Exploring the syntax-phonology interface in Arabic

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Despite an abundance of research on Arabic syntax and phonology as separate domains, there is as yet relatively little research at the syntax-phonology interface in Arabic. This paper begins by providing an overview of what we know so far, in an effort to identify reasons for the lack of work at the interface to date. The paper then presents a review of prior work on the syntax-phonology mapping in Egyptian Arabic (EA) - set in the context of developments in the wider syntax-phonology literature - in order to show that interface work requires expertise in both phonetics/phonology and syntax. Some early results are then presented from a pilot study which compares for the first time the basic syntax-phonology mapping patterns in two dialects of Arabic - EA, and Jordanian Arabic (JA) - and explores whether dialect-internal, inter-speaker variation, previously observed in EA, is also found in JA.

Keywords: Arabic, prosody, phrasing, intonation, sandhi

1 Introduction

1.1 Aim and outline

The aim of this paper is to make the case for greater collaboration among researchers on both sides of the syntax/phonology divide, in order to unlock

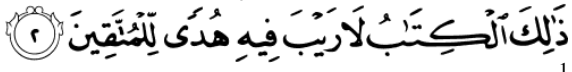
the potential of research at the syntax-phonology interface in Arabic. This is achieved by showing, through a review of prior work on the syntax-phonology mapping in Egyptian Arabic, that interface work is complex, and requires expertise, not just general skills, in both syntax and phonetics/phonology. The outline of the paper is as follows: the remainder of this section provides an overview of existing prior work at the syntax-phonology interface in Arabic; section 2 explores three areas of complexity which must be tackled in the course of interface work, traced through developments in the cross-linguistic syntax-phonology literature matched to lessons learned from prior work on Egyptian Arabic; section 3 presents early results from an ongoing pilot study which compares the mapping of syntactic structure to prosodic structure in Jordanian Arabic and Egyptian Arabic; a brief conclusion closes the paper in section 4.

1.2 Prior work at the syntax-phonology interface in Arabic

The idea that there are phenomena of interest to be found at the syntax-phonology interface in Arabic is by no means new. The rules of Quranic recitation (*tajweed*) include rules of 'stopping' (*waqf*) and 'starting' (*ibtidaa'*), by which the text is marked to show positions in the text at which a prosodic juncture is compulsory (ۘ), recommended (ۖ) or prohibited (ۚ) (see Sawalha, Brierley, & Atwell, 2012 for a summary). There are also

marks to show alternative potential juncture positions, each of which results in a different interpretation (◌̊---◌̊). For example, in the example in (**Error! Reference source not found.**, a pause can be placed either before or after the prepositional phrase 'in it', resulting in different interpretations. Translators, however, tend to select just one of the possible interpretations to render into the target language (Al-Ali & Al-Zoubi, 2009, p. 230), either (1a) or (1b).

(1) ذَٰلِكَ الْكِتَابُ لَا رَيْبَ ۛ فِيهِ ۛ هُدًى لِّلْمُتَّقِينَ



Surah 1: Al Baqarah, verse 2. [1]

ða:lika	*l-kita:b*	*la: rajba*	*fi:hi*	*hudan*	*li-l-mut:aqi:na*
this	the-book	no doubt	in it	a guidance	to those who fear Allah

a) [[This is the book (Qur'an); there is no doubt in it], [(it is) a guidance to those who fear Allah.]]

b) [[This is the book (Qur'an) without doubt] [in it is a guidance to those who fear Allah.]]

In the era of modern generative linguistics, there is relatively little work which specifically treats syntax-phonology interface issues in Arabic, in comparison to the large body of research on Arabic syntax or Arabic phonology in isolation. In addition, the studies that have been carried out encompass a wide range of motivations and approaches. A literature search in the Linguistics and Language Behavior Abstracts (LLBA) database,[2] using the search terms "arab* AND (inton* OR prosod*)", yields 155 results, many of which in fact treat 'prosody' in the sense of word-level morpho-phonology, which is not the focus of the present paper. A number

of individual papers investigate some aspect of Arabic prosody within the fields of language acquisition, language pedagogy or psycholinguistics. Among the remaining results, 15 papers treat some aspect of the phonetic and/or phonological realisation of sentence mode (questions vs. statements), information structure or discourse structure, generally without reference to formal syntactic structure. A further nine papers provide a description of the intonational phonology of individual Arabic dialects, without reference to syntax.

The LLBA search revealed just 10 papers which directly investigate the mapping between syntactic and prosodic structure above the level of the word, and these fall into two groups: syntactic studies which make reference to prosody, and prosodic studies which make reference to syntax.

Some prior work on Arabic syntax has made reference to prosody in an effort to account for a range of different syntactic phenomena. Appeal has been made to patterns of prosodic *constituency* (prosodic phrasing) to explain agreement asymmetries (Ackema & Neeleman, 2003, 2012; Benmamoun & Lorimor, 2006), the optionality of wh-movement in Egyptian Arabic (Yasin, 2012) and gradient patterns of agreement in long distance negative concord in Lebanese Arabic (Hoyt, 2014). In a similar way, patterns of prosodic *prominence* (the distribution of sentence accents) are used by other authors to offer a competing account of the optionality of wh-movement in Egyptian Arabic (Lassadi, 2005) and to account for the properties of bare nominals in Palestinian Arabic (Salem, 2003), and the

distribution of pro-drop in Egyptian Arabic (Jelinek, 2002). Most of these papers use native-speaker judgements as evidence of the possible or preferred prosodic phrasing, or accent distribution, in relevant target utterances. A few include analysis of small amounts of acoustic data, with varying degrees of phonetic accuracy.

