Prosodic weight and phonological phrasing in Cairene Arabic*

Sam Hellmuth
School of Oriental & African Studies, University of London

Introduction

This paper investigates patterns of phonological phrasing in Cairene Arabic (CA), the influential dialect of Arabic spoken in Cairo, Egypt. The study has a descriptive goal in that the phonology of CA above the level of the word has received relatively little attention, and in particular the detailed syntax-phonology interface properties, of this or any dialect of Arabic, are undocumented. The paper thus affords a theoretical gain, adding a dialect of Arabic to the database of languages for which any interface theory must account.

The theory of prosodic phonology (Nespor & Vogel 1986, Selkirk 1986, 2000), Inkelas & Zec 1995) proposes the existence of a prosodic representation which is independent of yet related to the syntactic representation. This prosodic representation consists of a hierarchy of constituents (illustrated here as assumed in Selkirk 2000, together with notational equivalents used by other authors):

(1) The prosodic hierarchy

Utterance	U	
Intonational Phrase	IP	
Major Phonological Phrase	MaP	phonological-/intermediate-phrase
Minor Phonological Phrase	MiP	accentual-phrase
Prosodic Word	PWd	

Different types of cues to phonological structure have been proposed in existing work on a variety of languages, and these include (non-) application of postlexical phonological rules, stress clash resolution strategies and tonal phenomena, both lexical and post-lexical. No recent study on any dialect of Arabic has explored the relation between prosodic structure and syntactic structure in detail, though Chahal (2001) reports systematic phonetic cues (final lengthening and peak delay) to intonationally defined prosodic domains. We explore below two types of potential cue to prosodic phrasing in CA: (non-) application of a syllable repair rule of epenthesis (Watson 2002) and a range of post-lexical tonal phenomena including local pitch range reset, final lowering and phrase final boundary tones.

* This study was undertaken with the support of AHRB award 59198. I am grateful to Monik Charette, Sonia Frota, Bob Ladd, Lisa Selkirk & the UMass (Amherst) prosody workshop for comments and advice at various stages of the work. All errors of course remain mine.

CA was chosen for the study because its segmental and metrical phonology is extremely well-documented (see, inter alia, Broselow 1976, McCarthy 1979, Watson 2002). In addition, CA is a mainstream, progressive dialect of Arabic, and the dialect best-known to the author (a fluent though non-native speaker). The literature confirms that CA is a stress-accent language in which tone is only used post-lexically (Watson 2002). Excellent descriptions of CA intonation exist that are accurate though non-technical (Harrell 1957, Mitchell 1993), as well as detailed phonetic studies (eg Norlin 1989 which investigated pre- and post-focal pitch range compression). However no phonological model of CA intonation has been proposed within the autosegmental-metrical (AM) theory of intonation that is assumed in the present work (Ladd 1996). AM studies do exist of Lebanese Arabic (Chahal 2001) and Modern Standard Arabic (Rifaat 2003). There has been no prior study on syntax-phonology interface properties in CA. Alharbi (1991) investigated the relation between prosodic phrasing and syntax in urban Kuwaiti Arabic, but in quite general terms: for example, intonation groups were observed to map equally often to 'a clause' or to 'elements of a clause'.

An important source of evidence for the independence of prosodic structure from syntactic structure is sensitivity of prosodic phrasing to phonological changes (constituent length measured in syllables and/or prosodic words) in the absence of changes to syntactic structure. Sensitivity of this kind has been widely reported in a variety of languages (Prieto (forthcoming), Sandalo & Truckenbrodt (2002), Selkirk (2000)). Elordieta et al (2003) undertook a comparative analysis of phrasing tendencies in Romance languages using a parallel database of subject-verb-object sentences in which prosodic weight (number of syllables) and syntactic complexity are systematically varied. They found differing sensibilities to the influence of constituent length/syntactic structure: whilst in Catalan and Spanish a 'default' (S)(VO) phrasing predominates, in Standard European Portuguese (SEP, Lisbon variety) the majority of phrasings are (SVO), deviated from only in cases of syntactic branching when the subject is long or the object has more than one level of syntactic embedding.

The goals of the present study are to establish what cues to phrasing are found in CA, and from these to identify typical patterns of phonological phrasing in the dialect. The data were collected using a language-specific modification of the Romance Languages Database (RLD), designed to create contexts where non-application of epenthesis and/or post-lexical tonal cues at phrasal boundaries would be apparent. This yields phrasing generalizations for CA for the first time, for which a constraint-based analysis is proposed. The implications of the analysis, as well as its potential applicability to other languages, are explored.

