# Prosodic Variation in Arabic

## 1 Introduction

The study of prosodic variation in Arabic is as yet in its infancy, but offers much scope for potentially fruitful future research. This chapter aims to equip researchers in Arabic sociolinguistics with the tools to identify potential prosodic variables to study, by setting up a working definition of what prosody is, by situating Arabic within the range and scope of observed cross-linguistic prosodic variation, and by summarising those studies which have already investigated prosodic variation in Arabic. The chapter closes by setting out some desiderata for future research on sociolinguistically conditioned prosodic variation in Arabic.

The main benefit that an understanding of prosodic variation can offer to researchers on Arabic sociolinguistics is the promise of potential new variables to study. Much of the work to date on Arabic sociolinguistics, for example, within variationist frameworks, has primiarily looked at phonological variables which can be classed as 'segmental', such as the realisation of individual phonemes [ʒ] <ج > and [q] <ق > (Yaeger-Dror & Fagyal, 2011). A goal of this chapter is thus to evaluate each of the prosodic features discussed, as instantiated in Arabic, with respect to their potential as variables for inclusion in variationist and/or sociophonetic studies on Arabic in future. Few of the studies on prosodic variation in Arabic outlined below have addressed the potential impact of properly sociolinguistic 'external' factors, such as age, gender or education; most studies to date have still focussed on regional variation, broadly defined. Review of this work is, however, instructive for sociolinguists in establishing the range of potentially relevant 'internal' linguistic factors which must be taken into account.

Researchers on Arabic prosody also stand to benefit from a more sociolinguistically informed understanding of prosodic variation. The study of prosodic variation *per se* is still a relatively new field of research, with most key publications in the field dated after 2000 (Jun, 2014; Jun, 2005), and although word stress has been extensively studied in Arabic, other aspects of Arabic prosody have received much less attention until very recently. With notable exceptions (Ingham, 1974; Rosenhouse, 1994; 2011), most grammars and descriptions of Arabic dialects include rather limited information about rhythm or intonation. With the advent of readily available tools for the analysis of pitch traces as a reflection of intonational contours (such as Praat, Boersma & Weenink, 2013), new descriptions of the intonation of Arabic dialects are emerging with increasing frequency, which is a welcome development. Nonetheless, researchers on Arabic prosody need to be aware of the range of sociolinguistic and other factors which can influence prosody, leading to variation in the data under study.

## 2 What is prosody?

### *2.1 Defining prosody*

The term 'prosody' is used in different ways by different authors in different contexts. Prosody is defined here as phonetic and/or phonological phenomena observed in domains larger than an individual speech segment: syllables, feet, phrases and combinations thereof. This definition equates prosody to suprasegmental, as opposed to segmental, phenomena, but excludes work on poetry or metre.[1] This chapter addresses three inter-related aspects of prosodic variation: stress, rhythm and intonation.

[1] Emphasis spread (or non-local pharyngealisation) is discussed by Khattab & Foulkes in Chapter X.

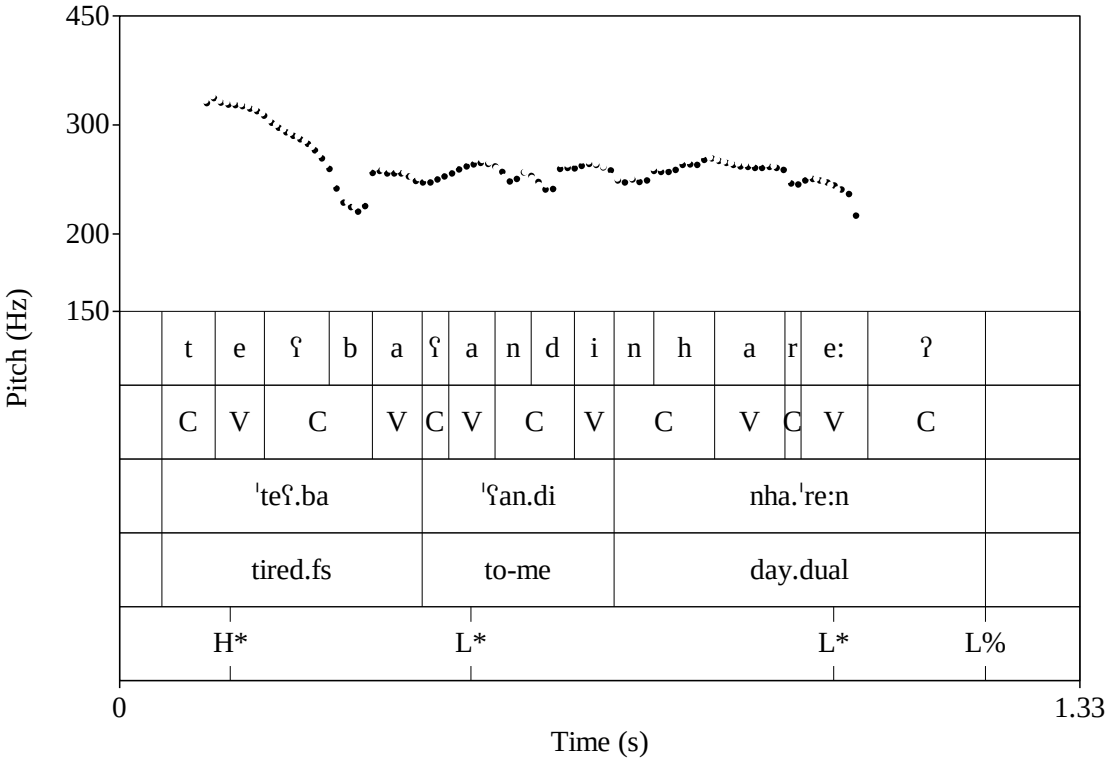


Figure 1: Sample utterance in Tunisian Arabic [tuns-dec5-f1]
[teʕba ʕindi nhareːn] 'I've been tired the last few days' with annotated tiers: 1 (top): segments; 2: consonantal/vocalic intervals; 3: words (marked for stress); 4: gloss; 5 (bottom): prosodic annotation