Some prior work on Arabic phonology has made reference to syntax to account for phonological phenomena. These fall into two groups depending on whether prosodic constituency or prosodic prominence is at issue, as was seen above for syntactic papers. Most of the work relating to prosodic prominence consists of descriptions of how focus and other information structure categories are realised phonetically in Arabic (see inter alia: Chahal, 2001; Cruttenden, 2006; de Jong & Zawaydeh, 1999, 2002; El Zarka, 2011, 2013; Hellmuth, 2009, 2011a; Yeou, 2004; Yeou, Embarki, & Al-Maqtari, 2007; Zawaydeh & de Jong, 1999). Only a subset of these works provide formal definitions of the semantic categories of focus and information structure which are relied upon, and few make reference to the potential role of interplay between syntax and phonology in the realisation of these categories (see Hellmuth, 2010 for discussion). A few authors have sought to use patterns of prosodic constituency to explain resyllabification phenomena in various dialects (Sudanese: Ali, 1996, 2014; Cairene: Wiltshire, 1998; Meccan: Abu-Mansour, 2011), or to use relative clause attachment preferences to explain patterns of implicit prosody observed during silent reading of Modern Standard Arabic (Abdelghany,

2010). To the author's knowledge, only a few studies have explored the mapping between prosodic constituency and syntactic structure for its own sake (Hellmuth, 2004, 2007, 2011b, 2012) and these are reviewed in detail in the next section, by way of illustration of the various complexities involved in work at the syntax-phonology interface.

In summary, then, prior work at the syntax-phonology interface in Arabic has primarily treated the topic within the confines of one or other discipline, and there are as yet few if any examples of truly collaborative work between syntacticians and phonologists/phoneticians. The next section seeks to illustrate why real collaboration will be needed if work at the syntax-phonology interface in Arabic is to bear fruit in future.

2 Why interface work is complex: a case study

This section presents key results from a sequence of my own research, in the context of wider developments in the syntax-phonology interface literature, as a case study of how and why work at the interface is a complex task.

2.1 Complexity 1: there is no simple syntax-prosody mapping

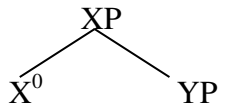
2.1.1 No simple syntax-prosody mapping: cross-linguistic evidence

A body of research from the 1980s onwards showed, firstly, that prosodic structure is not always isomorphic with syntactic structure, and secondly, that there is cross-linguistic variation in the degree and type of mismatch between prosody and syntax (Nespor & Vogel, 1986; Selkirk, 1986; Truckenbrodt, 1995; Inkelas & Zec, 1995; Selkirk, 2000, 2011). The idea that prosodic phrasing might provide a way for listeners to read the syntactic structure off the linear speech signal is plausible, because there clearly is a strong relationship between the two. A good proportion of the time strong prosodic junctures co-occur with the edges of syntactic clauses, and - in languages which mark them - the position of prosodic prominences can also more often than not be described in terms of syntactic clause structure (Chomsky & Halle, 1968; Gussenhoven, 1983; Cinque, 1993; Zubizaretta, 1998; Scheer, 2010). The notion of 'prosodic bootstrapping' was proposed (Pinker, 1984), suggesting that infants might use prosodic cues during L1 acquisition to learn language-specific syntactic patterns. The proposal was, however, criticised due to the wide range of variation across languages in the degree of isomorphy between prosodic and syntactic structure (Morgan & Demuth, 1996; cf. also commentary in Pinker, 2009) and this variation in the degree of isomorphy became itself the object of much cross-linguistic research.

A number of proposals were made in the literature seeking to show that patterns of non-isomorphy between syntactic and prosodic structure could be accounted for in principled ways. The most significant - and

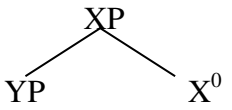
influential - proposal was that surface variation in the syntax-phonology mapping could be explained by proposing that prosodic boundaries mark either the left or the right edge of syntactic domains (Selkirk, 1986). Working within the prevailing syntactic theory of the day (Government and Binding Theory, GB), the syntactic domain in question was the XP, that is, any maximal projection headed by a lexical category (noun > NP, or verb > VP). Thus, languages were found which display prosodic boundaries which coincide with the right edge of all XPs, or with the left edge, as in (2) below (Clements, 1978; Selkirk, 1986; Cho, 1990; Hale & Selkirk, 1987).

(2) a) right-recursive languages (head-initial)



Chi Mwi:ni	[			]	mark right edge of XPs
Ewe	[	]	[	]	mark left edge of XPs

b) left-recursive languages (head-final)



Korean	[			]	mark left edge of XPs
Xiamen Chinese	[	]	[	]	mark right edge of XPs

The apparent simplicity of this proposal was challenged by empirical data from languages which seemed to display conflicting patterns. Many languages were found to display sensitivity of phrasing to syntactic branching (Nespor & Vogel, 1986; Zec & Inkelas, 1990; Inkelas & Zec,

1995). In Tohono O'odham (formerly known as Papago), phrasing was found to be sensitive to whether or not an XP was itself governed by another lexical head, such that only the edges of ungoverned (maximal) XPs coincided with a prosodic boundary.

The left/right edge-based analysis was later reformulated within Optimality Theory (Prince & Smolensky, 2004) in terms of interface constraints, which require a particular mapping between syntactic and prosodic representations (Truckenbrodt, 1995; Selkirk, 1996; Truckenbrodt, 1999; Selkirk, 2000). For example, a requirement to align the right edge of every syntactic XP with the right edge of a phonological phrase (PP) is formulated as ALIGN-XP,R. A role for left vs. right edge marking has been invoked again recently in an account of the cross-linguistic typology of wh-in-situ vs. wh-movement (Richards, 2010).