Methodology

The CA database contains a core set of 38 target SVO sentences in which the syntactic complexity of both subject and object are systematically varied[1]. A simplex subject for example consists of a head noun only [N], whilst a branching subject has a noun modified by an adjective phrase [AP] or prepositional phrase [PP]; a double-branching subject has a noun modified by an AP and a PP:

(2)	non-branching	branching	double-branching
	$[\ N\ ]_{DP}$	$[\ N\ [\ AP\ ]\ ]_{DP}$	$[\ N\ [\ AP\ ]\ [\ PP\ ]\ ]_{DP}$

As in the RLD, the constituent length of the subject and object was also varied systematically. However, since in CA long words of 5 syllables or more are relatively uncommon, sequences of nouns in the genitive Construct State (CS) were used to create prosodically heavy targets where necessary eg [bint ʕamm] (daughter-aunt) "cousin (f.)". CS sequences have been shown to function as a single syntactic word (Borer 1998) hence these can be used to increase prosodic weight without increasing syntactic complexity. This results in a database where increases in prosodic weight correspond with increases in number of prosodic words (unlike the RLD in which number of prosodic words varies with syntactic complexity and increases in prosodic weight are in terms of syllable count only).

In order to investigate (non-)application of epenthesis as a potential cue to phrasing in CA, epenthesis contexts were placed across all potential phrase boundaries. Epenthesis applies systematically in CA to break up sequences of three consecutive consonants, by insertion of an epenthetic vowel between C_2 and C_3: eg /bint gami:la/ → [binti gamiːla] "beautiful girl", and has been reported to apply across word boundaries within the phonological phrase (Watson 2002). Creation of segmentally parallel epenthesis contexts (C_2=[m]; C_3=[b]) greatly limited the choice of lexical items and it was impossible to vary the length in number of syllables of the verb (all suitable CC-final verbs in CA are bisyllabic).

Some additional sentences were recorded in which parenthetical expressions (such as [bin-nisba li-l-ʕamm] "according to-the-uncle") were inserted into otherwise 'non-branching' targets. These were used to help decide what level of phrasing was being cued, since it has been observed that parenthetical expressions induce a full intonational phrase (IP) boundary at their right edge (Nespor & Vogel 1986, Frota 1998).

An excerpt from the database showing variation in syntactic complexity & prosodic length in subject position, as an example, is given in (3) below.

[1] SVO is the most commonly observed word order in CA, and strongly preferred over VSO with imperfect verbs (Benmamoun 2000), which were therefore used in the database.

(3) non-branching object condition, subject condition varied

a	*il-film*			*biyɣumm*	*bint ʕammi*
	the-film			upsets	cousin-my
b	*nihaayit-l-film*			*biyɣumm*	*bint ʕammi*
	end-the-film			upsets	cousin-my
c	*siyaasi*	*muhimm*		*biyxumm*	*baladna*
	politician	important		cheats	country-our
d	*il-muhandis il-miʃmaari*	*l-muhimm*		*biyxumm*	*baladna*
	the-architect	the-important		cheats	country-our
e	*il-mumassil*	*l-muhimm*	*fil-film*	*biyɣumm*	*bint ʕammi*
	the-actor	the-important	in-the-film	upsets	cousin-my
f	*il-miɣannawaati*	*l-muhimm*	*fi-nihaayat-l-film*	*biyɣumm*	*bint ʕammi*
	the-singer	the-important	in-end-the-film	upsets	cousin-my

The full set of targets was recorded with two female CA speakers in their late twenties (NY and MF). Target sentences were typed in Arabic script using the spelling conventions of the CA dialect, and many of the lexical items used are exclusive to CA; these factors combined to encourage speakers to produce dialectal renditions of the sentences, and reduce potential interference of higher registers of Standard Arabic from use of written prompts. Speakers were asked to provide three repetitions of the data (the first at normal pace, the second slower, and the final repetition the slowest of the three) and to produce the targets as all-new, 'out-of-the-blue' declaratives. A total of 38 targets x 2 speakers x 3 repetitions yielded 228 tokens, which together with 3 x 2 additional repetitions of double-branching subject + object targets yielded a total of 234 tokens. Recordings were made in a sound-proof room using ProTools 6.0 on MBox directly to digital format at 44100Hz 16bit, then re-sampled at 22050Hz 16bit. Auditory transcriptions were made of all tokens by the author with reference to an F0 contour and spectrogram using Praat 4.2 (Boersma & Weeninck 1998-2004).