Figure 1 shows a sample utterance in Tunisian Arabic (from Hellmuth & Almbark, 2015), illustrating some techniques for labelling of prosodic features. Quantitative acoustic measurement of prosodic phenomena typically involves dealing with relative (rather than absolute) values of duration, pitch or loudness (as well as other 'segmental' effects such as formant values of vowels or phrase-edge effects on consonants). Qualitative impressionistic analysis might include identification of the position of the stressed syllable in a word (as on tier 3), or prosodic annotation of the intonation pattern in an utterance (as on tier 5). In a sociolinguistic analysis, this utterance would provide tokens of recognisably Tunisian (rather than, say, Egyptian) features which are both categorical (choice of lexical item) and gradient (vowel quality) in nature: she produces [teʕba], with a mid-vowel in the first syllable, not Cairene [taʕbaːna]. What prosodic features might also be included in such an analysis?

Stress (or 'word accent') denotes the relative prominence of one or more syllables in a word-sized domain, and is marked in an IPA transcription with a (ˈ) diacritic, at the beginning of the stress syllable (shown on the third tier in Fig.1). In stress languages there is typically one stressed syllable per word (Hyman, 2006), which native listeners can generally identify. The phonetic correlates of stress (acoustic cues observed on stressed vs. unstressed syllables) vary across languages (van Heuven & Sluijter, 1996), but generally include a mix of temporal (duration) and spectral (intensity, pitch [f0], vowel quality [F1/F2], spectral tilt) properties.

Rhythm is difficult to define precisely (Turk & Shattuck-Hufnagel, 2013), but relates to the degree of perceived regularity of prominences in an utterance. The myth of a strict dichotomy between syllable-timed and stress-timed languages persists in many quarters, but empirical

studies have found little evidence to support a simplistic rhythmic divide (Dauer, 1987; Nolan & Jeon, 2014). Instead, it is now widely agreed that there is a continuum of rhythmic variation across languages, which is a by-product of the general phonetic and phonological properties of each language, both segmental and suprasegmental (Wiget et al., 2010). Rhythm can be investigated quantitatively by comparing the relative duration of consonants and vowels in an utterance (shown on the second tier in Fig.1).

Intonation describes the shape of the pitch contour of an utterance (e.g. rising or falling), as well as the alignment of pitch peaks or pitch valleys with the segmental string (the words in the utterance), and the presence of phonetic and/or phonological cues to indicate the degree of juncture between the words in the utterance (which words are to be interpreted as grouped together, or not). Pitch events are generally aligned with the stressed syllable of one or more words in an utterance (known as 'pitch accents') and/or with the edges of prosodic domains of various sizes ('boundary tones'). In Figure 1, we see (on the bottom tier) that the speaker has produced this utterance with a pitch accent on each word, with the first word singled out somewhat, since it is the only word to bear a H* accent. The last word in the phrase displays laryngealisation (final /n/ realised as [ʔ]),a phonetic cue signalling the end of the utterance.

Which of the prosodic features of our sample of Tunisian Arabic in Fig.1 could serve as variables for inclusion in a sociolinguistic study? In terms of categorical variables, probably only the last feature (laryngealisation of the phrase-final /n/) is a good candidate, because the word stress and intonation patterns observed in this example vary little from those found in other varieties of Arabic. To identify potential prosodic variables, we need to know whether an observed feature is typical of the dialect under study, and to what extent that dialect differs in respect of this feature from other dialects. The main body of this chapter summarises what is known so far about the scope of variation, cross-linguistically, and cross-dialectally within Arabic, for stress, rhythm and intonation. There are however a number of conceptual pitfalls to be avoided in the study of prosody, which we deal with in the remainder of this section.

### *2.2 Issues in the study of prosody*

Stress, rhythm and intonation can all be described, analysed and understood in terms of both *form* and *function*, and studies vary as to whether both form and function are treated together. With respect to stress there are more studies of the phonological form of stress (what is the observed position of stress in words of different types) than of its phonetic form (what are the phonetic correlates of stress). The function of stress could be argued to co-vary with its form, and is either demarcative (picking out the edge of a word) or cumulative (identifying a 'head' syllable within the word domain), or both (Hyman, 2006). Most studies of the form of rhythm now make use of quantitative metrics which compare the relative duration of consonants and vowels. Earlier claims, that the function of syllable-timing was to create isochronous utterances, have largely fallen away, but it is clear that short stretches of isochrony are frequently to be found in naturally-occurring speech, which map onto independent cognitive notions of rhythm (Nolan & Jeon, 2014), and in these contexts rhythm can be shown to have communicative function (Schladebeck, 2015).