Sensitivity to whether or not an XP is itself governed was re-formulated as the WRAP constraint, requiring mapping of a whole XP domain to a prosodic domain, rather than marking just left or right edges (Truckenbrodt, 1995, 1999); cross-linguistic variation in surface prosodic phrasing patterns is modelled in terms of differences in the relative ranking of WRAP and ALIGN. A recent proposal by Selkirk (2011), Match Theory, argues that it is whole syntactic domains of various types that are matched to prosodic structure domains at different levels: clauses map to Intonational Phrases (IP), and XPs map to Phonological Phrases (PP). Cross-linguistic variation in surface prosodic phrasing is modelled in terms of whether or not

prosodic domains (at different levels) reflect the recursive structure of the syntactic domains from which they are mapped, in a particular language.

The edge-based mapping analyses and Match Theory presuppose the existence of a separate layer of phonological representation, known as the Prosodic Hierarchy, listed in (3).

			also known as:	
(3)	Utterance	U		
	Intonational Phrase IP	IP		
	Major Phonological Phrase	MaP	Phonological Phrase	PP
	Minor Phonological Phrase	MiP	Accentual Phrase	AP
	Prosodic Word	PWd		

Initially, the Strict Layer Hypothesis (Selkirk, 1981, 1984) proposed that domains within the Prosodic Hierarchy were nested directly beneath each other in so-called strict layers. This claim was strongly criticised on empirical grounds (see, for example, Ladd, 2008), and many recent proposals now allow for recursive embedding of prosodic domains (Selkirk, 2011; Itô & Mester, 2012; Elfner, 2012; Myrberg, 2013). Recursive vs. non-recursive prosodic structure is modelled within OT in terms of relative ranking of an exploded set of independent constraints: LAYEREDNESS, HEADEDNESS, EXHAUSTIVITY, and NONRECURSIVITY (Selkirk, 1996).

One argument in favour of an independent phonological representation for prosodic structure, such as the Prosodic Hierarchy, is the existence of prosodic weight effects. Selkirk (2000) proposed that some of the non-isomorphy between syntactic and prosodic structure could only be

analysed as due to phonological restrictions on the minimal and/or maximal size of prosodic domains. She proposed a constraint BINMAP, which requires all Major Phonological Phrases (MaP) to contain at least two Minor Phrases (MiP). Prosodic weight phenomena have been observed in a number of Indo-European languages (Ghini, 1993; Sandalo & Truckenbrodt, 2002; Prieto, 2005).

Other authors have argued that patterns of prosodic phrasing can be analysed without the need for an intervening prosodic representation. That is, prosodic structure can be read from the syntax directly. This proposal has a long history (Cooper & Paccia-Cooper, 1980; Kaisse, 1985; Scheer, 2010), but its most recent incarnation within the Minimalist Program proposes that 'phases' are spelled out as prosodic phrases (Chomsky, 2001, 2005). Standardly, the functional projections CP and vP^3 are phases, and the spellout domain (the complement to the functional head) is mapped to a phonological phrase (PP) (Adger, 2007). The spellout domain of vP is the VP so, under this analysis, the whole VP domain should map to a single PP, resulting in a boundary between the subject and verb only in an SVO sentence, with no VP internal boundaries marking either the left or right edges of any VP-internal XPs (in contrast to the predictions of edge-based mapping). In phase-based analyses, cross-linguistic variation in surface phrasing patterns is argued to reflect variation in syntactic structure, rather than variation in the interface mapping itself (Cinque, 1993; Zubizaretta, 1998; Wagner, 2005, 2010), with some exceptions (Ishihara, 2007; Kratzer

& Selkirk, 2007; Pak, 2008). Scheer (2010) argues that spell-out must result in a phonological representation of some kind, in order to preserve the modularity of the grammar, that is, the inability of syntactic constraints to 'see' phonology, and vice versa. He argues however that this representation should not comprise domains of the type which make up the Prosodic Hierarchy, but rather indicate only the position of boundaries.

Many of the early proposals put forward to account for the mapping between syntactic and prosodic structure were based on judgements from one or two native speakers about possible or preferred realisations of particular target sentences. Increasingly however, the phrasing patterns for which a mapping analysis must account are derived from experimental or corpus data, across larger numbers of utterances and/or from larger numbers of speakers (Post, 2000; Frota, 2000; Elordieta, Frota, Prieto, & Vigario, 2003; Elordieta, Frota, & Vigario, 2005; Frota, D'Imperio, Elordieta, Prieto, & Vigario, 2007). Data of this type can sometimes reveal that a particular syntactic structure may be realised by speakers in a range of different ways, reflecting different possible mappings from the syntax to the phonology, within a single language (Post, 2000).

2.1.2 No simple syntax-prosody mapping: evidence from Egyptian Arabic

The most detailed studies to date of the mapping between prosodic and syntactic structure in Arabic have been on the Cairene dialect of Egyptian Arabic (EA). The first of these (Hellmuth, 2004, 2007) showed that EA

displays prosodic boundaries at the right edge of XPs, but only if the resulting prosodic phrase is of sufficient prosodic weight. This means that in a typical SVO sentence, unless the subject constituent is composed of several prosodic words (PWds), there will be no prosodic boundary at the right edge of the subject XP; instead, the subject will be realised in the same prosodic phrase as the following VP: (SVO) not (S)(VO). In the example in (4), this means that (4a) will almost always be realised within a single prosodic phrase: (SVO); whereas (4b) is more likely to be realised in two prosodic phrases, with a boundary after the subject: (S)(VO).

