syllable of the first word and an accent on the first syllable of the final word, plus an additional accent on the first syllable of the third word (dotted lines indicate word boundaries).
5.6.3.3 Three-accent intonation phrases

Seventeen percent of the intonation phrases in the corpus have three accents.

5.6.3.3.1 First and final words

Seventy-two percent of three-accent intonation phrases (12% of corpus) have accents on the first syllable of both the first and final word, as in the majority of two-accent intonation phrases, plus an additional accent discussed in Section 5.6.3.3.3.

Figure 5.18 shows a three-accent Fo contour of this type. The Fo rises and peaks on the first syllable of the first word - ɖədəbəτə 'a little later + COMPARATIVE'. It then falls sharply during most of the second syllable before declining gradually to the onset of the third word, ɓaŋguməŋgəndu 'there-ERGATIVE + one of many-ERGATIVE'. The Fo then rises for the second accent, peaks at the offset of the vowel of the first syllable and again drops sharply. The Fo rise for the third accent begins on the final vowel of ɓaŋguməŋgəndu. It is not possible on the spectrogram to segment the [uwɓ] sequence of buwamə 'tell + NON-FUTURE TENSE' so it is impossible to determine where the Fo peak occurs in the syllable structure of the word. However, the Fo level drops off rapidly after the peak before rising again to the boundary tone.

This intonation phrase follows the preferred word order; that is, the time qualifier precedes all else, the nominative NP (NPo) precedes the ergative NP (NPA), which in turn precedes the verb. The NPo is the only word in the utterance that is not accented. This is presumably because it is the topic NP (for this and the preceding topic chain) and is given information (see Section 5.5). The intonation phrase is a complete clause as well as a complete topic chain.

5.6.3.3.2 Non-initial and non-final words

Nine percent of the three-accent intonation phrases (2% of corpus) have the first accent on the first syllable of the second word and the final one on the first syllable of the last word.

The following are the first (and unaccented) words of those
intonation phrases and their number of occurrences:

- personal pronoun: 2
- particle: 2

Although these words were located in the utterance-initial position they were not assigned pitch accents. Both pronouns were part of a NP with an adjective. Adjectives tend to follow the pronouns or nouns they are qualifying but are higher on the accent assignment hierarchy (see Section 5.6.2). The adjectives are therefore accented causing the first accent of these intonation phrases to occur on the second word rather than on the first word. Both of the particles listed above are the type which tend to be placed utterance-initially (see Section 5.2.7) but, since particles are one of the word classes least likely to be accented, it is the words which follow them in the intonation phrases that are accented; that is, a noun and a demonstrative pronoun.

Thirteen percent of three-accent intonation contours (2% of corpus) have the third accent on the first syllable of the penultimate word and the first accent on the first syllable of the first word. The following are the final (and unaccented) words of those intonation phrases and their number of occurrences:

- noun: 2
- personal pronoun: 2
- noun marker: 1

Although these words were located in the utterance-final position they were not assigned pitch accents. Both pronouns were topic NPs and were given information (see Section 5.5). One of the nouns was a repeat of an accented noun in the same intonation phrase and was thus given information. The noun marker was a part of a NP with an adjective which is a word class more likely to be assigned the accent. The verb was a part of a VC containing an adverbial which is the highest ranked word class in the accent assignment hierarchy (see Section 5.6.2). Thus those words which occurred in the penultimate position and which were accented are:

- verb: 2
- adverbial: 1
- adjective: 1
- time qualifier: 1
- noun marker: 1

Six percent of the three-accent intonation phrases (1% of corpus) have an accent on neither the first nor the final word. Figure 5.19 illustrates an intonation phrase of this type. The only words in the
"I was standing with my spear and he went straight past me (without me really seeing him)."

Fo course of a three-accent intonation phrase consisting of two complete syntactic clauses. It has an accent on the first syllable of the second word and an accent on the first syllable of the penultimate word, plus an additional accent on the third word and a boundary tone (clause boundary is marked by the dashed line; dotted lines indicate word boundaries).
intonation phrase which are not accented are the first and the final ones. The Fo remains fairly level throughout the duration of the first word ɲaɗa 1st sg and bɑŋgajbila 'spear + with' make up the nominative NP. bɑŋgajbila is an adjective which, in accordance with the preferred word order, follows the pronoun it qualifies. As an adjective outranks a pronoun in the accent assignment hierarchy, it is the adjective within the NP which receives the accent. Thus it is the second rather than the first, word which is accented in this intonation phrase. The adverb ḋuŋu 'didn't know' and the verb gudamban 'go past + VERBALISER + NON-FUTURE' constitute a VC. Since an adverb is more likely to receive an accent than a verb and there is a strong tendency for adverbs to precede verbs, it is the adverbial in the penultimate position that is accented (see Section 5.6.3.4 for further discussion of this intonation phrase).

