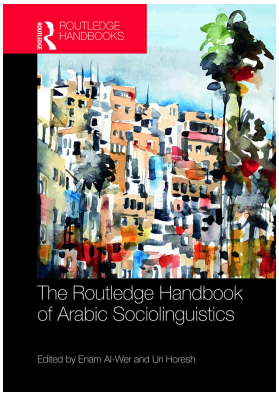

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Prosodic variation

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PROSODIC VARIATION

Sam Hellmuth

Introduction

The study of prosodic variation in Arabic is as yet in its infancy, but offers much scope for potentially fruitful future research. Nevertheless, prosody is an interface phenomenon, and successful investigation of prosodic variation requires skills and knowledge which transcend individual sub-disciplines of linguistics. 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 primarily 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 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 (e.g. Ingham 1974; Rosenhouse 1994), 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 2018), 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.

What is prosody?

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. This chapter addresses three inter-related aspects of prosodic variation: stress, rhythm and intonation.

Figure 12.1 shows a sample utterance in Tunisian Arabic (from Hellmuth & Almbark 2017), 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 stressed syllable (shown on the third tier in Figure 12.1). 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 Figure 12.1).

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

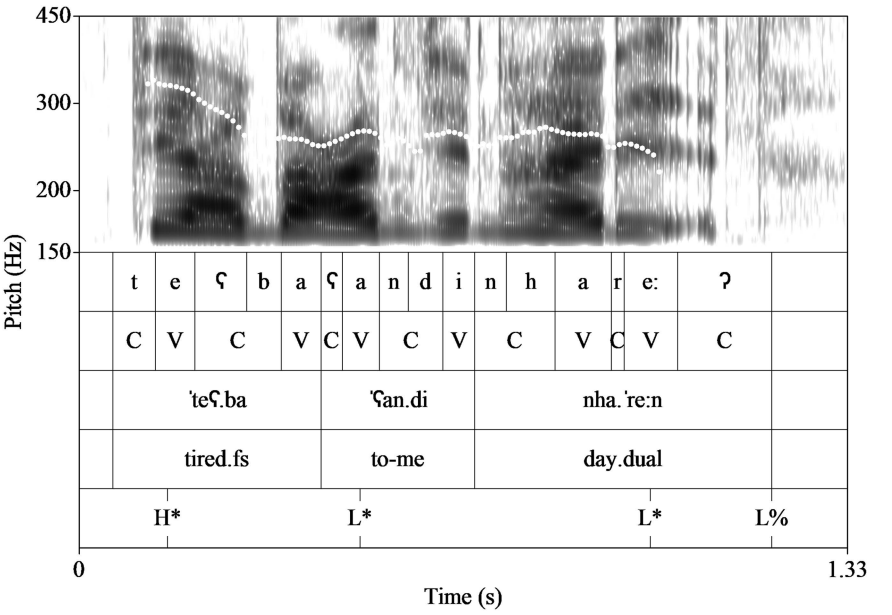

Figure 12.1 Sample utterance in Tunisian Arabic [tuns-dec5-f1] [teʕba ʕandi nhare:n] 'I've been tired the last few days' with annotated tiers: 1 (top): segments; 2: consonantal/vocalic intervals; 3: words (marked for stress); 4: gloss; 5 (bottom): prosodic annotation

words in an utterance (known as 'pitch accents') and/or with the edges of prosodic domains of various sizes ('boundary tones'). In Figure 12.1, 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 Figure 12.1 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.

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 culminative (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 (the International Transcription Systen for Intonation, Hirst & Di Cristo 1998). The influential Autosegmental-Metrical (AM) theory of intonation treats the intonation contour as a sequence of pitch targets, associated with landmarks in the metrical structure, namely the heads and/or edges of prosodic domains (Pierrehumbert 1980). The Tones and Break Indices (ToBI) annotation system for intonation is based on the AM framework (Beckman et al. 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 culminative function (known as 'tonicity', with pitch accents identifying which words are singled out as salient in the utterance), and different contour shapes ('tone') may frequently co-occur with a certain function in a particular language, such as marking out an utterance as interrogative 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, with varying degrees of success.

This chapter focusses on the phonetic and phonological form of stress, rhythm and intonation, since variation in the surface realisation of these features is most likely to yield potential sociolinguistic variables.

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 a 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 of notational interpretation (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, as noted in the introduction, a practical issue is that the study of prosody generally requires skills and insights from different sub-disciplines of linguistics. 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 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 (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; Hall 2013) or the presence/absence of contrastive vowel 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 complex range of skills and related information needed to carry out comparative studies of prosodic features in Arabic (and indeed in other languages) is probably why there have been few studies to date. Nonetheless, prosodic variation exists, and is becoming 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.