(4)	a)	*il-film*			*bijˈɣumm*	*bint ˈʕammi*
		the-film			upsets	my-cousin(f)
	b)	*il-muˈmassil*	*l-muˈhimm*	*fi- l-film*	*bijˈɣumm*	*bint ˈʕammi*
		the-actor	the-important	in-the-film	upsets	my-cousin(f)
		< ---------	subject	--------->	verb	object

The data in (4) are part of the experimental stimuli used in Hellmuth (2004) to elicit production data from two speakers of EA, in which the prosodic weight and syntactic complexity of the subject and object were systematically varied in a stimulus set of constructed SVO sentences (following Frota et al., 2007).

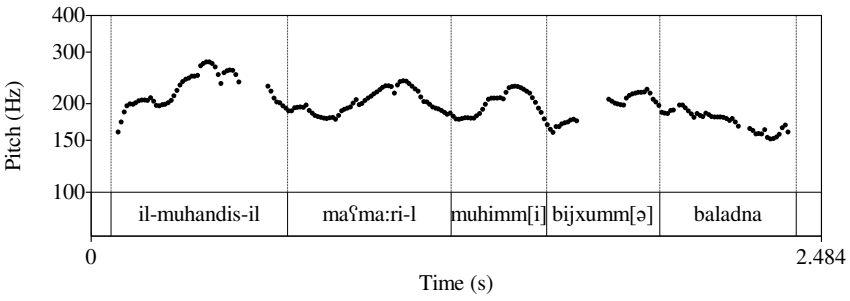
Hellmuth (2004) made two main observations for EA, which match the findings in the literature for other languages: i) a single syntactic structure can be realised prosodically in a range of different ways; ii) across

the whole dataset, however, a pattern emerges which is amenable to analysis.

Figure 1 below illustrates how the same sentence can be realised prosodically in different ways; in this case, by the same person on different occasions. In (1a) the whole utterance is realised in a single prosodic phrase; in (1b) there is a prosodic boundary after the last word in the complex subject [muˈhimm]. The cues observed at this boundary, in (1b), include: pre-boundary lengthening (the word [muˈhimm] is lengthened), phrase-final lowering (the f0 peak on the word [muˈhimm] is somewhat lower than expected, relative to preceding peaks), and local pitch reset (the f0 peak on the verb is higher than on the word [muˈhimm]). The full range of boundary cues observed in EA are discussed in 2.2.2 below.

(5) *il-muˈhandis* *l-maʕˈmaːri* *l-muˈhimm* *bijˈxumm* *baˈlad-na*
the-engineer the-architectural the-important cheats-1ms our-country
<----------subject----------> verb object
'The important architect is cheating our country.'

a)



b)

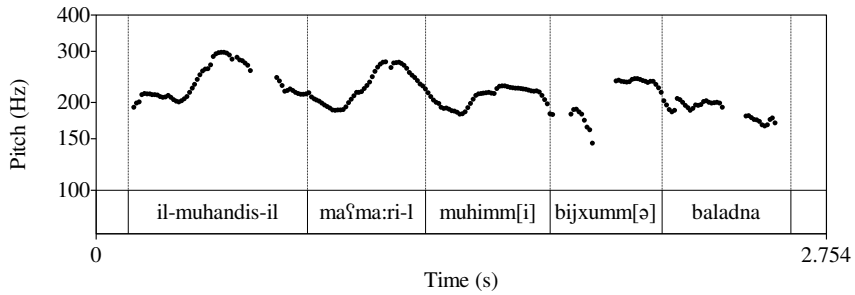


Figure 1: Two different prosodic realisations of the sentence in (5) by speaker NY (taken from Hellmuth 2004, p. 102)

Variation such as that illustrated in Figure 1 was found only in sentences in which the subject is of sufficient prosodic weight. The stimuli for this experiment were designed in such a way that additional prosodic weight was generated by adding whole Prosodic Words (PWd), and as a result it was possible to formulate the effect in terms of a restriction on the minimal size of major prosodic phrases (MaP): BINMAP. In an OT analysis, ranking this constraint above ALIGN-XP, R yields the right result (see Hellmuth, 2004 for full details).

The key findings of Hellmuth (2004) were replicated in Hellmuth (2007), which analysed prosodic phrasing in a small corpus of read and semi-spontaneous narratives, elicited by asking speakers to read a folk story and then re-tell it from memory. It was found that the same utterance could be realised prosodically in different ways (this time, by different speakers),[4] but, looking across the whole dataset, the same pattern emerged whereby no

prosodic boundary was observed at the right edge of XPs when the resulting prosodic phrase would be too short (would not contain sufficient PWds).

In summary then, in these studies EA was found, like other languages, to display no single mapping from syntactic structure, in that the same sentence can be realised in different ways on different occasions. This variation is limited, however, and the limitations on the range of possible prosodic realisations can be analysed in EA as arising from interaction between an edge-based mapping from syntactic structure (ALIGN-XP,R) and a phonological restriction on the size of prosodic phrases (BINMAP).