5.6.3.3.3 The additional accent

Apart from the accent on the first syllable of the first (or in the minority of cases, second) word and the accent on the first syllable of the final (or occasionally, penultimate) word, the three-accent intonation phrases have an additional accent. The placement of this additional accent is not as predictable as the other two accents in a three-accent intonation phrase. The location and numbers of these additional accents in the corpus are as follows:

- adverb
- time qualifier
- personal pronoun
- noun (only accented word in NP)
- noun (first of 2 accented words in NP)
- noun (second of 2 accented words in NP)
- noun marker (second of 2 accented words in NP)
- final syllable of accented noun root
- affix on accented noun root
- verb (only accented word in VC)
- verb (second of 2 accented words in VC)
- affix on accented verb root
- affix on accented verb marker

Number of additional accents:

- adverb: 2
- time qualifier: 1
- personal pronoun: 1
- noun (only accented word in NP): 3
- noun (first of 2 accented words in NP): 1
- noun (second of 2 accented words in NP): 5
- noun marker (second of 2 accented words in NP): 2
- final syllable of accented noun root: 1
- affix on accented noun root: 1
- verb (only accented word in VC): 11
- verb (second of 2 accented words in VC): 2
- affix on accented verb root: 1
- affix on accented verb marker: 1
"I was an orphan."

For course of a three-acent intonation phrase with an accent on the first syllable of the first word and an accent on the first syllable of the final word, plus an additional accent on the final syllable of the final word (dotted lines indicate word boundaries).
The accent on the final syllable of the accented noun root is the only additional accent which does not follow the 'preferred' stress pattern for Dyirbal which states "... that the first syllable should be stressed, and that there should be exactly one unstressed syllable between each two successive stressed syllables. The ideal situation is for the first and all odd-numbered syllables to be stressed, and for the second and all even-numbered syllables to lack stress. Final syllables are never stressed" [Dixon, 1972: 274]:

The Fo course of the intonation phrase with the accented final syllable (included in the list of additional accents above) is shown in Figure 5.20. This intonation phrase has an accent on the first syllable of the first word (ŋaŋa) and an accent on the first syllable of the final word (wubu) as do the majority of intonation phrases with more than one accent. However, the final word, wubu 'orphan', has an additional accent on its final syllable which is the most prominent of the three accents. See Section 5.6.3.2.4 for further discussion of this type of accent placement.

5.6.3.4 Summary

The positioning of first and final accents within an intonation phrase appears to be have a predictability of at least 83%. This percentage is a significant majority which suggests that Dyirbal speakers deliberately order their words so that the salient information is located at the beginning and at the end of an intonation phrase (and in most cases a clause). The pitch accents are assigned to these words to act as signposts to the most salient information in the utterance. Unlike English, in which the word order plays a major role in grammatical relations, Dyirbal relies on its morphology to fulfil that function. Thus word order is much freer in Dyirbal. However, it can be inferred from the prosodic evidence presented in the above sections that there are, nevertheless, certain constraints on Dyirbal word order within declarative utterances. These constraints appear to be more pragmatic than syntactic in nature. It certainly appears to conform to Comrie's [1981: 56] definition of pragmatic roles: "Pragmatic roles ... refer to the different ways in which essentially the same information, or the same semantic content, can be structured differently to reflect the flow of given and new information".

Dyirbal word order appears to more closely resemble that of
The page contains text, but the content is not clearly visible in the image provided.
Russian than to that of English. "In Russian the basic marker of grammatical relations is not the word order, but rather the morphology ... Changing the word order does not affect the distribution of grammatical relations or of semantic roles" [Comrie, 1981: 71]. The most salient information in a Russian utterance is positioned at the beginning and at the end of the sentence [Comrie, 1981: 72]. Bolinger [1978: 489] suggests that it is a universal tendency for utterances to have pitch accents at the beginning and the end of an utterance. t’Hart et al. [1990] have certainly reported this accent configuration for Dutch which they call the ‘hat pattern’.