Studies of the form of intonation can be divided into those which analyse the observed pitch patterns as contours, and those which analyse them in terms of interpolations between pitch targets (a comprehensive overview of this debate is provided in Ladd, 2008). Contour-based frameworks include the largely qualitative British School of intonation transcription (O'Connor & Arnold, 1961) and phonetic approaches which model the shape of the f0 contour, such as INTSINT (Hirst & Di Cristo, 1998; Hirst, 2005). The influential

Autosegmental-Metrical (AM) theory of intonation analyses the intonation contour in terms of a sequence of pitch targets, associated with landmarks in the metrical structure, namely the heads and/or edges of prosodic domains of various sizes (Pierrehumbert, 1980; Beckman & Pierrehumbert, 1986). The Tones and Break Indices (ToBI) annotation system for intonation is based on the AM framework (Beckman & Elam, 1993; Beckman, Hirschberg, & Shattuck-Hufnagel, 2005). As for function, intonation, like stress, can serve a demarcative function (sometimes known as 'tonality', indicating the degree of juncture between words or phrases) as well as cumulative function (known as 'tonicity', with pitch accents identifying which words are singled out as salient in the utterance). In addition, the choice of the shape of the intonation contour ('tone') may indicate the modality of the utterance as a question or declarative. Some authors analyse the function of intonation patterns componentially (Pierrehumbert & Hirschberg, 1990; Truckenbrodt, 2012). Although it is not possible to entirely separate intonational form and function, most studies focus on either form or function, while attempting to control the other factor, with varying degrees of success.

This chapter focuses on the phonetic and phonological form of stress, rhythm and intonation, since it is variation in surface forms of these features which is mostly likely to yield potential sociolinguistic variables.[2]

Another issue is that some prosodic features straddle the boundary between *linguistic* and *extra-linguistic* phenomena, and there has been much debate as to whether there can be said to be a grammar of intonation, at all (Ladd, 2008). The emerging consensus is that there is indeed such a thing as intonational phonology (a grammar of intonation), just as there is such thing as metrical phonology (i.e. a grammar of stress), and thus variation in prosodic features of this type should be analysed as language-internal factors in a sociolinguistic study.

Ladd (2014) points out that prosodic phenomena are sometimes thought of as being extra-linguistic if the features involved are gradient, rather than categorical, in nature. It would be easy to assume that all of the gradient phenomena are phonetic, and all of the categorical phenomena are phonological, however, degrees of difference in e.g. prosodic prominence may be realised gradiently (e.g. an increase in f0 excursion) but interpreted categorically (e.g. accented or unaccented) (see Ladd & Morton, 1997 for an example in English intonation). In addition, the manner in which gradient prosodic features are grammaticalised varies cross-linguistically (Gussenhoven, 2004).

Analytical decisions about what type of phenomena are worthy of systematic analysis necessarily depends on the theoretical position taken about what the primitives in the system are, for example, whether intonation is best described in terms of contours or levels/targets. The study of prosody is relatively new, and techniques and theoretical positions are still evolving. As a result, some reported differences between languages or varieties may not in fact reflect empirical differences, but instead be due to differences in e.g. notational systems (Bennett, 2015); in the same way, two varieties which have been described as being similar may hide pockets of variation, and, in turn, potentially viable sociolinguistic variables.

Finally, a practical issue is that the study of prosody generally requires skills and insights from different sub-disciplines of linguistics; that is, prosody is an interface phenomenon. For example, if surface variation in the position of word stress is to be used as a variable in a sociolinguistic study, the analyst will need to take into account the extent to which the

[2] See section 5.1 for how variation in function might intersect with variation in form, however.

phonology of each of the varieties under study interacts with morphology: does the domain of stress assignment include affixes and clitics or not; that is, is stress assignment cyclic or non-cyclic (cf. Brame, 1973; Kenstowicz, 1983). Similarly, due to the broad range of factors that have been suggested to contribute to the percept of rhythm (Turk & Shattuck-Hufnagel, 2013), studies of rhythmic variation across Arabic dialects will need to consider a range of phonological factors, both segmental, such as the degree of reduction of unstressed vowels (Cantineau, 1937) or the presence/absence of contrastive vowel/consonant length, and suprasegmental, such as the degree of prominence related lengthening (Chahal, 2003). Finally, due to the inherent difficulty of teasing apart form and function, study of intonation requires knowledge of the syntactic, semantic and phonological properties of the varieties under study.

The range of skills and related information which is needed to carry out comparative studies of prosodic features in Arabic (and indeed in other languages) is one of the reasons why there have been few studies to date. Nonetheless, prosodic variation exists, and is becomingly increasingly well-documented cross-linguistically, as well as increasingly easy to analyse given advances in technology. The next sections explore word stress, rhythm and intonation in turn, situating Arabic within the scope of observed cross-linguistic variation for each.

## 3 Stress

### *3.1 Cross-linguistic variation in word stress*

Languages vary as to whether they have word-level stress or not (Hyman, 2006). Within the set of languages classified as having stress ('stress accent languages' (Yip, 2002)), there is variation in the degree of predictability of the position of stress in the word, and if stress is fixed, i.e. predictable, there is considerable variation as to what factors govern the surface position in which stress is observed. Typical factors – all of which interact - include proximity to the left or right edge of the word (left/right edge *alignment*), sensitivity to the syllabic structure of the word (*quantity sensitivity*), immunity of word-final syllables to stress (*extrametricality*) and sensitivity of stress rules to the morphological complexity of the word. A rich theoretical literature has sought to account for the range of cross-linguistic variation in stress (see Gordon, 2011 for a good recent summary). Most theories (though not all, Hulst, 2012) argue a role for the *foot* (a domain containing one or more syllables) in explaining stress assignment, with competing proposals as to the set of possible foot shapes. Hayes (1981; 1995) proposes a basic divide between left-headed *trochees* and right-headed *iambs*.