2.2 Complexity 2: there is no single set of cues to prosodic structure

2.2.1 No single set of cues to prosodic structure: cross-linguistic evidence

Early proposals about prosodic phonology assumed that consistent phonetic and/or phonological phenomena would be observed as cues to the edges of prosodic domains (Nespor & Vogel, 1986). Phonological phenomena which are sensitive to prosodic boundaries are sometimes called segmental sandhi effects, by analogy with well-documented tonal sandhi phenomena, which occur at word and phrase boundaries (Yip, 2002). For example, in the four languages exemplified in (2) above, the observed phrasing patterns were based on evidence from a range of different phenomena, both tonal and segmental. In Chi Mwi:ni, evidence comes from a rule of Phrasal Stress which permits only one long vowel per PP (Kisseberth & Abasheikh, 1974;

Selkirk, 1986). In Ewe, evidence comes from the distribution of 'extra high' tones, realised when a mid tone occurs between two high tones in the same prosodic domain (Clements, 1978). In Korean, evidence comes from a rule of Obstruent Voicing (OV) which voices plain consonants between any other two voiced segments occurring within the same prosodic domain (Cho, 1990). Finally, in Xiamen (Taiwanese/Southern Min) Chinese, evidence comes from the domain of tone sandhi, which is blocked at the right edges of PPs (Hale & Selkirk, 1987).

Increasingly, however, it became apparent in the literature that there was often sufficient inter- and intra-speaker variation in the realisation of cues as to render it difficult to make clear statements about consistent marking of prosodic structure at different levels (D'Imperio & Gili Fivela, 2004). Recent work has also documented systematic variation among speakers of the same dialect in how prosodic boundaries are marked phonetically. In a series of studies based on experimental data in German, Truckenbrodt found that the speakers who participated in his studies fell into two groups, marking the edges of prosodic domains in different ways: some speakers marked boundaries by compressing the pitch excursion of the final accent in the first phrase (final lowering), then raising the pitch of first accent in the following phrase (local pitch reset); other speakers raised the pitch of the final accent in the first phrase (upstep) (Truckenbrodt, 2002, 2004, 2007).

2.2.2 No single set of cues to prosodic structure: evidence from EA

For Arabic, a number of phonological processes have been described as applying across PWd boundaries within the PP: these include melodic processes such as voicing assimilation (Watson, 2002, p. 245; Al-Omar, 2013, p. 107ff.) and place assimilation (Youssef, 2013, p. 30ff.), as well as prosodic processes operating within the domain of syllabification, such as syncope (Ali, 2014; Abdelghany, 2010; Abu-Mansour, 2011). The domain of such processes may vary however: in Egyptian Arabic (EA), a rule of epenthesis serves to break up all sequences of three adjacent consonants (CCC), and this rule applies within a domain at least as large as the IP, if not the utterance (Watson, 2002; Hellmuth, 2004; Aquil, 2006). For most processes, Watson (2002) reports variation in the distribution of such phenomena, dependent on speaker, speech rate and speech style. A few attempts have been made to map the occurrence of Arabic segmental sandhi phenomena to syntactic structure (Hellmuth, 2004; Abdelghany, 2010; Abu-Mansour, 2011; Yasin, 2012; Ali, 2014).

In an effort to find robust cues to prosodic structure in EA, Hellmuth (2004) relied primarily on phonetic tonal cues to determine prosodic phrasing. Specifically, and in order to arrive at the most conservative phrasing analysis, a boundary was marked only when *two* out of the following possible cues to phrasing was observed: local pitch reset, phrase-final pitch accent lowering, pre-boundary lengthening, failure of epenthesis, pause, high (H-) or low (L-) phrase tone. It was possible however that this

strategy over-simplified; thus Hellmuth (2011b, 2012) used both qualitative and quantitative analysis to document a much wider range of possible cues to phrasing in EA, as listed in Table 1, reproduced from Hellmuth (2012, p. 262).

label	*definition*
boundary tone	boundary shows a full boundary tone (usually a fall)
downstep	peak of the word at the boundary is produced at a lower level than expected from effect of downstep alone, relative to previous peak (final lowering)
phrase tone	boundary shows either a H- or L- phrase tone
lengthening	word at the boundary is lengthened
pause	boundary is followed by pause (filled or unfilled)
reset	following peak is produced at a higher level than the peak of the word at the boundary
suspension of downstep	peak of the word at the boundary is produced at the same level as the previous peak
upstep	peak of the word at the boundary is produced at a higher level than the previous peak

Table 1: Cues labels used for fine-grained qualitative description of junctures.

Qualitative analysis using the above cue labels was matched to f0 measurements taken at the f0 peak within each content word. This parallel approach revealed that different groups of speakers of the same dialect consistently use different cues to phrasing. Two different strategies were observed. The 'H speakers' consistently marked boundaries with a high phrase tone or upstep (high pitch at the boundary edge, followed by lower pitch at the start of the next phrase). In contrast, the 'R speakers' consistently marked boundaries with a local pitch reset, that is with low pitch at the end of the phrase followed by higher pitch at the start of the next

(see Hellmuth, 2012 for details; see also Hellmuth, 2014, for a principled account of this variation).

2.3 Complexity 3: there is more than one possible analysis

2.3.1 There is more than one possible prosodic analysis

The two preceding sections have set out some of the complexities involved in establishing a *prosodic* analysis of any particular utterance. Section 2.1 argued that there is not necessarily a single mapping from syntactic structure to prosodic structure, but that, across a range of data, patterns do emerge. If the 'typical' patterns observed in a language are known, then it is possible to make use of them to some extent during prosodic transcription of data, for example, to decide between competing possible analyses. A specific issue for work at the syntax-phonology interface in Arabic is, however, that for most dialects the typical phrasing patterns are not known, as they have never been described in a systematic fashion. A key empirical need – if work at the syntax- phonology interface in Arabic is to expand – is to determine to what extent, if at all, the typical or 'basic' phrasing patterns of Arabic dialects differ from each other. If no substantive differences are observed then analyses based on one dialect could plausibly be extrapolated to other dialects. In Portuguese, variation in the typical phrasing patterns has been observed, however, even between closely related dialects of the same language (Frota & Vigario, 2003; Cruz, 2013). It is thus possible that similar

variation will also be observed across Arabic dialects. The pilot study reported in section 3 below seeks to address this question, as well as establish a methodology which could be used to document the phrasing patterns in further dialects, if needed.