There appear to be three main factors which determine the word order and accent placement in Dyirbal declarative utterances. These are:

(a) pragmatic rules - that state which constituents are salient and must go first and last in an utterance;

(b) preferred word order (Section 5.2.7) - this can influence the speaker’s ordering of words within constituents; and

(c) accent assignment hierarchy (Section 5.6.2) - determines which word/s of the salient information will be accented.

The effects of these three factors on word order and accent placement are demonstrated in the following three-accent intonation phrase (this intonation phrase was discussed in Section 5.6.3.3.2 and illustrated in Figure 5.19):

I was standing with my spear and he went straight past me (without my really seeing him).

This intonation phrase is made up of two complete clauses (the stroke
marks the clause boundary) and constitutes a complete topic chain. It appears from the corpus that each clause must have at least one accent (see Section 5.4.1). However, the first/final-word accent configuration applies to the intonation phrase not the clause; that is, an intonation phrase with an accent on both the first and the final word and a clause boundary in the middle can consist of one clause with an accent only on the first word and the other clause with an accent only on the last word. The second clause in a two-clause intonation phrase does not have to have an accent assigned to its first word.

In the above intonation phrase:

(a) the pragmatic rules have stated that each constituent (NP, VC) must have an accent because they contain the most salient information;

(b) the speaker has adhered to the preferred word order (Section 5.2.7). The adjective follows the noun in the NP and, in the VC, the adverbal precedes the verb; and

(c) the accent assignment hierarchy states that adjectives outrank nouns and that adverbals outrank verbs (Section 5.6.2). Therefore the accent within the NP is assigned to the adjective and the adverbal receives the accent in the VC.

Thus the above intonation phrase has an accent on the second, rather than the first, word and an accent on the penultimate, rather than the final, word.

The three factors above interrelate with each other to determine the word order and accent placement within a Dyirbal declarative utterance. However, further investigation into the pragmatic roles in Dyirbal will be necessary before the extent and the nature of their interrelationship can be determined.
<table>
<thead>
<tr>
<th>Position of boundary tones</th>
<th>Percentage of all / %</th>
</tr>
</thead>
<tbody>
<tr>
<td>First clause boundary in topic chain</td>
<td>16</td>
</tr>
<tr>
<td>Final clause boundary in topic chain</td>
<td>23</td>
</tr>
<tr>
<td>Only clause boundary in topic chain</td>
<td>5</td>
</tr>
<tr>
<td>Internal clause boundary in topic chain</td>
<td>26</td>
</tr>
<tr>
<td>Intonation phrase boundary within a clause</td>
<td>11</td>
</tr>
<tr>
<td>Single clause replies in conversation</td>
<td>19</td>
</tr>
</tbody>
</table>

The positions of the boundary tones in the corpus and the percentage of occurrence.
5.7 THE BOUNDARY TONE

A phonetic and phonological description of the boundary tone was given in Chapter 4. This section discusses the possible linguistic significance of the boundary tone.

5.7.1 Boundary tone location

There were fifty intonation phrases that had a boundary tone (%) within the corpus. The linguistic significance of the boundary tone in Dyirbal declarative intonation is difficult to determine from uncontrolled and untested data. I firstly looked at the position of each intonation phrase with a boundary tone:

- in relation to other intonation phrases,
- in relation to syntactic clause structure,
- in relation to turn-taking in conversations, and
- within a topic chain

I then examined the content of each intonation phrase with a boundary tone and its relationship with that of the following intonation phrase. This procedure enabled the extrapolation of possible linguistic roles for the boundary tone.

Eighty-nine percent of the boundary tones occurred at a clause boundary. This suggests that at least one of the roles of the boundary tone in Dyirbal is to mark syntactic boundaries. Table 5.10 shows the six locations in which boundary tones occur in the corpus. Forty-three percent of the boundary tones in the corpus occurred in the first three positions in the table; that is, at the first, final or only syntactic clause boundary in a topic chain. Thus the boundary tone may also play a role in delineating topic chains. Nineteen percent of the boundary tones in the corpus occurred at the end of a single clause reply in a conversation. This may have implications for turn-taking cues in discourse. "At the end of any utterance, whether or not it completes the speaker's turn, we would expect to find a fall in baseline pitch, a decrease in amplitude and some segmental lengthening. Prosodic turn-yielding cues, if any, would have to be overlaid upon this characteristic utterance-final prosodic pattern . . . Thus in the unmarked case fundamental frequency declines across the utterance ...[V]iolations of these effects are marked as carrying information - for example, the terminal rise associated with
TABLE 5.11