The combination of theoretical interest, and the relative ease with which stress can identified, auditorily, means that cross-linguistic patterns of stress assignment are reasonably well described: information about stress or word accent is found in most descriptive grammars. In contrast, the range of variation in the phonetic correlates observed on stress and unstressed syllables is less well described, though is known to vary (van Heuven & Sluijter, 1996).

### *3.2 Word stress variation in Arabic*

Variation in the metrical phonology of different varieties of Arabic, geographically defined, is for the most part well-documented, and has been the subject of much research (useful reviews are provided in: van der Hulst & Hellmuth, 2010; Watson, 2011; Hellmuth, 2013).

The stress patterns of most Arabic dialects are broadly similar, in that almost all dialects display rule-governed variation in the position of stress within the word, and the position of

stress is thus predictable from the syllable structure of the word in question. As a result, it is possible to describe the stress patterns of Arabic dialects by means of a stress 'algorithm', such as the one shown in (1) below, which is reported for Gulf Arabic (Holes, 1990):

(1) a. assign stress to a final superheavy syllable (CVVC or CVCC), if present
b. else to the penultimate syllable

There are some differences between dialects in the stress patterns observed in words of certain shapes. These pockets of systematic variation yield an interesting challenge for phonological theories which attempt to account for the scope of cross-linguistic variation in stress assignment (e.g. Hayes, 1995), and the facts of Arabic dialects have forced theoretical innovation (Watson, 2011). Surface differences between dialects are however confined to only a subset of word shapes, some of which may be relatively infrequent, and differences in stress assignment between a particular pair of dialects may be quite difficult to find or elicit, as a result. Since almost all dialects place stress on a final superheavy or penult heavy syllable, so differences are usually only to be found in words containing one or more light syllables (see Hellmuth, 2013 for details). Identification of the stressed syllable in a word is relatively easy, however, and this makes categorical variation in surface word stress a feature which has good potential to serve as a variable in sociolinguistic studies, if the varieties under study differ in stress assignment in word shapes which are sufficiently frequent. An example is a recent study of dialect convergence in Minya, Upper Egypt (Sadiq, 2016), in which the non-local Cairene stress pattern in words containing two final light syllables e.g. [mak .ˈtaba], competes with the local Minya variant [ˈmak. taba], and convergence to the Cairene stress variant correlates positively with level of education.

The acoustic correlates of stress have been explored in a few dialects, though many studies suffer from a confound in that the correlates of word stress are studied in contexts in which the word in question also bears sentence stress (i.e. intonational prominence). As such, the reported correlates may in fact be those of sentence stress, rather than word stress per se (see Beckman & Edwards, 1990 for how to avoid this confound). A study which sought to avoid this problem through careful experimental design is Bouchhioua (2008), in a study of Tunisian Arabic. The difficulties of isolating the acoustic correlates of word-level stress, as opposed to phrase- or sentence- level stress, render gradient variation in the correlates of word-stress rather unsuitable for detailed sociophonetic study.

## 4 Variation in rhythm

### 4.1 The scope of cross-linguistic variation in rhythm

The current consensus in the literature (see section 2) is that there is no simple dichotomy between stress-timed and syllable-timed languages (Turk & Shattuck-Hufnagel, 2013). A number of quantitative measures of rhythm, usually known as 'rhythm metrics' have been proposed which seek to capture the durational properties of speech. Studies which use these metrics show a continuum of variation across languages, with typical syllable- vs. stress-timed languages falling at either extreme of the continuum. The first metrics proposed were a measure of the overall amount of vocalic material in an utterance (V%) and the degree of variation in the length of non-vocalic intervals (ΔC). These early measures have been shown to be strongly affected by speech rate, and normalised metrics are now recommended (Wiget et al., 2010). Evidence from metrics should be interpreted with caution, however, as the full range of factors which give rise to the percept of rhythm is not yet known (Turk & Shattuck-

Hufnagel, 2013). Dauer (1987) suggested a long list of linguistic properties which might give rise to the overall percept of relative stress- vs. syllable-timing, but the metrics largely reflect the contribution to rhythm of the durational properties of vowels and consonants; these include the presence/degree of vowel reduction in a language, or the presence/complexity of consonant clusters. Recent work has however begun to consider the contribution of prosodic features, such as lengthening of segments in phrase-final position or under accentual prominence, and have shown cross-linguistic variation in the degree of lengthening observed in these positions (Prieto, Vanrell, Astruc, Payne, & Post, 2012).