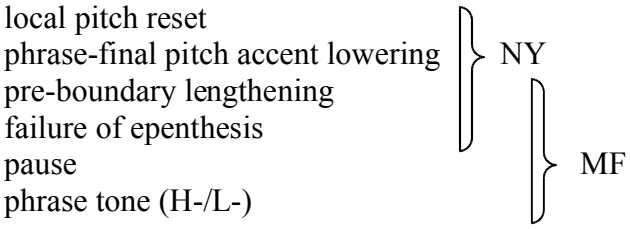
Results 1: phrasing cues

The first thing to notice is that very few phrase boundaries were observed in the corpus, and where observed they were largely at slower speech rates. Of 234 tokens only 20 were transcribed as containing a phrase break; 17 of these were from one speaker (NY) of which 16 were in her slowest repetition (speaker MF unfortunately did not slow her speech rate but instead increased the duration of pauses between targets in successive repetitions). Targets produced in a single phrase showed a typical CA declarative intonation contour in which a pre-nuclear

rising pitch accent is associated with the stressed syllable of each prosodic word in the sentence (see (5a) below). Each successive peak is lower than the previous one, assumed to result from a process of downstep, full analysis of which is beyond the scope of this paper. The peak of the final (nuclear) pitch accent, associated with the last word in each sentence, is usually produced considerably lower than might be expected from the effects of downstep alone however (the effect known as 'final lowering' Beckman & Pierrehumbert 1988). The last word is also lengthened due to its pre-boundary position (Frota 1998).

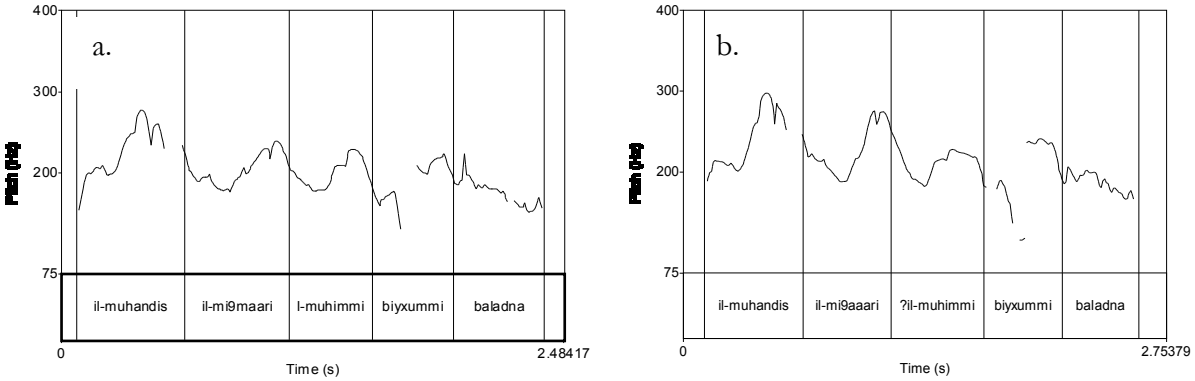
Where a phrase boundary was inserted, the two speakers used different clusters of cues to mark these boundaries. A range of possible cues to phrasing were transcribed: local pitch range reset, local pitch accent lowering (ie a non-sentence-final pitch accent produced lower than might be expected from the effects of downstep), lengthening (of a word to the left of a boundary), failure of epenthesis (no epenthetic vowel inserted), insertion of a pause and a high (continuation) or low phrase tone. Speaker NY used the first four, speaker MF the second four:

(4) cues to phrasing used by the two speakers



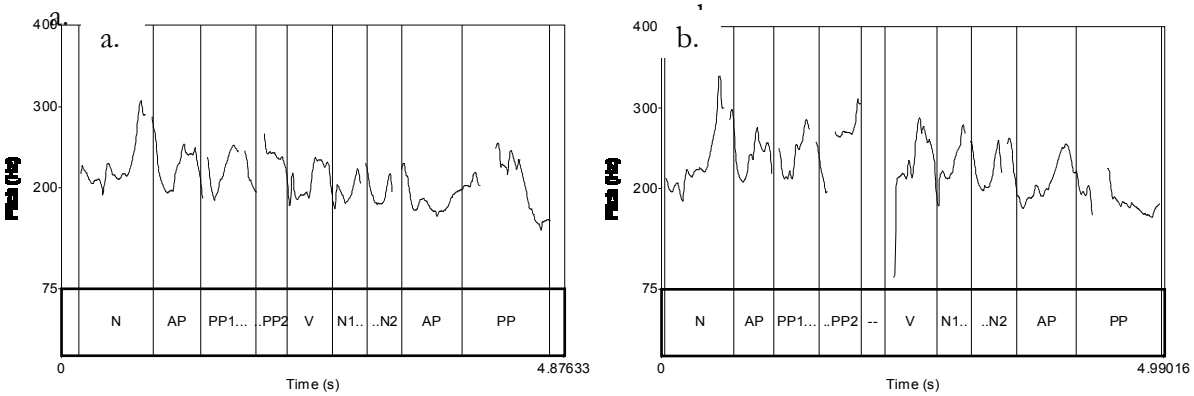
As a working hypothesis during transcription, whenever two or more of these cues were observed at a single point this was marked as a phrase boundary. A sample pair of utterances from each speaker, with and without phrase boundaries, are provided in (5) and (6) below. The question arises as to which level of phrasing within the prosodic hierarchy is being cued here, however infrequently, by the two speakers. Evidence to support the view that these boundaries mark the edges of (major) phonological phrases (MaP) comes from the additional recordings containing parenthetical expressions. For speaker MF, epenthesis fails across all her (few) boundaries (3 out of 120), whereas for speaker NY this cue is most frequently observed at the right edge of a parenthetical expression. For NY at least then, failure of epenthesis seems to mark a higher level of phrasing than that observed by Watson (2002), namely the intonational phrase (IP). Those NY boundaries across which epenthesis applies, but which are nonetheless marked by a cluster of tonal cues, are therefore judged to be MaP boundaries.