A further complexity in establishing a *prosodic* analysis was highlighted in section 2.2, which showed that there are a range of possible acoustic cues that speakers can use to mark prosodic boundaries, and that speakers appear to vary in which particular constellation of cues they habitually use. The standard method used in the prosody literature to deal with this problem is to base prosodic analyses, wherever possible, on the analysis of more than one transcriber, and to report the degree of inter-transcriber agreement.

For less studied languages, including Arabic, it is as yet not always possible to find transcribers who have both training in prosodic analysis and sufficient understanding of Arabic to work on the data. Expanding the pool of such personnel will greatly enhance the chance of expanding work at the syntax-phonology interface in Arabic. In addition, the field is in need of materials for training in prosodic analysis which are based on prosodic analysis of Arabic, rather than other languages, since transcription systems developed for other languages, such as the ToBI system developed for General American English, are not intended to serve as 'an IPA for intonation' (Beckman, Hirschberg, & Shattuck-Hufnagel, 2005).

2.3.2 There is more than one possible syntactic analysis

The discussions in sections 2.1 and 2.2 conceal a further source of complexity, however. Models of the mapping from syntactic structure to prosodic structure presuppose that we know what the syntactic structure of an utterance is. A particular surface linear sequence will frequently however be amenable to more than one analysis, either due to syntactic ambiguity (the syntactic tree may be constructed in more than one way, resulting in a difference in meaning, as in (1) above) or due to the availability of competing arguments about the correct syntactic analysis.

A key aim of the work described in Hellmuth (2011b, 2012) was to determine whether the patterns of phrasing in EA could be accounted for in a phase-based mapping. It was not possible to reach firm conclusions about this, however, due to the fact that the SVO and VOO ('double object') sentences analysed in those studies are open to more than one syntactic analysis (for full details see Hellmuth, 2011b, 2012). The papers did however demonstrate an effect of prosodic weight, independent of which syntactic analysis was applied: a final prepositional phrase (PP) was much more likely to be phrased separately from the rest of the sentence if it was prosodically heavy (consisting of 2-3 PWds, rather than a single PWd).

Even the apparently ordinary SVO sentences analysed in Hellmuth (2004, 2007) are open to more than one syntactic analysis. This is particularly true in Arabic, which displays both SVO and VSO word orders, with the result that opinions vary in the literature as to whether the 'subject'

is merged vP internally or externally in Arabic, and the issue is essentially unresolved (Aoun, Benmamoun, & Choueiri, 2010, p. 72). In an edge-based mapping analysis of the syntax-phonology interface, this ambiguity of analysis does not result in different prosodic analyses, since the final position of maximal XPs in the syntactic structure can be assumed to reflect their surface linear order. In a phase-based mapping analysis, however, the vP-internal vs. vP-external analyses make different predictions for prosodic structure.

In the case of Spanish and Portuguese, surface variation in prosodic phrasing has been argued to provide a source of evidence to support the claim that the two languages differ in exactly this respect (Elordieta et al., 2005). Spanish, which always shows a prosodic boundary after the subject in an SVO sentence, (S)(VO), has been argued independently to have vP-external subjects; in contrast, European Portuguese, which typically displays (SVO) phrasing of SVO sentences, is argued to have a vP-internal subject.

If surface variation in the typical phrasing patterns between two Arabic dialects is found, this could provide evidence in support of a basic difference in syntactic structure between the two dialects. There is of course, however, an alternative account of the (SVO) vs. (S)(VO) variation available, namely that it is due to the effects of prosodic weight (Hellmuth, 2004 et seq.). If prosodic structure is to be used to choose between analysis of the subject in Arabic as vP-internal/-external, then the data to be examined must control and/or systematically vary both prosodic weight and

syntactic complexity. Such data are difficult to elicit semi-spontaneously, and as a result read speech data are likely to be needed. Section 4 describes some early results from a pilot study using a parallel corpus of read speech data of this type to determine whether the same typical phrasing patterns are observed in Jordanian Arabic as in Egyptian Arabic.

2.4 Summary

Prior work has shown that – in EA as in other languages – there is no simple syntax-prosody mapping (though a typical, 'basic' mapping tendency can be observed) and no single set of cues used to mark prosodic structure. In addition, even when a prosodic analysis for a particular utterance is established, the syntactic structure of the sentence must also be unambiguously determined, before claims can be made about the mapping between syntactic and prosodic structure. The subject vP-internal/-external controversy is but one of many areas within Arabic syntax which are open to competing analyses. Given the complexities on both sides of the analysis, prosodic and syntactic, it is clear that collaboration between phoneticians/phonologists and syntacticians will be needed to make real advances in research at the syntax-phonology interface in Arabic.

In the next section we present some early results from an ongoing pilot study which aims to determine whether there is variation between dialects of Arabic in the basic mapping tendencies, as has been observed

cross-linguistically, e.g. among Romance languages, and whether the patterns of intra-dialectal/inter-speaker variation observed in EA (Hellmuth 2012) may also be observed in other dialects.