### 4.2 Rhythmic variation in Arabic

Ghazali et al (2002) explored rhythmic variation across a set of geographically defined dialects of Arabic using metrics. As an early study, the only metrics used were the rather basic V% and ΔC measures, so the results must be interpreted with caution, in the light of recent findings regarding the susceptibility of these measures to perturbation by speech rate. Nevertheless, the study found a clear continuum of variation, in the expected direction: speakers from Morocco, Algeria, Tunisia, Egypt, Jordan and Syria participated, and the V% measure for their speech samples increases steadily from west to east. This is as expected, due to the presence of vowel reduction and complex consonant clusters in the Maghreb dialects, and less vowel reduction/complexity of clusters in the Mashreq dialects. A recent study investigated rhythm in Najdi Arabic using a range of metrics for the first time, and found V% values intermediate between those of the Tunisia-Egypt and Syria-Jordan groups (Algethami, 2013), as illustrated in Figure 1 below. The values of V% for all of the dialects fall within the range expected for a stress-timed language (Hamdi, Barkat-Defradas, Ferragne, & Pellegrino, 2004), and the continuum of rhythmic variation across Arabic dialects is thus generally accepted to be in terms of less-syllable-timed to more-syllable-timed. Nevertheless, the extremes of the continuum can be distinguished by listeners: Barkat et al (1999) found that listeners were able to identify a speech sample (resynthesized so as to remove segmental information) as being from an eastern or western dialect, based on durational properties alone.

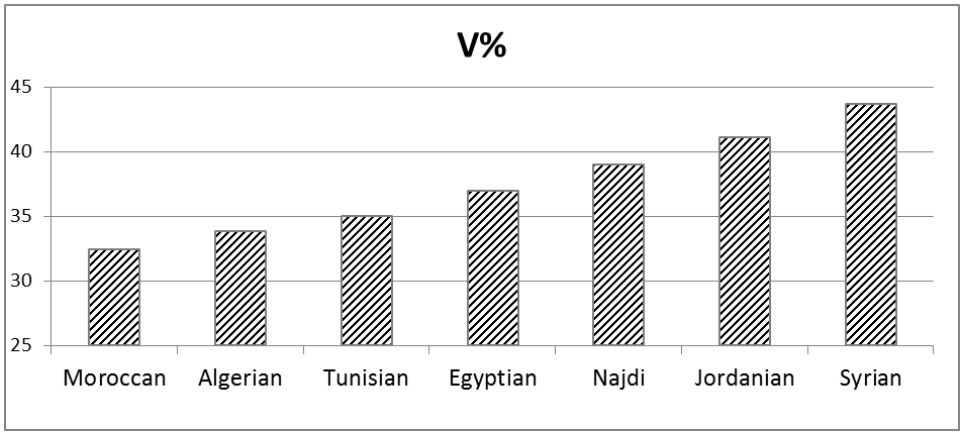


Figure 1: Rhythmic variation across Arabic dialects,
based on V% scores reported in Ghazali et al (2002) and (for Najdi Arabic) AlGethami (2012).

The rhythm metrics provide a means of investigating rhythm quantitatively, and the findings of Ghazali et al. (2002) and following studies suggest that further sociophonetic studies into rhythmic variation across dialects might be very fruitful, for example as a source of quantitative evidence for potential ad- and/or sub-stratal influences on the various dialects (Yaeger-Dror & Fagyal, 2011). The metrics must be handled with care, however, in light of

the many questions in the literature regarding their reliability (Wiget et al., 2010; Arvaniti, 2012). Another approach might be to use rhythm metric variation as a means to identify which potential contributing features (such as presence/absence of vowel reduction or of consonant clusters) to include as a categorical variable in a variationist study. For example, Hamdi et al (2005) found a correlation between rhythm metric scores and the range of permitted syllable types, across six Arabic dialects, in which V% co-varies roughly with the presence/absence of phonemic vowel length (lost in the Maghreb varieties), and ΔC with the complexity of permitted consonant clusters (which increases from east to west).

Finally, a recent study found evidence of rhythmic variation according to gender (Meftah, Selouani, & Alotaibi, 2013). The effect was replicated across samples from three different corpora of colloquial Arabic speech, and was attributed to differences in speech rate: males used faster speech rate in two corpora of colloquial spoken Arabic (Najdi /Levantine) but females used faster speech rate in their samples of MSA (which were however very short in duration). Although this finding should be interpreted with caution, due to the differences in speech style and sample utterance size between the corpora, this effect suggests that studies of differences in discourse-related effects on rhythm might be worthy of investigation, such as use of silent or filled pauses and hesitation markers (Yaeger-Dror & Fagyal, 2011) or back-channels (Ward & Al Bayyari, 2006; Ward & Al Bayyari, 2007).

## 5 Variation in intonation

### 5.1 The scope of cross-linguistic variation in intonation

All languages have intonation, in the sense of some use of pitch to indicate the degree of juncture between prosodic domains such as words or phrases (Yip, 2002). The relative scarcity of solid descriptions of intonation in the world's languages (Beckman & Venditti, 2011), means that the task of establishing the scope of cross-linguistic variation in intonation is still very much in progress. Extrapolating from Wells' (1982) work on accents of English, Ladd (1996; 2008) predicted four parameters of cross-linguistic intonational variation, shown in (2) below, which have also been applied to variation among dialects of the same language, for example, in a comparative study of high-rising final contours in different dialects of English (Fletcher, Grabe, & Warren, 2005).

(2)

| | | |
|---|---|---|
| a. | semantic | variation in the meaning or use of phonologically identical tunes |
| b. | systemic | variation in the inventory of phonologically distinct tune types, irrespective of semantic differences |
| c. | realisational | variation in the phonetic realisation of what may be regarded phonologically as the same tune |
| d. | phonotactic | variation in tune-text association and in the permitted structure of tunes |

Jun (2005; 2014) brought together Autosegmental-Metrical (AM) framework descriptions of a range of typologically diverse languages, and based on this sample Jun identifies three main parameters of cross-language variation: i) presence/absence of tonal marking of the heads and/or edges of prosodic phrases; ii) differences in the size of the inventory of pitch accents and boundary tones; and iii) cross-linguistic differences in the distribution of pitch accents (Hellmuth, 2007) which Jun (2014) characterises as variation in 'macro-rhythm'. These are all parameters which can be investigated as *categorical* differences across languages.