(5) sample pair of utterances: speaker NY
(long branching subject + short non-branching object)



	il-muhandis	*l-miʕmaari*	*l-muhimm*	*biyxumm*	*biladna*
	the-architect		the-important	cheats	our-country
a.	(				)
b.	(		)	(	)

(6) sample pair of utterances: speaker MF
(long double-branching subject + long double-branching object)



il-miɣannawaati *l-muhimm* *fi-nihaayat-il-film* *biyɣumm...*
the-singer the-important in-end-the-film upsets

... banaat ʕammiti *l-ʕayːaːniːn* *min-l-ʔiskandriyːa*
cousins(f)-m the-ill from-Alexandria

	N	AP	PP	V	N	AP	PP
a.	(						)
b.	(		)	(			)

In addition, as discussed in detail below, those phrase breaks which are marked tonally but not by failure of epenthesis fall between the subject and verb (at the right edge of the subject DP). Treating them as MaP breaks is therefore consistent with Truckenbrodt's (1999) assertion that cross-linguistically the level of phrasing sensitive to syntactic maximal projections is an instantiation of the phonological phrase (notated here as MaP)[2].

Results 2: phrasing patterns

Single MaP productions of the target SVO sentences predominate: 91% of tokens are produced as (SVO). Those additional boundaries that do occur fall between the subject and the verb: (S)(VO). A break in any other position, particularly between verb and object, is never observed: *(SV)(O). At normal (fast) speech rates, (S)(VO) occurs only when both subject and object are double-branching and long. At slow speech rates, from speaker NY, (S)(VO) occurs additionally in long branching subject condition, regardless of syntactic complexity of object. Note that (S)(VO) rendition is possible in these prosodically heavy conditions, but is not obligatory, as (SVO) phrasings also observed.

(7) MaP phrasing patterns observed a. at normal rates and b. at slow rates

a. *fast* subject:	#PWds	non-branching object	branching object	double-branching object
non-branching	1	(SVO)	(SVO)	(SVO)
	2	(SVO)	(SVO)	(SVO)
branching	2	(SVO)	(SVO)	--
	3	(SVO)	(SVO)	
double-branching	3	(SVO)	--	(SVO)
	4	(SVO)		**(S)(VO)~(SVO)**

b. *slow* subject:	#PWds:	non-branching object	branching object	double-branching object
non-branching	1	(SVO)	(SVO)	(SVO)
	2	(SVO)	(SVO)	(SVO)
branching	2	(SVO)	(SVO)	--
	3	**(S)(VO)~(SVO)**	**(S)(VO)~(SVO)**	
dbl-branching	3	**(S)(VO)~(SVO)**	--	**(S)(VO)~(SVO)**
	4	**(S)(VO)~(SVO)**		**(S)(VO)~(SVO)**

Comparing these results with those observed by Elordieta et al (2003) for Romance languages, the patterns in CA match those of Standard European Portuguese (SEP) almost exactly. In both CA & SEP (SVO) predominates (in contrast to a default (S)(VO) in Spanish and Catalan), any phrase breaks fall

[2] Two unusual NY phrasings in which epenthesis failed after a one-word subject were analysed as topicalisations of the subject, with an IP boundary inserted at the right edge of the subject.

between the subject and verb, and non-branching subjects always show (SVO), regardless of the length or complexity of the object. Elordieta et al (2003) observe that in many cases even though a phrase break after the verb would yield a more balanced division of the utterance into phrases of similar length, nonetheless * (SV)(O) phrasings are not attested, and the same holds for CA.

Analysis

The most striking aspect of the results reported above is the lack of phrasing breaks in the corpus: the overwhelming majority of target sentences in CA are produced as a single phrase (SVO). This phrasing is not explained by reference to syntax-phonology interface constraints alone since all of the main interface theories (eg relation-based Nespor & Vogel 1986; edge-based Selkirk 1986; prosodic-sisterhood-based Inkelas & Zec 1995) predict a phrasing break between subject & verb in SVO sequences with an overt object. Importantly however, any explanation of the predominance of (SVO) must be analysed as interacting with syntax-phonology interface conditions, since when phrase MaP breaks occur they invariably fall at the right edge of the subject DP. This interaction lends itself to treatment in terms of (violable) constraints in conflict (Prince & Smolensky 1993): the effects of the interface constraint are consistent, yet only emerge when some other (higher ranked) condition is satisfied.

