Focus-related pitch range manipulation (and peak alignment effects) in Egyptian Arabic

Sam Hellmuth

Department of Linguistics, SOAS, University of London
& Institut fur Linguistik, Universitat Potsdam
shellmut@rz.uni-potsdam.de

Abstract

This paper explores focus-related effects on pitch range and on peak alignment in Egyptian Arabic (EA), and interaction between them. Qualitative analysis of elicited focus data shows that even when post-focal and 'given', EA words bear a pitch accent. Quantitative analysis reveals gradient effects of focus in the form of pitch range manipulation but which reflects identificational/contrastive focus, not information focus. Peak alignment shows an indirect effect of post-focal F0 compression.

1. Introduction

The prosodic reflexes of focus in EA are relatively under-described although Norlin [1] in a pilot study found gradient effects in the form of pitch range expansion on focussed items and pitch range compression on post-focus items. Syntactic evidence in Standard Arabic supports a distinction between given~new/information focus ('*focus*') and contrastive/identificational focus ('*FOCUS*') [2-4] and the two types of focus are thus distinguished here. Norlin found that statements with any part in focus break the usual EA pattern of declination through declarative sentences (c.f. [5]): the focussed part is marked by a wider frequency range, and there is compressed pitch range after the focus (this parallels findings for Lebanese Arabic [6]). It is however not possible to reconstruct fully from Norlin's description how the focus contexts were elicited and thus whether the observed expansion/compression is a reflex of information focus or identificational focus. This study seeks to reproduce Norlin's result but further to clarify whether pitch range manipulation in EA reflects the presence of information focus or identificational focus.

Another purely prosodic means of marking the distinction between *focus* and *FOCUS* has been reported for a number of languages, in which speakers have a choice between two pitch accent types, reflected in a surface difference in peak alignment ([7-10]). In view of the potential relevance of peak alignment to the *focus*/*FOCUS* distinction, it is examined in the experimental data here.

2. Methods

2.1. Materials

In order to clarify the empirical facts of EA focus effects two lexically distinct SVO target sentences were each placed in one of four frame paragraphs designed to manipulate focus relations within the sentence. The *FOCUS* status of the subject (the 'trigger') and the *focus* status of the direct object (the 'target') were varied, resulting in four possible *FOCUS~focus* combinations [trigger~target]: [+F+f], [+F-f], [-F+f], [-F-f]. The SVO sentences and some sample context paragraphs are set out in Tables 1 and 2 below:

Table 1: *SVO sentences used in focus experiment.*

	trigger		target	
A	*maama*	*bititʕallim*	*yunaani*	*bil-layl*
	mum	learns	Greek	in-the-night
	'Mum	is learning	Greek	at night'
B	*maama*	*bitnayyim*	*in-nounou*	*bil-layl*
	mum	puts-to-bed	the-baby	in-the- night
	'Mum	puts	the baby to bed	at night'

Table 2: *Sample paragraphs used in focus experiment.*

		context paragraph (target sentence in *italics*)
A1	[+F+f]	'My colleague said they heard my dad went to university in the evenings but I told him no. *Mum is learning Greek in the evenings.* Dad sits at home and watches TV.'
A2	[-F+f]	'My mother loves learning new things. *Mum is learning Greek in the evenings* and she also studies history.'
A3	[+F-f]	'My colleague said they heard my dad was learning Greek in the evenings but I told him no. *Mum is learning Greek in the evenings.* Dad sits at home and watches TV.'
A4	[-F-f]	'My mother loves Greek. *Mum is learning Greek in the evenings* and she likes to watch films on Greek history.'

2.2. Data collection and analysis

The 8 paragraphs (2 lexical sets x 4 focus contexts) were interspersed with filler paragraphs, pseudo-randomised, and presented to speakers printed in Arabic script using EA spelling conventions. This, together with use of EA-specific lexical items, was designed to elicit a spoken register from speaker and reduce interference from use of written prompts. Speakers had no difficulties producing the required register. No two paragraphs from the same lexical set appeared on the same page and after each set of repetitions of paragraphs speakers performed an unrelated narrative-based task. Each paragraph was read 3 times by 6 speakers of EA (3 female, 3 male), yielding 18 x 8 targets (N=144) for analysis.