<table>
<thead>
<tr>
<th>The clause or intonation phrase containing the boundary tone:</th>
<th>actual number</th>
</tr>
</thead>
<tbody>
<tr>
<td>has an overt subject NP and is followed by a copular complement with the same subject NP but which is not overt</td>
<td>3</td>
</tr>
<tr>
<td>is followed by a VC containing the same verb but which is inflected for PURPOSE (see Section 5.1.6)</td>
<td>2</td>
</tr>
<tr>
<td>contains the subject NP and the VC of a clause and is followed by an intonation phrase containing the DATIVE NP of the same clause</td>
<td>3</td>
</tr>
<tr>
<td>is a main clause and is followed by a relative clause</td>
<td>3</td>
</tr>
<tr>
<td>also contains one of two particles - ḍna ‘new topic/action’ and ḅnum ‘and then’</td>
<td>6</td>
</tr>
<tr>
<td>has a NPA which is not overt and is followed by an intonation phrase in which the same NPA is overt</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

The relationship of intonation phrases separated by a boundary tone.
question forms" [Cutler & Pearson, 1986: 140].

The terminal rise to the boundary tone in Dyirbal replies diverges from
the expected decrease in Fo at the end of an utterance. The terminal rise
in Dyirbal (and many other languages) can be associated with questions
after which the speaker yields her/his turn in order to allow the addressee
to respond [King, in press]. Therefore question-type intonation may be
used in Dyirbal declarative utterances to signal a yield of turn in a
conversation in much the same way as in questions.

A further 26% of the boundary tones in the corpus occurred at a
syntactic clause boundary that is internal to a topic chain; that is, a clause
boundary which is not the first, final or only one in a topic chain. The
remaining 11% of the boundary tones occurred at intonation phrase
boundaries within clauses and thus do not appear to mark a major
syntactic boundary.

There were 18 boundary tones which did not occur at a topic chain
boundary or in a reply. Table 5.11 shows the relationship between these
clauses or intonation phrases which terminate in a boundary tone and
those which follow them (plus the actual number of occurrences for
each). It would appear from the data in the table that in these cases at least
there is a strong pragmatic and/or semantic relationship between the
intonation phrase (in most cases a syntactic clause) which terminates in a
boundary tone and that which follows it. All of the second intonation
phrases except those containing the particles refer back to the intonation
phrase which contains the boundary tone. The two particles - ḍndog ‘new
topic/action’ and bānum ‘and then’ - draw the listener’s attention to what
is going to be said next. Thus, in all 18 cases the boundary tone appears to
indicate that there is something of importance coming in the next
utterance - whether it be closely related to or qualifying the previous
utterance, or announcing something new or progressive.

5.7.2 Segmental lengthening and the boundary tone

Seventy-nine percent of the boundary tones in the corpus co-occur
with segmental lengthening. As was discussed in Chapters 1 and 4, it has
been shown in many languages that segment lengthening can provide
perceptual cues to major syntactic boundaries [Pickett, 1980: 95].
Kanerva [1990: 147] reports that in Chichewa there is considerable
lengthening of the final two syllables of an intonation phrase while in
English Gussenhoven and Rietveld [1992:284] suggest that phonological
constituents of different ranks can trigger different degrees of pre-
boundary lengthening.

"Phrase-final lengthening provides listeners (of English) with a
valuable cue to the location of a phrase boundary within a
sentence and ... listeners use this feature to recover the position
of the phrase boundary via the effect it produces on the rhythm
of the stress beats of the sentence". [Scott, 1982: 1005]

In Dyirbal, the majority of final boundary tones with lengthened
segments occur at a clause boundary. The following are the percentages
of lengthened boundary tones which occur at syntactic clause boundaries:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CG</td>
<td>80%</td>
</tr>
<tr>
<td>GW</td>
<td>86%</td>
</tr>
<tr>
<td>JM</td>
<td>82%</td>
</tr>
</tbody>
</table>

with the remainder occurring at intonation group boundaries within a
clause. (Dyirbal has no length distinction for syntactic phrase boundaries
as in English due to the freer word order and the role played by
affixation - see Section 5.3.2).