Jun's sample does not include any examples of closely-related languages which differ in head- vs. edge-marking (though this is found in Arabic, see 5.2 below). However, even among languages which all systematically mark the heads of phrases (i.e. which have clear sentence stress prominences), there is cross-linguistic variation in the nature of the mapping of prosodic phrasing to syntactic structure, and the degree of sensitivity of that mapping to prosodic weight. The Romance Languages Database[3] (Elordieta, Frota, & Vigario, 2005) is a corpus of parallel sentences in six Romance languages, in which the syntactic complexity and prosodic weight (number of syllables) in the subject and object constituents of SVO sentences is systematically varied. The study found clear differences between languages in the 'default' or most common phrasing choice, in parallel contexts, and cues observed at prosodic boundaries varied across languages also (Elordieta, Frota, Prieto, & Vigario, 2003).

Differences in the size of the inventory of pitch accents and boundary tones are probably most reliably detected by comparing the range of observed nuclear contours across varieties. The nuclear contour is the shape of the pitch contour across the last pitch accent in the utterance together with the following boundary tone. Variation in the nuclear contours used in particular sentence types has been observed in British English (Grabe, 2004; Grabe, Kochanski, & Coleman, 2005), in Irish English (Kalaldeh, Dorn, & Chasaide, 2009) and in Irish (Dalton & Chasaide, 2003). For example, in data from speakers from Newcastle a 'rise-plateau' boundary (analysed as LH* %, with a final 'zero', or mid/level boundary) contrasts with a high rising boundary (LH* H%, with a final high boundary); whereas only the high rising contour is observed in the data from Cambridge speakers (Grabe et al., 2005). The inventory of boundary tones in Newcastle English can be said to be larger than in Cambridge English, since the Newcastle variety has an additional tone available (the '%' zero boundary). If an AM analysis which proposes an inventory of pitch accents and boundary tones is available, it is also possible to compare this inventory directly with those reported for other languages/varieties (Jun, 2014; Jun, 2005). It is important to remember however that a proposed inventory of pitch accents and boundary tones is the result of a phonological analysis. Direct comparison of the results of such analyses involves an element of risk, however, since different analysts may make different methodological and/or theoretical choices about how to treat otherwise empirically parallel phenomena (Bennett, 2015).

Finally, there is cross-linguistic variation in the distribution of accents across utterances (Jun, 2005; Hellmuth, 2007). This has also been observed across dialects of the same language, in Portuguese (Vigario & Frota, 2003; Cruz, 2013): in Northern European Portuguese an accent is routinely observed on all content words in an utterance, whereas in Standard European Portuguese accents are more sparse (e.g. occurring on the first and last lexical items only). There is also cross-linguistic variation in the interaction of pitch accent distribution with focus and information structure, which is discussed further below.

Although these categorical features of intonational variation are based on comparison between speech communities, they could in principle serve as potential variables for inclusion in studies of externally-conditioned variation within speech communities. To my knowledge, there are no such studies yet, nevertheless, a growing body of evidence suggests that prosodic variation within speech communities is the norm, and worthy of investigation in its own right, rather than to be set aside as 'noise' in the data (Niebuhr, D'Imperio, Gili Fivela, & Cangemi, 2011; Cangemi, Grice, & Krüger, 2015). For example, categorical variation in the mapping of prosodic phrasing from syntax, across speakers of the same

[3] http://rld.letras.ulisboa.pt/index.php

variety, has been observed in French (Post, 2000), Swedish (Myrberg, 2013) and Spanish (Feldhausen, 2014). Variation in the acoustic cues used to mark prosodic phrases has been observed in German (Truckenbrodt, 2004; 2007) and in British English (Peppé, Maxim, & Wells, 2000). Although this variation is formalised in different ways in these various studies, in the absence of clear predictor factors, all treat the patterns essentially as free variation. In contrast, in their sample of 90 British English speakers, Peppé et al (2000) also noted subsets of speakers who realised focus utterances in categorically different ways (e.g. without any clear prosodic marking and/or without de-accenting of words appearing after a narrow contrastive focus) and hypothesised that this might be due to contact of these speakers with varieties of English which resist de-accenting, such as Indian English and Jamaican English (see Peppé et al., 2000 for full details).

Intonational variation can also be more fine-grained, and *gradient* in nature. For example, small differences in the alignment of the f0 peak relative to the segmental string (e.g. inside or outside the accented syllable), in otherwise phonologically parallel pitch accents (e.g. in 'default' pre-nuclear accents), have been observed in a number of languages (Arvaniti, Ladd, & Mennen, 1998; Ladd, Mennen, & Schepman, 2000), though it is important in such studies that contextual factors, such as proximity of the target accented syllable to the utterance- or word-edge, are held constant (Prieto, van Santen, & Hirschberg, 1995). Differences in peak alignment have also been observed between different dialects of the same language (Northern vs. Southern varieties of German: Atterer & Ladd, 2004).