Three investigations were carried out by the author with reference to F0 and spectrogram using Praat 4.2 [11]: i) a qualitative analysis to determine the presence or absence of pitch accents on target words; ii) a quantitative analysis to determine whether F0 excursion varies in trigger and/or target words; iii) an alignment investigation to determine whether there are differences in alignment in trigger and/or target words which could reflect different pitch accent choices.

The qualitative analysis determined whether or not a local F0 maximum occurred during target words, and thus whether or not target words were ever ‘de-accented’. The target word in each token was labelled as an interval using Praat 4.2 and the automatic pitch maximum identification function used to decide whether a local F0 maximum occurs within (or near to) the target word. When this method is used on unaccented function words the local maximum is identified as being at the start of the word because pitch simply falls steadily throughout the word. So it was seen as being a practical and unambiguous way to determine whether a F0 maximum occurs or not, avoiding labeller bias. The absence of an F0 maximum would be interpreted as an instance of de-accenting.

The quantitative analysis used F0 excursion as the dependent variable in order to determine whether there were gradient effects of focus on F0 in both target and trigger words. The position of minimum (L) and maximum (H) F0 turning points associated with the trigger and target word in each token was labelled by hand (using the automatic pitch minima/maxima function within Praat 4.2 as a guide). The F0 value at each of these points was then extracted in semitones and F0 excursion within each word was calculated by subtraction: xn = F0max - F0min. F0 excursion was calculated in this way for the trigger word (‘xxn’) and target word (‘yxn’) in each token, and the differential in excursion between each trigger-target pair was calculated (in semitones): ‘xndf’ = xxn - yxn. The expectation is that F0 excursion would be greater in focussed words. The *focus*/*FOCUS* distinction made here is designed to clarify which type(s) of focus are marked by F0 excursion in EA.

If pitch range manipulation in EA reflects *FOCUS*, F0 excursion in trigger words (xxn) will be greater in +F contexts than in -F contexts, and, with pitch range compression on post-FOCUS items, F0 excursion in target words (yxn) will be smaller in +F contexts than in -F contexts. If pitch range manipulation in EA reflects *focus*, F0 excursion in target words (yxn) will be greater in +f contexts than in -f contexts. If however pitch range manipulation reflects both types of focus to some extent, then we expect a large excursion differential between target and trigger (xndf) in [+F-f] condition, in which the trigger words is new and bears *FOCUS*, whereas the target word is given and therefore bears neither *focus* nor *FOCUS*. F0 excursion differential properties in other conditions are harder to predict, but may reveal in what ways the two types of focus are marked, if they are both marked.

The alignment analysis investigated the alignment properties of the pitch contour relative to the segmental string. Specifically the distance of the F0 peak (H) from the consonantal onset of the stressed syllable (C0) was measured in both trigger and target words. The position of the segmental landmark, together with pitch events already retrieved for investigation of F0 excursion, was labelled by hand in each target syllable as in Figure 1.

The key dependent variable for comparison across focus conditions is peak delay in both trigger and target words (in milliseconds): trigger peak delay (XH-XC0) and target peak delay (YH-YC0).

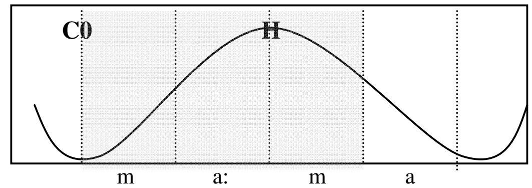

Figure 1: *Position of C0 landmark & H pitch peak*

3. Results

3.1. Qualitative results

Categorical analysis of *target* words in the full focus dataset reveals that in all 144 tokens there is a local F0 maximum on or near the target word, which is taken to be a pitch movement associated with the word. There is thus no categorical de-accenting of target words in the EA data, regardless of the *focus* status of the target, or the *FOCUS* status of the trigger. This is consistent with the generalisation that in EA there is a pitch accent on every content word [12]. A typical pitch track is provided in Figure 2 below in which it is visually clear that there is a pitch movement on the target word [yunaani] (‘Greek’), in a [+F-f] token (123faa1). It is however also clear that F0 excursion varies in the different words, suggesting that gradient manipulation of pitch range is likely to be relevant to focus expression in EA, as expected.