Interface conditions on prosodic structure have been shown to be sensitive to the edges of syntactic maximal projections (Selkirk 1986, 2000; Truckenbrodt 1999). The presence of MaP boundaries at the right edge of the subject DP yielding (S)(VO), and the systematic absence of such boundaries at the left edge of the object DP, *(SV)(O), suggest that right-edge sensitivity is at work in CA. This can be expressed as an alignment constraint ALIGNXP,R requiring for each maximal projection (XP) an MaP such that the right edge of the XP coincides with the right edge of the MaP (Selkirk 2000), as shown in (8):

(8) $[[\ S\ ]_{DP}$ $[V$ $[O]_{DP}]_{VP}]$
$(\quad)_{MaP}$ $(\qquad\qquad)_{MaP}$

What type of condition in most cases obscures the effects of ALIGN XP,R resulting in the predominance of (SVO) phrasings in CA? One possible explanation would be a processing constraint of some kind which limits the length of phrases due to cognitive restrictions on processing load. Interestingly Cooper & Paccia-Cooper's (1980) processing algorithm included a phrase bisection rule which applied only to utterances of seven words or more, and this is very close to the minimum length of utterance which may in CA be divided at normal speech rates (eight prosodic words). However it is not clear whether a purely cognitive constraint should be integrated with the grammar in the ways that would be necessary to explain the facts: its effects are not surface-true in all languages (Elordieta et al (2003) observe default (S)(VO) phrasing in Catalan & Spanish) and eight word phrases in

CA 'survive' when interface constraints would be violated by dividing them. A more obviously grammar-internal explanation seems preferable, either to restrict single phrases that become 'too long' or to provide a minimal size restriction on what is a possible phrase.

Phonological well-formedness constraints on the size of prosodic constituents have been proposed for other languages in order to account for phrasing properties that cannot be ascribed to interface constraints alone. For example, Selkirk (2000) employs a constraint BINMAP$_{MiP}$, requiring a MaP to consist of at least two Minor Phonological Phrases (MiP), to explain patterns of MaP phrasing in English. Similar analyses have been proposed for Brazilian Portuguese (Sandalo & Truckenbrodt 2002) and Catalan (Prieto f.c.). The remainder of this section presents an analysis of this type for CA, which proposes that (SVO) phrasings predominate due to a phonological well-formedness constraint. This constraint is sensitive to the internal structure of lower level prosodic constituents, with a preference for branching (binary) structure. Specifically, in CA, the constraint BINMAP$_{MiP}$ outranks ALIGN XP,R: MaP phrase breaks fall at the right edge of XPs, but only when all resulting phrases are of a certain prosodic weight.

The definition of the well-formedness constraint implies that the Minor Phonological Phrase (MiP) plays a role in the phonology of CA. This constituent is well-motivated in Japanese being tonally marked with an initial F0 rise (Pierrehumbert & Beckman 1988; Kubozono 1993; Selkirk & Tateishi 1988), and as already mentioned MiP has been proposed to be at work in English (Selkirk 2000 above). By analogy with observations made for Japanese that MiP can be defined as a node that branches into two words (Kubozono 1993), the present analysis hypothesises that MiP in CA at normal (fast) speech rates is a constituent formed of two prosodic words (PWd). A MaP that meets the minimal binarity requirement of BINMAP$_{MiP}$ contains at least two MiPs thus at least four PWds[3]. This formulation of the phonological well-formedness of MaPs in CA correctly predicts the contexts were only (SVO) phrasings are observed at normal rates.

Sentences with subjects of increasing numbers of prosodic words are again used in most of the examples given here: a subject composed of one, two or three PWds is not 'heavy' enough to form an independent MaP; only four PWds is enough (recall the table in (7a.) above). The tableau for 2PWd non-branching subjects in (9) motivates the ranking between well-formedness and interface constraints: BINMAP$_{MiP}$ >> ALIGN XP,R:

[3] The BINMAP$_{MiP}$ constraint as defined here requires minimally, as opposed to exactly, binary phrases; an alternative view of the same notion would be that a well-formed phrase is headed, with head-hood defined as having at least one dependent in the same phrase.

(9) non-branching long S (2PWds) + non-branching short O (2PWds)

[[N]$_{XP}$ [V [N]$_{XP}$]$_{XP}$] ω ω ω ω ω	BINMAP$_{MiP}$	ALIGN XP,R
a. ( )( ) (S)(VO)	**	
☞ b. ( ) (SVO)		*
c. ( )( ) (SV)(O)	**	*
d. ( )( )( ) (S)(V)(O)	***	

Examples in double-branching subject condition as in (10) show that *all* potential MaPs must be phonologically well-formed. Even though the long double-branching subject is phonologically well-formed, the verb-object complex is too 'light' since it contains insufficient PWds to form two MiPs:

(10)double-branching long S (4PWds) + non-branching short O (2PWds)