There are also cross-linguistic differences in the fine-grained phonetic realisation of tonal contours in contexts where there is a limited amount of segmental material available. For example, if a final falling nuclear contour (H*+L L%) is realised on a monosyllabic word, in some languages (e.g. German), the fall will be truncated, with only the first part of the falling contour realised, whereas in other languages, the tonal contour is compressed (i.e. the slope of the fall is increased), so that the whole fall is realised within the one available accented syllable (e.g. English) (Grabe, 1998); in still other languages, additional segmental material (such as an epenthetic final vowel) will be added so that the whole falling contour can be realised without the need for compression (e.g. Portuguese) (Frota, 2009). Differences in the choice between truncation and compression have also been observed between different dialects of the same language (e.g. Cambridge English vs. Leeds English: Grabe, 2004).

Finally, variation has been observed in the gradient prosodic marking of focus and information structure in different languages. The key difference is between languages in which lexical items denoting old or 'given' information are de-accented (i.e. realised without an accent) and those languages in which de-accenting of such words is resisted (i.e. such words are realised with more compressed pitch excursion). This could be seen as a categorical variable ('±de-accented'), but in practice it is hard to distinguish an unaccented-but-stressed word from a word which is accented but realised in a compressed pitch span (Xu & Xu, 2005). Cross-linguistically, however, there is a basic divide between Germanic languages, in which old information is general de-accented, and Romance languages, in which de-accenting of old information is resisted (Cruttenden, 2006; Ladd, 2008), and parallel differences in the degree to which de-accenting of old information is resisted have been observed between dialects of the same language (Wiltshire & Harnsberger, 2006; Xu, 2011).

Each of these gradient features would be suitable variables for inclusion in sociophonetic studies within speech communities, but I am not aware of any such studies, to date.

## 5.2 Intonational variation in Arabic

No dialect of Arabic has yet been found which uses pitch to create lexical contrasts, though some Arabic creoles are reported to have hybrid prosodic systems (Gussenhoven, 2006). Comparative studies of intonation in Arabic are as yet relatively rare. Chahal (2006) provides a very useful overview, based on secondary analysis of a number of descriptions of a small number of dialects, and notes that the size of the reported inventory of nuclear tones appears to vary: some allow complex boundary tone combinations (such as a fall-rise, or rise-fall) and others display only simple contours (fall or rise); similarly, different tonal contours are observed in different contexts, such as in questions vs. statements. The source descriptions vary greatly in the type of data studied and the notation system used, so some of this apparent variation may yet turn out, on closer inspection, to be an artefact of methodological differences, rather than a real empirical distinction.[4] Nevertheless, there is sufficient evidence here to suggest that typologically interesting patterns of intonational variation across varieties of Arabic exist, which could yield potential variables for inclusion in sociolinguistic studies.

Using Jun's (2005) typology (from section 5.1), we can identify potential variation among regionally defined Arabic dialects. Firstly, with regard to tonal marking of the heads and/or edges of prosodic domains, it is likely that most varieties of Arabic are head-marking, but evidence is emerging to support analysis of Moroccan Arabic as an edge-marking variety (Burdin et al., 2014; Hellmuth, Louriz, Chlaihani, & Almbark, 2015; cf. Grice, Ridouane, & Roettger, 2015). With regard to the size of the inventory of pitch accents and boundary tones, differences between dialects in the availability of complex boundary tones (as noted in Chahal's 2006 survey) can be analysed as a difference in the size of the inventory of boundary tones[5]. As for distribution of pitch accents, most varieties of Arabic have accents distributed at the phrasal level (with at least one accent per phrase), but Egyptian Arabic appears to display a much richer accent distribution (Hellmuth, 2007; Chahal & Hellmuth, 2015). Going beyond Jun's typology, it seems likely that the mapping from syntax to prosody may vary across dialects, either in the mapping from syntax or in the sensitivity of prosodic phrasing to prosodic weight (see Hellmuth, 2016 for preliminary results in this area).

Looking beyond regionally-defined variation, work on different registers of Arabic has observed differences in use of contextual forms at pause (Parkinson, 1991). Evidence is also emerging that there is intonational variation in Arabic within speech communities of a single dialect, i.e. indications of systematic inter-speaker variation. To date this has been observed in the acoustic cues used to mark prosodic phrase boundaries (Hellmuth, 2011; Hellmuth, 2012), and in the use of scaling and/or alignment of the f0 peak to mark narrow contrastive focus (Cangemi, El Zarka, Wehrle, Baumann, & Grice, 2016). In these studies the variation is so far treated as free variation, but might in principle be due to language-external factors rather than language-internal factors.

Gradient intonational variation is also observed in Arabic, which could be exploited in sociophonetic studies of individual features or bundles of features. Variation is known to occur in alignment of the f0 peak of pitch accents, both across dialects (Yeou, Embarki, AlMaqtari, & Dodane, 2007), and in specific contexts, such as in questions (Hellmuth et al., 2015) or under focus (Yeou, Embarki, & Al-Maqtari, 2007). In such studies it is important to

[4] This is noted in another recent secondary analysis of the literature on Arabic intonation (El Zarka in press).
[5] If complex boundary tones are analysed in terms of a phrase accent + boundary tone (e.g. fall-rise: H* L-H%; rise-fall: L* H-L%) this can also be seen as a reflex of differing levels of phrasing across dialects (see Chahal & Hellmuth, 2015 for further discussion).

carefully control the environment in which the peak is observed, as peak alignment is highly sensitive to neighbouring prosodic environment (Chahal, 2001; Chahal, 2003). There are as yet no studies of truncation vs. compression effects in Arabic dialects, and this would be a relatively easy feature to elicit (by varying the number of syllables in the final lexical item in an utterance) and to identify (by examining the position of the peak and the slope of the contour in these target items). Another gradient feature which might prove fruitful for sociophonetic study across dialects is overall f0 range of speakers (Natour & Wingate, 2009).