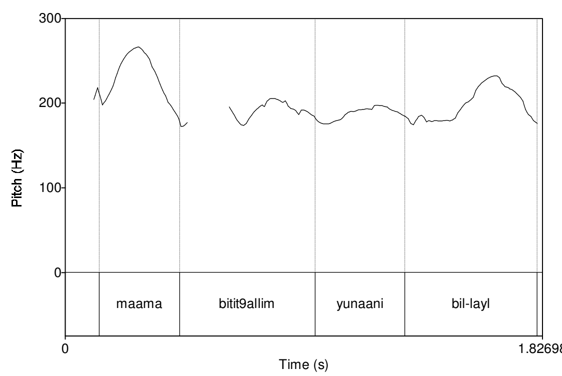

Figure 2: *Sample pitch track from a [+F-f] token.*

3.2. Quantitative results: pitch excursion

The results of the gradient analysis are explored by looking at three variables: the differential in F0 excursion between trigger and target words (xndf), then F0 excursion in trigger words (xxn) and target words (yxn) separately.

Figure 3 plots mean values of xndf across the four focus conditions. The differential in F0 excursion between trigger and target is higher in [+F+f] and [+f-f] conditions than in [-F+f] and [-F-f] conditions. Across all speakers there are clear effects of *FOCUS*: post-hoc Tamhane’s tests reveal that the difference in mean values of xndf is significant between [+F+f] and [-F+f] conditions ($p=0.007$), and approaches significance between [+F-f] and [-F-f] ($p=0.074$). In contrast however, there appear to be no effects of *focus*: the difference in mean values of xndf are not significant either between [+F+f] and [+F-f] ($p=0.988$) or between [-F+f] and [-F-f] (p=0.245). This suggests that expansion and/or compression of F0 excursion in EA is a reflex of *FOCUS* rather than *focus*.

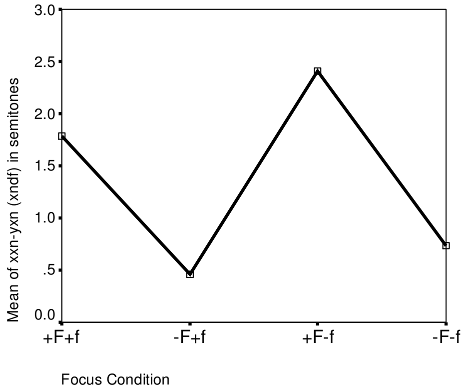

Figure 3: *Mean F0 excursion differential in semitones between trigger & target words (xndf) by focus condition.*

F0 excursion in triggers and targets was also examined separately in order to determine whether variation in F0 excursion differential between trigger and target arises as a result of F0 expansion on triggers only or F0 compression on targets only, or whether both effects are found.

F0 excursion in trigger words (xxn) can only be expected to vary with *FOCUS* status (all context paragraphs were designed to elicit trigger words as new in context), so F0 excursion in trigger words (xxn) should be greater in +F contexts than -F contexts. Figure 4 displays mean values of xxn by focus condition/speaker. The patterns of F0 excursion produced by female speakers pattern as expected, with greater mean F0 excursion in +F than -F contexts, whilst patterns of male speakers vary more widely. Although the trend across all speakers is in the expected direction, the degree of variation in behaviour among male speakers leads to non-significant results when mean values of xxn in +F vs -F condition are compared across all speakers (variances are not equal (Levene's statistic = 0.009) and a non-parametric post hoc test (Tamhane's) yields no significant results). Analysis of female speakers' data only using a oneway ANOVA (xxn by focus condition) however shows that the differences in mean values of F0 excursion in trigger words among female speakers are highly significant (p<0.001). A post-hoc test (Tukey HSD) shows that the significant distinctions are in the expected direction (reflecting *FOCUS*): mean trigger F0 excursion across female speakers varies significantly between [+F+f] and [-F+f] (p=0.046) and also between [+F-f] and [-F-f] (p=0.025).