[[N[AP]$_{XP}$ [PP]$_{XP}$]$_{XP}$ [V [N]$_{XP}$]$_{XP}$] ω ω ω ω ω ω ω	BINMAP$_{MiP}$	ALIGN XP,R
a. ( )( ) (S)(VO)	*	*
☞ b. ( ) (SVO)		**
c. ( )( ) (SV)(O)	*	**
d. ( )( )( ) aligned	***	

An additional interface constraint is required to explain why an (SVO) phrasing is observed in cases where two well-formed MaPs could form if the phrase break were between the subject and verb. The constraint WRAPXP requires each syntactic XP to be contained within a MaP (Truckenbrodt 1995,1999). In (11) below candidates b. and c. are both phonologically well-formed and both incur equal alignment violations (both have XP right edges without corresponding MaP right edges). WRAPXP acts as a tie-breaker, favouring the (SVO) production (the VP is not divided prosodically but 'wrapped' with the subject in a single MaP):

(11)double-branching short S (3Pwds) + double-branching short O (4PWds)

[[N[AP]$_{XP}$[PP]$_{XP}$]$_{XP}$ [V [N [AP]$_{XP}$[PP]$_{XP}$]$_{XP}$]$_{XP}$] ω ω ω ω ωω ω ω	BINMAP$_{MiP}$	ALIGN XP,R	WRAP XP
a. ( )( ) (S)(VO)	*	*	
☞ b. ( ) (SVO)		**	*
c. ( )( ) (SV)(O)		**	***
d. ( )( )( )( ) aligned	***		

From the present data there is no way to infer how WRAPXP is ranked with respect to the other constraints (hence it is illustrated separately here at the side of the

tableau)[4]. From a typological point of view, since interaction between WRAPXP and ALIGNXP is observed in other languages (see Selkirk 2000 for discussion), and since constraints are assumed to be universal, the theory predicts WRAPXP to be present in the CA grammar, as this case indicates.

If both the subject and the verbal complex are of sufficient prosodic weight to meet the well-formedness condition then the surface (winning) candidate is the one that least violates the interface constraint. Note that ALIGNXP,R is not unviolated here since alignment calls for the right edge of each embedded XP to be lined up with the right edge of a MaP. The winning candidate in (12) has the least alignment violations:

(12)double-branching long S (4Pwds) + double-branching long O (4PWds)

[[N[AP]$_{XP}$[PP]$_{XP}$]$_{XP}$ [V [N [AP]$_{XP}$ [PP]$_{XP}$]$_{XP}$]$_{XP}$ ω ω ω ω ω ωω ω ω	BINMAP$_{MiP}$	ALIGN XP,R
a. ( )( ) (S)(VO)	*	*
☞ b. ( ) (SVO)		**
c. ( )( ) (SV)(O)	*	**
d. ( )( )( )( ) aligned	***	

The analysis predicts *only* (S)(VO) phrasings when all potential MaPs are sufficiently heavy (when BINMAP$_{MiP}$ is unviolated). However the production results show variation between (S)(VO) and (SVO) as seen in table (7a) above. Further investigation is needed with a larger number of speakers to clarify whether the prediction of the analysis is confirmed or whether this limited variation reflects a real tendency to free variation.

Discussion

Evidence in support of proposing a MiP level of phrasing in CA comes primarily from instances in the database where an MiP boundary appears to be tonally marked: the pitch accent at the right edge of the MiP shows local final lowering, and is followed by a local pitch reset at the start of the new MiP (to the pitch level of the start of the previous MiP, rather than to the pitch level of the start of the previous MaP). This resembles the 'rhythmic boost' pitch peak enlargement observed at the left edge of two-PWd MiPs in Japanese (Kubozono 1993).

The hypothesis that MiP consists of two PWds must be revised however when phrasing patterns at slower rates are considered. At slower rates boundaries occur which mark the edges of 'smaller' MaPs, containing fewer than 4PWds.

[4] There are no surface violations of WRAPXP in the present corpus (neither (SVO) nor (S)(VO) violate the constraint whatever the complexity of the subject/object DPs). Establishing a ranking for Wrap with respect to BinMaP/Align would require targets of considerable, and probably implausible, length (eg 4Pwd N + 4PWd AP or PP; 4PWd N-AP + 4PWd PP).

Specifically, at slower rates phrases form that contain 3PWds, but not 2PWds (recall 7b. above). Two types of account of rate sensitive variation have been proposed in constraint-based work on the syntax-phonology interface: in some analyses variation is due to re-ranking of constraints (Truckenbrodt 2003 for Bengali; Yip 1999 for Nantong Chinese), whilst in others prosodic structure is subject to restructuring (Nespor & Vogel 1986 for Italian; Dresher 1994 for Tiberian Hebrew; cf Yip 1999 who proposes limited restructuring within an alternative phonetic implementation account for Nantong Chinese).