Stress

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 (Gordon 2011). Most theories (though not all, Hulst 2012) argue a role for the *foot* (a domain comprising 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 be auditorily identified means cross-linguistic patterns of stress assignment are reasonably well described: information about stress or word accent is found in most descriptive grammars. In contrast, variation in the phonetic correlates observed on stressed and unstressed syllables is much less described, though is known to vary (van Heuven & Sluijter 1996).

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 (i) a. below, which is reported for Gulf Arabic (Holes 1990):

(i) a. assign stress to a final superheavy syllable (e.g. CVVC, CVCC etc.), if present
b. else to the penultimate syllable

There are some differences between dialects in the stress patterns 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, differences are usually only to be found in words containing one or more light syllables (see Hellmuth 2013b 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 (Beckman & Edwards 1990). Bouchhioua (2008) avoided this problem, through careful experimental design, 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.

Variation in rhythm

The scope of cross-linguistic variation in rhythm

The current consensus in the literature 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 any of the 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 et al. 2012).

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. The reason this is expected is 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 12.2. The values of V% for all of the dialects fall within the range expected for a stress-timed language (Hamdi et al. 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 (resynthesised so as to remove segmental information) as being from an eastern or western dialect, based on durational properties alone.

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 (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

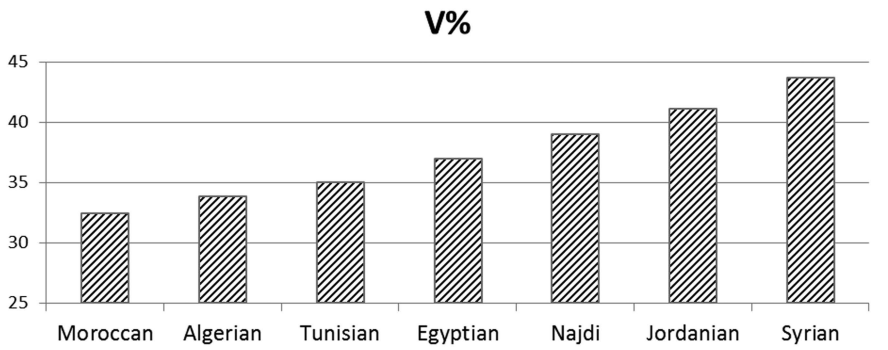

Figure 12.2 Rhythmic variation across Arabic dialects, based on V% scores reported in Ghazali et al. (2002) and (for Najdi Arabic) Algethami (2013)

(absent 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 et al. 2013). The effect was replicated across samples from three different corpora of spoken Arabic dialects, 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 2007).

Variation in intonation

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 (2008) predicts four parameters of cross-linguistic intonational variation, shown in (ii) 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 dialects of English (Fletcher et al. 2005).

(ii) 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 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 below). There is cross-linguistic variation among head-marking languages (i.e. which have clear sentence stress prominences) in the mapping of prosodic phrasing to morphosyntactic structure. Elordieta, Frota, Prieto & Vigario (2003) investigated the effects of syntactic complexity and prosodic weight (number of syllables) on phrasing of SVO sentences in six Romance languages, and found differences between languages both in the most common phrasing choice and in the cues observed at prosodic boundaries.

Differences in the size of the inventory of pitch accents and boundary tones can be 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. For example, variation in the nuclear contours used in particular sentence types is observed in British English (Grabe et al. 2005): for speakers from Newcastle a 'rise-plateau' (analysed as LH* %, with a mid/level boundary) contrasts with a full rise (LH* H%, with a final high boundary), whereas only the full rise is observed in data from Cambridge speakers. The inventory of boundary tones can be said to be larger in Newcastle English than in Cambridge English, since the Newcastle variety has an additional tone available (the '%' mid-level boundary). It is important to remember, however, that an inventory of pitch accents and boundary tones is the result of a phonological analysis, and analysts may make different methodological and/or theoretical choices about how to treat otherwise empirically parallel phenomena (see critique of Jun 2014 in Bennett 2015).

Finally, there is cross-linguistic variation in the distribution of accents within utterances (Jun 2005; Hellmuth 2007). This is observed across dialects of the same language, in Portuguese (Vigario & Frota 2003; Cruz 2013): in Northern European Portuguese, an accent is typically observed on all content words in an utterance, but in Standard European Portuguese, accents are more sparse. Pitch accent distribution also interacts with focus and information structure, as discussed further below.