3 Comparing Jordanian and Egyptian Arabic: a pilot study

3.1 Background to the study

This section briefly describes the results of analysis of a subset of data from a pilot study comparing prosodic phrasing in Jordanian Arabic (JA) and Egyptian Arabic (EA). The long-term aim of the eventual main study will be to document, in a representative sample of Arabic dialects,[5] both a) observed cues to prosodic phrasing and b) sensitivity of phrasing to syntactic complexity and prosodic weight. The experimental design is modelled closely on that used to create the Romance Languages Database (Elordieta et al., 2003; Elordieta et al., 2005).[6]

An initial subset of data from the pilot study is analysed here, in order to provide preliminary answers to the following research questions: i) are the typical phrasing patterns seen in Egyptian Arabic also seen in Jordanian Arabic?; ii) is the inter-speaker variation result observed in Egyptian Arabic in Hellmuth (2010, 2012) replicated in the present data; and, iii) is inter-speaker variation also observed in Jordanian Arabic?

3.2 Methods

A set of 76 SVO sentences was devised in which the syntactic complexity and prosodic weight of both subject and object were systematically varied (following Elordieta et al., 2005). Analysis is presented here from just two sentences, shown in (6) below, which both have a non-branching short object: (6a) has a subject which is syntactically non-branching but prosodically long (in terms of number of syllables) whereas (6b) has a subject which is prosodically long but also syntactically branching.

(6)		S	V	O
	a)	*mu.dar.ri. ˈsi:n.na* teachers(m.pl)-our 'Our teachers love Arabic.'	*bij.ˈħib.bu* they-love	*l-ˈʕa.ra.bi* the-arabic
	b)	*mu.dar.ri. ˈsi:n.na l-mu.ta.daj.ji. ˈni:n* teachers(m.pl)-our the-devout(m.pl.) 'Our devout teachers love Arabic.'	*bij.ˈħib.bu* they-love	*l-ˈʕa.ra.bi* the-arabic

The full set of 76 sentences was pseudo-randomised, and interspersed with filler items (used for another study) then presented to participants in typed Arabic script. Non-standard, colloquial spelling conventions were used in the text as these have been shown to successfully elicit a colloquial register of speech (Siemund et al., 2002). The sentences were read aloud by 12 speakers of Egyptian Arabic (recorded in Cairo) and 12 speakers of Jordanian Arabic (recorded in Amman). All speakers were aged 18-30 years

and none reported any speech or hearing difficulties. The data were recorded by speakers individually, using a head-mounted Shure SM10 microphone, directly to .wav format at 44.1KHz 16 bit on a Marantz PMD660 solid state data recorder. The sound files were edited to yield one sentence per sound file, and annotated at the word and segmental level using the Prosody-Lab Aligner tool (Gorman, Howell, & Wagner, 2011).

The data were subjected to two levels of prosodic analysis. Firstly, a qualitative transcription was carried out by the author, to identify phrase boundaries at the PP (Break Index 3) and IP (Break Index 4) level. Secondly, a quantitative analysis of f0 was carried out: a Praat script was used to automatically identify the f0 peak within each content word, and f0 was measured in Hz at this point within each word. Outliers were plotted and used to identify pitch tracking errors, which were manually corrected.

3.3 Results

The first research question to be addressed is whether the phrasing patterns observed in EA and JA differ. Although this is a small sample of data, based on just one sentence pair, nonetheless a clear pattern emerges, as shown in Table 2. The JA speakers consistently produce an (S)(VO) phrasing pattern, even in sentences with a non-branching subject, whereas, in the same sentence, the EA speakers generally produce an (SVO) phrasing.

	EA	*JA*
non-branching subject (5a)	3	12
branching subject (5b)	12	12

Table 2: Number of observed (S)(VO) phrasings observed
(out of a maximum of 12 per dialect).

The remaining questions relate to inter-speaker variation in the realisation of prosodic cues to phrasing. Recall that, in EA, in Hellmuth (2012) – which reported on data collected with six female speakers of EA – the speakers were observed to vary in whether they marked a boundary with a pitch reset (high pitch after the boundary), or with a high boundary tone (high pitch before the boundary). This pattern appears to be replicated in the present pilot study, across a group of 12 speakers of the same dialect.[7]

Figure 2 shows f0 values measured in Hz at the f0 peak of each content word in SVO sentences with a light vs. heavy subject, in EA and JA. The light subject sentences have a non-branching subject and thus an (S)(VO) boundary will be visible, if present, as a disjunction in the f0 level between word 1 and word 2; the heavy subject sentences have a branching subject, composed of two words, and thus an (S)(VO) boundary will be visible, if present, as a disjunction in the f0 level between word 2 and word 3. The f0 values for the male and female speakers separate clearly into two groups, at higher/lower f0 levels, due to normal male/female variation in pitch range.