The facts in the present CA corpus can be argued to be consistent with a constituent restructuring analysis in which the well-formedness constraint $\text{BIN}\text{MA}\text{P}_{\text{MiP}}$ holds at all speech rates but the formation of the lower level unit MiP is rate-sensitive. Building on the idea that a 2PWd MiP is a rhythmic unit (as observed in Japanese) we suggest that whilst at normal (fast) speech rates a MiP consists of two PWds, at slower speech rates eurhythmy can be achieved by means of 'smaller' MiPs. At slow rates MaPs are formed of these smaller MiPs resulting in the wider distribution of (S)(VO) phrasings observed at slow rates in the present corpus. A potential strength of this analysis is that under this view rate-sensitivity originates at a level of phrasing not directly subject to interface conditions with morpho-syntactic structure (Truckenbrodt 1995); morpho-syntactic structure clearly does not alter as rates vary. Rather variation originates at a level which is rhythmically defined, in some sense to be determined.

What determines MiP formation in CA at slow rates? A possible answer arises by analogy with Tiberian Hebrew (TH) (Dresher 1994:34-5) in which a two-word phrase in a prominent position (which Yip 1999 suggests may equate to slow speech productions) may be divided if one of the words is 'long' containing two or more metrical Feet (Ft). If this were true of MiP formation at slow rates in CA however then there should be more (S)(VO) renditions of sentences containing multipedal words than in those without. This hypothesis can be tested in the present corpus since long branching subjects (3PWds) contained nouns which differed in number of metrical feet, but post-hoc analysis of these tokens shows that phrasing does not co-vary with the presence/absence of a 'long word'.

From the present data then it seems that internal foot structure does not play a role in MiP formation in CA. In fact (13) below shows that the switch to availability of (S)(VO) at both normal and slow rates coincides with only a small increase in prosodic weight measured in terms of PWds or feet, but with a large increase if measured in terms of syllables. This could be consistent with a rhythmic definition of MiP, which disfavours long sequences of unstressed syllables between phrasal stresses. However further investigation using a more finely-grained database is needed to clarify exactly to what aspect of prosodic structure (if any) MiP formation in CA is sensitive.

(13) structure of subjects in PWds/feet/syllables
(S)(VO) phrasings possible at normal / slow rates

subjects		PWds	feet	syllables
non-branching	short	1	1	2
	long	2	2	5
branching	short	2	2	5
	long	3	3 or 4	10
double-branching	short	3	3	10
	long	4	5	15

An alternative definition of MiP would be to say that, as has been proposed for Japanese & English, MiP in CA is the domain of intonational pitch accent distribution (Japanese, Beckman & Pierrehumbert 1986; English, Selkirk 2000). However this does not match the tonal facts observed in the present data either, since throughout the corpus a pitch accent is associated with every prosodic word, regardless of speech rate. At normal rates, definition of MiP both as a branching node (two PWds) for phrasing purposes and as the domain of pitch accent distribution (always a single PWd), are incompatible. The precise formulation of MiP in CA cannot be established from the present data alone.

Conclusions

This paper has presented evidence of two cues to prosodic phrasing in CA: post-lexical tonal marking & durational effects marking the edges of (major) phonological phrases (MaP) cues, and, at least for one speaker, non-application of the syllable repair rule of epenthesis marking the edges of intonational phrases (IP). The presence of these cues in the database, in which prosodic and syntactic weight are systematically varied, indicate MaP phrasing patterns for CA in which (SVO) phrasings predominate. A phonological account of these patterns is proposed which invokes the presence in CA of the minor phonological phrase (MiP). Evidence to support this level of phrasing comes empirically from optional tonal marking and, potentially, theoretically from confining rate-sensitivity to a level of structure not subject to interface conditions. However the exact definition of MiP in CA is left open for future investigation.

The question arises whether this MiP-based analysis could be extended to other languages in which (SVO) phrasings predominate, such as Standard European Portuguese (Elordieta et al 2003). Direct comparison cannot be made between the SEP and CA results since in the original RLD database prosodic weight was increased purely in terms of number of syllables (there was no variation in number of prosodic words independent of changes in syntactic complexity). Nonetheless the two languages show a shared preference for (SVO) phrasings. The arguments supporting a role for MiP in CA are hard to maintain for SEP however since (S)(VO) phrasings are observed when both subject and object are complex and long

even though no 4PWd subjects appear in the SEP corpus (the heaviest subject is 3PWd double-branching with prosodic weight increased in number of syllables).

Frota (p.c.) suggests that the SEP facts, and the predominance of (SVO) within them, reflects a link between sparse prosodic structure (fewer prosodic phrases in general) and sparse pitch accent distribution. Frota & Vigario (2003) report RLD-based data from both Northern European Portuguese (NEP) and SEP which show a correlation between sparsely populated pitch accent distribution and (SVO) phrasings in SEP, contrasting with more richly populated pitch accent distribution and (S)(VO) phrasings in NEP. Interestingly however this correlation (and Frota's explanation for an (SVO) preference therefore) does not hold of CA, which is a language with richly populated pitch accent distribution (an accent on every prosodic word) which shows a preference for (SVO) phrasings.