5.8 SUMMARY

This chapter has discussed the relationship between the declarative
intonation and the syntax and pragmatics of Dyirbal. The clause has been
shown to be the syntactic constituent which is strongly delineated by the
intonation. Clause boundaries in the majority of cases are accompanied by
a pause and reset in the Fo and sometimes by a boundary tone and
segmental lengthening. In 64-74% of cases the syntactic clause is
coextensive with an intonation phrase (Sections 5.4 & 5.7).

Dyirbal has a syntactically free word order. However in Section
5.6 it was demonstrated that there are certain pragmatic constraints on
the ordering of words within an intonation phrase. The positioning of the
first and the final accents on the first syllable of the first and the final
words of an intonation phrase has a predictability of at least 83%. This
suggests that Dyirbal speakers deliberately position the most salient
information at the beginning and at the end of an intonation phrase.
Which words within that salient information receive an accent is determined in part by the preferred word order (Section 5.2.7) and an accent assignment hierarchy which ranks word classes by their likelihood to be accented (Section 5.6.2).

It was suggested in Section 5.7 that the boundary tone plays a role in marking major syntactic boundaries as well as indicating a strong pragmatic/semantic relationship between two utterances.
The preceding chapters have presented a description of the declarative intonation of Dyirbal. In this chapter the main points of the study are recapitulated.

Five texts were selected for this study from the collection of Dyirbal recordings of R.M.W. Dixon made during the 1960s and early 1980s. The texts consisted of three narratives and two conversations involving one female and four male speakers. Spectrographically derived measurements were obtained from 187 intonation phrases within these texts and, in conjunction with auditory impressions, were analysed to develop a phonetic and phonological description of the declarative intonation of Dyirbal. The basic principles of Pierrehumbert's [1987, 1988] model for English intonation have been used for the description of Dyirbal intonation. The fact that the tones are regarded as individual phonemes means that they can be used to account for any tonal sequence unlike in the British Tradition. However, in contrast to Pierrehumbert's study, auditory impressions were used in conjunction with the Fo traces to investigate and describe the corpus.

To prepare the data for analysis spectrograms were made on a sonograph and manually segmented and measured. This was due to the uncontrolled nature of the recordings. Because the texts were not recorded in a laboratory there was inevitably some interference in the recordings and, in some recordings, the energy in the higher frequencies was missing. These problems can be manually factored out but if the spectrographic measuring
is done on computer there is a risk that the interference will be included in the measurements of the sound wave.

The uncontrolled texts ensured that the intonation that was analysed was of natural speech. It ensured that the corpus did not include any of the unnatural intonation patterns that can result from scripted utterances. However it necessitated the editing out of such things as interruptions, interjections and coughing.

The results of the analysis show that Dyirbal declarative intonation has two tones - a pitch accent and a boundary tone. The pitch accent is always signalled by a rise in pitch which is reflected in the Fo. The phonetic form of the accent is \([LHL]\). The Fo peak of the pitch accent can occur anywhere within the same syllable as the accent onset or within the following syllable. There appear to be three major locations to which Dyirbal speakers may target their accent peaks - the first and the second vowel/consonant boundaries after the accent onset and in the central portion of the first vowel. The significance, if any, of these peak locations is unknown. The boundary tone is signalled as a rise in pitch on the final syllable of the intonation phrase. The phonetic form of the boundary tone is \([H]\).

The tones are concatenated into intonation phrases which have between one and three pitch accents and which may or may not terminate in a boundary tone. The Fo in the majority of intonation phrases in the corpus has a downward trend between the Fo excursions which signal the pitch accents. This downward trend in the Fo can be accounted for by declination within the Association Domains of the pitch accents and as downstep from one Association Domain to the next. A form of upstep similar to that of some interrogative and imperative contours is evident in a small number of the syntactically declarative intonation phrases in the corpus.

The degree of prominence given to a pitch accent is determined by the amount of emphasis a speaker wishes to give a syllable. The determination of relative pitch accent prominence is not possible without the judgements of native speakers, however it appears that a pitch accent in Dyirbal can be given the most prominence regardless of where it occurs in relation to the other accents in the intonation phrase. There is also evidence in Dyirbal intonation of syllable-lengthening associated with pitch accents and boundary tones in which the duration of vowels is increased by over 50%.