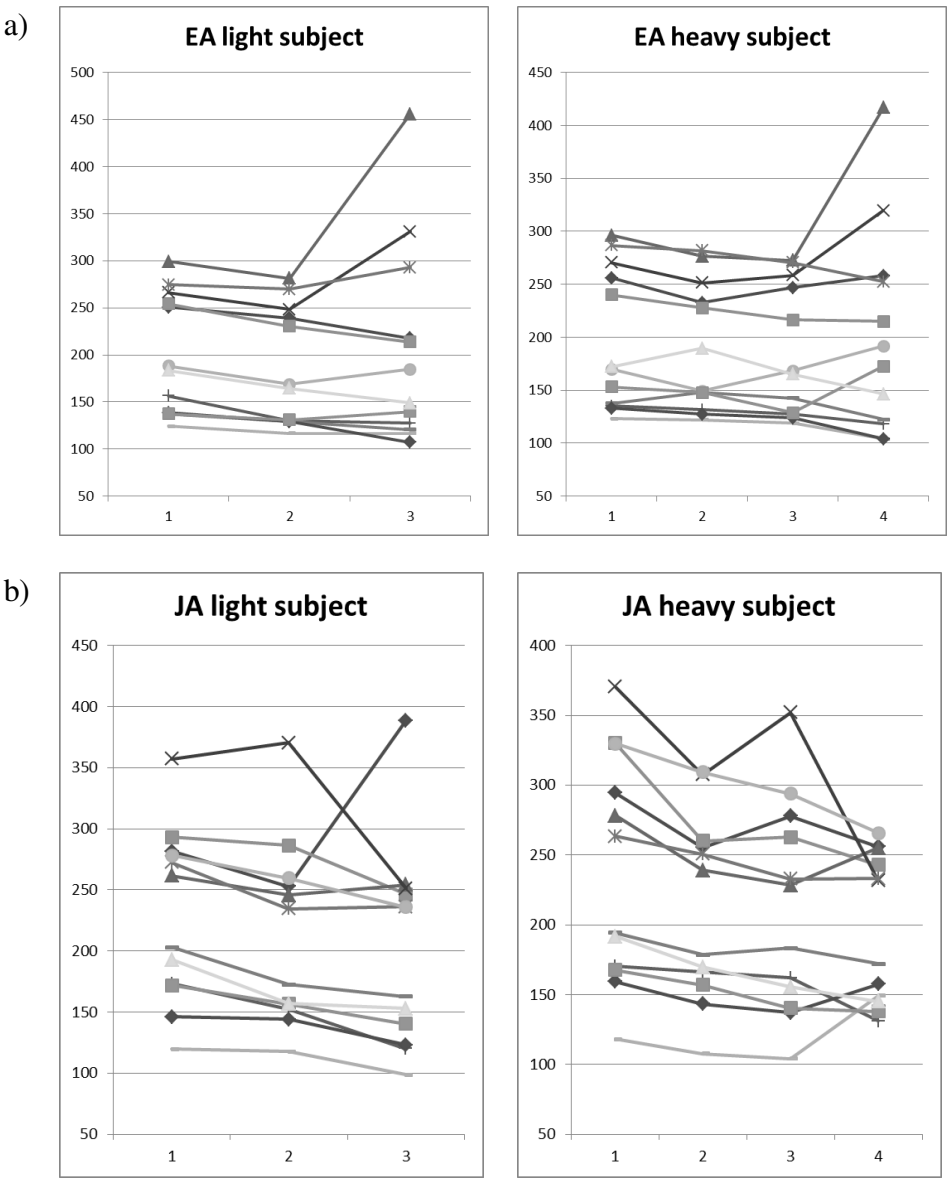


Figure 2: F0 values (in Hz) measured at the f0 maximum within each content word in SVO sentences with a light or heavy subject, by speaker, in a) EA and b) JA. Connected points thus represent the relative pitch height of successive content words through an utterance, as produced by an individual speaker.

The f0 values observed in EA in a light subject sentence show no clear disjunction in f0 between word 1 and word 2, confirming the qualitative analysis of the majority of these utterances as (SVO) phrasings. In the heavy

subject, some of the EA speakers show a rise in f0 from word 1 to 2, whereas (most) others show a fall between words 1 and 2, with a following rise (a pitch reset) up to word 3. This suggests that this group of EA speakers also vary in how they realise prosodic boundaries, as was seen in Hellmuth (2012).

The f0 values observed in JA show a disjunction in f0 between word 1 and 2 in the light subject sentence, and between word 2 and 3 in a heavy subject sentence, confirming the qualitative analysis that all of these utterances were realised as (S)(VO) phrasings. In both sentences, a few of the JA speakers show a rise in f0 at the expected boundary point (between words 1-2 or words 2-3), but most show a fall at this point, followed by a subsequent rise (a pitch reset) up to the next word. The data sample is small, but this pilot analysis suggests that further examination of data of this type is warranted.

4 Conclusion

The pilot study reported on in section 3 suggests that further study of dialectal variation in the mapping between syntactic structure and prosodic structure is likely to prove fruitful. We observe variation in the incidence and distribution of phrase boundaries, and in their prosodic realisation, across and within dialects. The prosodic differences between EA and JA

observed, albeit preliminarily, here, are worthy of further investigation given their potential to disambiguate between competing syntactic analyses.

Work at the syntax-phonology interface is complex and will be most effective if done in collaboration, with input from both sides of the disciplinary divide, but the benefits are likely to be substantial.

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[1] http://quran.com/2/1-5
[2] The LLBA search was carried out on 14th September 2013.
[3] This assumes a 'VP shell' analysis of the verbal projection, in which the VP is embedded within a further functional projection, known as vP. The analysis is motivated by various phenomena notably double object constructions (Larson, 1988, 1990).
[4] The variation in this corpus was due mainly to differences in the treatment of function words, which could be realised as full stress-/accent-bearing Prosodic Words (PWd) or in a phonologically reduced form (see Hellmuth, 2007, p. 304 for details).
[5] For further details see www.york.ac.uk/res/ivar .
[6] http://rld.fl.ul.pt/
[7] Recordings for the two studies were made with different individuals at different times (in 2004 and 2012), but all were students at the same private language school in Cairo; they are thus likely to represent a sociolinguistically homogenous dialect across the two datasets.