Whilst a number of questions remain for future investigation this paper demonstrates the benefits to prosodic theory of extending the descriptive coverage to include languages whose prosody has not previously been documented.

References

Alharbi, L. 1991. *Formal analysis of intonation: the case of the Kuwaiti dialect of Arabic.* PhD Thesis, Herriot-Watt University.

Borer, Hagit. 1996. 'The construct in review' Lecarme, Lowenstamm & Shlonsky (eds) *Studies in Afroasiatic Grammar*. HAG: The Hague pp30-61.

Broselow, Ellen. 1976. *The phonology of Egyptian Arabic.* PhD Thesis, University of Massachusetts.

Chahal, Dana. 2001. *Modeling the intonation of Lebanese Arabic using the autosegmental-metrical framework: a comparison with English.* PhD thesis, University of Melbourne.

Dresher, B. Elan. 1994. 'The prosodic basis of the Tiberian Hebrew system of accents.' *Language* 70:1-52.

Elordieta, Gorka, Sonia Frota, Pilar Prieto & Marina Vigario. 2003. 'Effects of constituent weight and syntactic branching of phrasing decisions in Romance'. *Proceedings of the XIVth International Congress of Phonetic Sciences*: 487-490.

Frota, Sonia & Marina Vigario. 2003. *The intonation of Standard and Northern European Portuguese*. Paper presented at the Oxford TIE Workshop, April 2003.

Harrell, R. 1957. *The phonology of colloquial Egyptian Arabic.* American Council of Learned Societies.

Inkelas, Sharon & Draga Zec. 1995. 'Syntax-phonology interface'. in Goldsmith, J. (ed.) *The handbook of phonological theory*. Oxford: Blackwell. pp535-549.

Kubozono, Haruo. 1993. *The Organization of Japanese Prosody*. Tokyo: Kurosio Publishers.

Ladd, D. Robert. 1996. *Intonational Phonology*. CUP: Cambridge.

McCarthy, John. 1979. 'On stress and syllabification.' *Linguistic Inquiry* 10:443-466.

Mitchell, T.F. 1993. *Pronouncing Arabic 2*. Clarendon Press: Oxford.

Nespor, M. & Vogel, I. 1986. *Prosodic phonology*. Dordrecht: Foris.

Norlin, K. 1989. "A preliminary description of Cairo Arabic intonation of statements and questions". *Speech Transmission Quarterly Progress and Status Report* 1:47-49.

Pierrehumbert, Janet & Mary Beckman. 1988. *Japanese tone structure.* MIT Press: Camb., MA.

Poser, William J. 1984. *The phonetics & phonology of tone and intonation in Japanese.* Doctoral dissertation, MIT.

Prieto, Pilar. forthcoming. 'Syntactic and eurhythmic constraints on phrasing decisions in Catalan.' *Studia Linguistica*.

Prince, Alan & Paul Smolensky. 1993. *Constraint interaction in generative grammar.* New Brunswick, NJ: Rutgers University Center for Cognitive Science. [ROA-537]

Rifaat, Khaled. 2003. *The structure of Arabic intonation*. Ms. University of Alexandria, Egypt.

Sandalo, F. & Hubert Truckenbrodt. 2002. 'Some notes on phonological phrasing in Brazilian Portuguese.' *MIT Working Papers in Linguistics* 42: 285-310.

Selkirk, E. O. 1986. 'On derived domains in sentence phonology.' *Phonology Yrbk* 3:371-405.

Selkirk, Elisabeth. 2000. 'The interaction of constraints on prosodic phrasing.' in *Prosody: theory and experiments*. M. Horne (ed.) Dordrecht, Kluwer.

Selkirk, Elisabeth & Koichi Tateishi. 1988. 'Constraints on Minor Phrase formation in Japanese.' *Proceedings of the 24th Annual CLS.* Chicago:CLS.

Truckenbrodt, Hubert. 1995. *Phonological phrases: their relation to syntax, focus and prominence*. MIT, Cambridge, MA. PhD Dissertation.

Truckenbrodt, Hubert. 1999. 'On the relation between syntactic phrases and phonological phrases.' *Linguistic Inquiry* 30:219-255.

Truckenbrodt, H. 2002. 'Variation in p-phrasing in Bengali' *Linguistic Variation Yrbk* 2: 257–301.

Watson, Janet. 2002. *The phonology and morphology of Arabic*. OUP; Oxford.

Yip, Moira. 1999. 'Feet, tonal reduction and speech rate at the word and phrase level in Chinese.' in Kager, R. & Zonneveld, W. (eds). *Phrasal Phonology*. Nijmegen: Nijmegen University Press. pp 171-94.