The relationship between the syntax, the pragmatic structure and the
intonational system of Dyirbal has also been examined in this study. The
majority of syntactic clause boundaries in the corpus are marked by a pause
and a reset in the Fo. Clause boundaries are sometimes also accompanied by
a boundary tone and segmental lengthening. Syntactic clauses and intonation
phrases have a strong tendency to be coextensive.

The word order in Dyirbal is syntactically free. However it is evident
from the intonational system that there are certain pragmatic constraints on
the word order within an intonation phrase. Eighty-three percent of the
intonation phrases in the corpus have the first and final accents on the first
syllable of the first and the final words (or in the case of intonation phrases
with a single pitch accent, on just the first word). This suggests that Dyirbal
speakers deliberately position the most salient information at the beginning
and at the end of an intonation phrase. Which word within a salient
constituent receives the pitch accent is determined both by the preferred
word order and by an accent assignment hierarchy which ranks word classes
by their likelihood to be accented. The boundary tone was shown to play a
role in delineating major syntactic boundaries and it was suggested that it
may also indicate a strong pragmatic/semantic relationship between two
adjacent utterances.

These findings have shown that there are some differences between
the intonation of Dyirbal and that of English. One of the main differences is
the low pitch accent (L*) which occurs in English but not in Dyirbal. The Fo
value of the low accent in English decreases as prominence increases.
Prominence in Dyirbal however is only accompanied by an increase in the
Fo values. Another difference is the number of accent types. Dyirbal has
been shown to have just one accent type whereas English has seven
[Cruttenden, 1986; Pierrehumbert, 1987]. A third difference between
Dyirbal and English is the high initial boundary tone (H%). Dyirbal does
not have a phonologically high onset of intonation phrases as English does.
All onsets are phonologically low in Dyirbal and the 6% of intonation
phrases in which the onset is equal to or higher than the first accent are
accounted for phonetically. Thus it has been shown that there is no initial
boundary tone in Dyirbal declarative intonation.

It can be seen from the findings that Dyirbal does have certain
intonational aspects in common with other languages. A downward trend in
Fo values over the duration of an utterance has been attested in a number of
languages including English [Cooper & Sorensen, 1981; Pierrehumbert,
1987], Dutch [t'Hart et al., 1990], German [Kohler, 1991], Danish [Thorsen,
1983] and Swedish [Gårding, 1983]. Dyirbal has been shown to share this feature with these other languages. Accent placement in Dyirbal declarative intonation phrases has been shown to occur at the beginning and the end of an utterance in the majority of cases. This suggests that the most salient of the information in an utterance is deliberately located at the beginning and the end much the same as it is in Russian. This phenomenon has also been documented for Dutch and is what t’Hart et.al. [1990] call the 'hat pattern'.

The present study of Dyirbal intonation is confined to declarative utterances. Preliminary results from the analysis of the interrogative intonation of Dyirbal are contained in King [in press] and are briefly summarised here. Eighty-three percent of declarative intonation phrases have pitch accents on the first and the final words of the intonation phrase. This is also the case in 72% of the interrogative intonation phrases. Eighty-five percent of the declarative intonation phrases analysed have a declination in the Fo between the tones which corresponds to a decrease in pitch. In contrast, the Fo declination in 86% of the interrogative intonation phrases in the corpus is suspended between the pitch accents and this Fo suspension corresponds to a levelling of pitch. Interrogative utterances in many languages are marked by a terminal rise. The terminal rise in Dyirbal however occurs in interrogative utterances in the same proportion as in declarative utterances. This suggests that the suspension of the Fo between pitch accents, when accompanied by a corresponding levelling of the pitch, is a more important cue to interrogatives than the terminal rise or accent placement. More analysis will be required to determine further cues to interrogative intonation.

There are no speakers of Dyirbal remaining who could act as language consultants for the collection of further data and who could participate in perception tests [Dixon, personal communication]. This means that only the declarative and interrogative intonation is likely to be documented. There will be no opportunity to determine the perception of relative accent prominence or any normalisation mechanism carried out by a listener to allow for the declination in an utterance. It is also unlikely that the meanings of the intonational units (tones, contours, etc) will ever be ascertained and until further work is done on the pragmatic structure of Dyirbal, the relationship between the intonation and the pragmatics cannot be fully understood.

Little is known about the intonation of other Australian Aboriginal languages. Analyses and descriptions of the intonation of other Aboriginal
languages are vital for future comparative and historical intonational studies. Research on intonation will contribute to the overall knowledge of Australian Aboriginal languages.
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