Although we have much to learn about the scope and degree of intonational variation across varieties of Arabic, the potential for inclusion of intonational variables in sociolinguistic studies is good. Analysis of categorical differences would be facilitated by development of a cross-varietal system for prosodic annotation of Arabic, however. In the meantime, the easiest variables to operationalise for inclusion in variationist studies will be those that are most salient, as these will be the easiest to reliably elicit and identify. Of the phenomena listed above the easiest to find would be: i) differences in the 'default' tune assigned to certain sentence types e.g. the realisation of questions; ii) differences in the distribution of accents and/or in the reflexes of focus e.g. whether given/old material is de-accented, and iii) differences in prosodic phrasing. The main problem for the researcher will be finding ways to reliably elicit these phenomena, and to provide replicable identification of them.

## 6 Future research on prosodic variation in Arabic

Prosodic variables are rarely included in variationist or sociophonetic studies, as yet, cross-linguistically, as well as for Arabic. One reason for this may be that research on prosody is essentially inter-disciplinary, requiring skills in phonetics, phonology, syntax, semantics and pragmatics (Hellmuth, 2014). A further complicating factor for non-experts, in intonational analysis in particular, is the range of different descriptive frameworks used to document intonation patterns, and the relative opacity of the theoretical motivations which underpin the choice of one framework over another. In contrast, although competing theoretical approaches to the analysis of metrical stress patterns exist (compare: van der Hulst & Hellmuth, 2010; Watson, 2011), there is nonetheless a theory-neutral way of describing the key surface stress patterns and how they differ from one variety to another (in the form of a stress 'algorithm', as seen in (1) above). A useful first attempt at a theory-neutral cross-dialectal description of basic intonation patterns in Arabic, was made by Chahal (2006), in her table of the set of nuclear contours observed in different dialects, discussed above. The choice to describe intonation patterns in terms of rises and falls, is of course not entirely theory-neutral (since some formal theories claim contours as cognitively primitive), so even a simple description of contours should be accompanied by some explanation of the conventions which have been assumed (e.g. over what domain the contour is defined).

Increased inclusion of prosodic variables in sociolinguistic investigations of Arabic is likely to be facilitated by the provision of baseline descriptions of the prosodic properties of different varieties of Arabic, which contain a theory-neutral description alongside more detailed, theoretically-motivated analysis. This approach is followed in materials accompanying the Intonational Variation in Arabic corpus (Hellmuth & Almbark, to appear) which combine a basic description of the intonation patterns typically observed in each dialect under study, alongside more formal proposals regarding the intonational phonology of each dialect (framed in the Autosegmental-Metrical theory.

An issue for sociolinguistically motivated studies of prosody is the relative difficulty of eliciting sufficient tokens of the phenomena under study. When dealing with a segmental variable, it is possible to elicit specific target lexical items, chosen because they contain the desired phoneme/context. This can be replicated for stress, by eliciting specific words. For quantitative analysis of rhythm, one needs to elicit whole utterances which are parallel across speakers, which necessitates collection of longer stretches of read speech, which would not be found in either word lists or spontaneous sociolinguistic interview data. For intonational analysis, it is important to have data from a range of speaking styles: read speech data which is parallel across speakers can be useful in establishing the basic patterns of a dialect, but it is very unlikely to provide examples that illustrate the full range of intonational expression (Hellmuth, 2015).

The lack of prior descriptions of the prosodic properties of most varieties of Arabic means that analysts may need to provide corroboration of the descriptive facts of the varieties under study, and this is perhaps most easily achieved through use of a mix of quantitative and qualitative methods. The methods adopted should be informed by what we have learned about prosody in other languages, hence inclusion here of a detailed review of prior studies on cross-linguistic prosodic variation, alongside studies on Arabic itself.

We close by highlighting two potentially fruitful research questions in prosodic variation within and across Arabic varieties. An empirical question, which awaits full investigation, is the extent to which prosodic and segmental variables co-vary. We know that language variation and change does not proceed wholesale, but rather feature by feature (e.g. Llamas, Watt, & Johnson, 2009). This variation may be across different regional varieties, or between different speech communities within a single geographic area, or between different registers or styles of speech within a single speech community. Preliminary investigation of register-based variation case in Arabic suggests that segmental and prosodic variables may vary independently within the speech of a single speaker, depending on the targeted register (Hellmuth, 2013). Since patterns of sociolinguistically conditioned variation in segmental variables are relatively well-described for some varieties of Arabic, there is scope for additional layers of research which addresses prosodic variables as well, on these dialects. A second, related, empirical question concerns the status of prosodic variables in establishing identity for speakers of different varieties, or in eliciting attitudinal responses. In particular, it is an open question whether prosodic variables of the sort discussed in this chapter are above the level of consciousness or below. Although some studies have explored the extent to which listeners are able to distinguish regional varieties based on prosodic properties alone (Barkat, Ohala, & Pellegrino, 1999) there is much scope for further work on the contribution of prosodic features to the establishment of identity and attitudes within and across spoken Arabic dialects.

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