These categorical features of intonational variation could in principle serve as potential variables for inclusion in studies of externally conditioned prosodic variation within speech communities. To my knowledge, there are no such studies yet, but 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 (Cangemi et al. 2015). Categorical variation in the mapping of prosodic phrasing from syntax, across speakers of the same variety, is observed in French (Post 2000), Swedish (Myrberg 2013) and Spanish (Feldhausen 2014). Variation in the acoustic cues used to mark prosodic phrases is observed in German (Truckenbrodt 2007) and British English (Peppé et al. 2000). This variation is formalised in different ways in these various studies, but all treat the patterns essentially as free variation, though Peppé et al. (2000) noted subsets of speakers who realised focus utterances with/without de-accenting and attributed this to contact with varieties of English which resist de-accenting, such as Indian English and Jamaican English.

Intonational variation can also be more fine-grained, and *gradient* in nature. 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' prenuclear accents), is observed between languages (Arvaniti et al. 1998; Ladd et al. 2000) and between 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 monosyllable, in some languages (e.g. German), the fall is truncated, so only the first part of the contour is realised, whereas in other languages (e.g. English), the contour is compressed, and the slope of the fall increases (Grabe 1998); in still other languages (e.g. Portuguese), additional segments (e.g. an epenthetic vowel) are added so the whole contour is realised, without truncation or compression (Frota 2014). Variation between truncation and compression strategies are observed between dialects of the same language (e.g. Cambridge English vs. Leeds English: Grabe 2004).

Finally, variation is observed in the prosodic marking of focus and information structure in different languages. A 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. accents on such words are still realised but in a compressed pitch span). This is often 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). Nevertheless, there is a basic cross-linguistic divide between Germanic languages, in which old information is de-accented, and Romance languages, in which de-accenting of old information is resisted (Cruttenden 2006; Ladd 2008), and parallel differences are also 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.

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, upon closer inspection, to be an artefact of methodological differences, rather than a real empirical distinction.[1] 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 (outlined in the previous section), 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, though evidence is emerging to support analysis of Moroccan Arabic as a

non-head-marking variety of Arabic (Bruggeman 2018). 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.[2] 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 displays richer accent distribution (Chahal & Hellmuth 2014). Going beyond Jun's typology, it is likely that patterns of prosodic phrasing will vary across dialects, due to differences in the mapping from syntax and/or the sensitivity of 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 of intonational variation within Arabic speech communities, i.e. indications of systematic inter-speaker variation: this has been observed in acoustic cues to prosodic phrase boundaries (Hellmuth 2011, 2012), and in the scaling and/or alignment of the f0 peak to mark narrow contrastive focus (Cangemi et al. 2016). In both of these studies, the patterning is treated as free variation, but might in principle be due to language-external factors.

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

Future research on prosodic variation in Arabic

Prosodic variables are as yet rarely included in variationist or sociophonetic studies 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 a theory-neutral way of describing the key patterns and how they differ from one variety to another (in the form of a stress 'algorithm', as seen in (i) above). An equivalent theory-neutral approach to intonation was used by Chahal (2006), in her summary table of the nuclear contours observed in different dialects, discussed above. The choice to describe intonation patterns in terms of rises and falls is not entirely theory-neutral (since some theories claim contours as cognitively primitive), so descriptions of contours should be accompanied by explanation of the conventions which have been assumed (e.g. over what domain the contour is defined), and ideally also some evidence to substantiate the claim that the contour is indeed typical.

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 provide theory-neutral description alongside more detailed, theoretically motivated analysis. This approach is followed in analysis of the Intonational Variation in Arabic corpus (Hellmuth, forthcoming) which combines a visualisation of the intonation patterns typically observed in different contexts, in each dialect under study, alongside formal proposals about the intonational phonology of each dialect (in AM theory).

An issue for sociolinguistically motivated studies of prosody is the relative difficulty of eliciting sufficient tokens of the phenomena under study. With segmental variables, it is possible to elicit specific lexical items, chosen because they contain the target phoneme or context. This can be replicated for stress by eliciting specific words. For quantitative analysis of rhythm, one must elicit whole utterances which are parallel across speakers, which necessitates collection of longer stretches of read speech, which are not typically included in 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 is invaluable in establishing the basic patterns of a dialect, but it is 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 the 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 et al. 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 a 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 2013a). 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 on these dialects which address prosodic variables as well. 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 et al. 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.

Notes

1 This is noted in another recent secondary analysis of the literature on Arabic intonation (El Zarka 2017).
2 If complex boundary tones are analysed in terms of a phrase accent plus 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 2014 for further discussion).

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