F0 excursion in target words (yxn) could be expected to vary either according to *FOCUS* (ie whether or not the target words follows a *FOCUS*) or according to *focus* status of the target itself or to reflect both types of focus in some way. If the post-focal F0 compression effects reported by Norlin arise due to post-*FOCUS* position, then F0 excursion in target words (yxn) will be smaller in +F than -F conditions. If post-focal F0 compression effects reflect the *focus* status of target words themselves then yxn will be greater in +f than -f conditions. If there is some implicational relation between *focus* and *FOCUS*, whereby for example the *focus* status of a word becomes relevant only when it falls after a *FOCUS*, then one might expect to see a difference between target F0 excursion in [+F-f] condition (given target after a *FOCUS*) as compared to [-F-f] condition (new target after a *FOCUS*).

Figure 5 shows mean values of target F0 excursion (yxn) by focus condition and by speaker. The trend observed is in the direction expected if F0 compression marks post-*FOCUS* position, rather than *focus* status of the target itself: mean target F0 excursion is generally smaller in +F conditions than in parallel -F conditions. A oneway ANOVA (yxn by focus condition) shows that the differences in mean value of target F0 excursion between different focus conditions approach but do not reach significance (p=0.073; α = 0.05). Comparison of mean differences in F0 target excursion by *type* of focus condition (oneway ANOVAs: yxn by ±*FOCUS* status; yxn by ±*focus* status) reveals that the difference in target F0 excursion between grouped +F vs. -F conditions is highly significant (p=0.009), whereas target F0 excursion in grouped +f vs. -f conditions cannot be assumed to come from different populations (p=0.898).

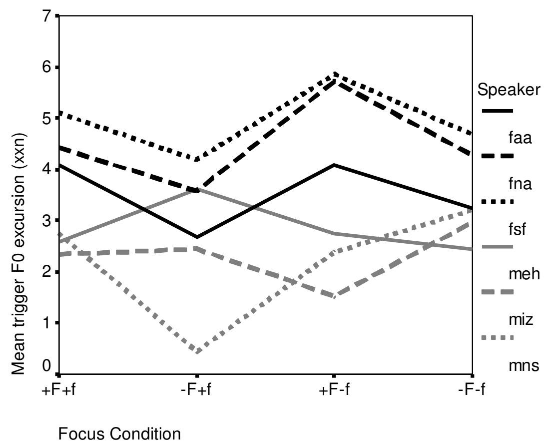

Figure 4: *Mean trigger F0 excursion (xxn) by focus condition & by speaker.*

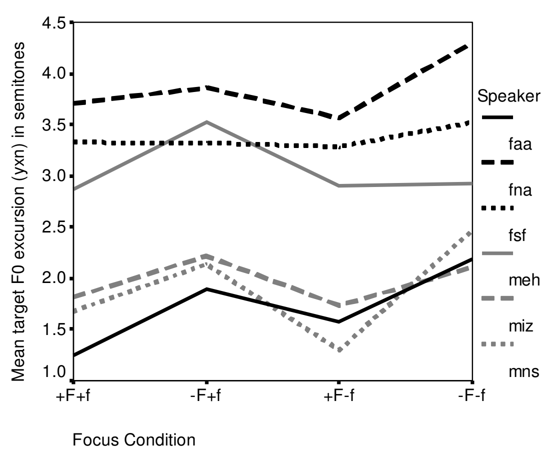

Figure 5: *Mean target F0 excursion (yxn) by focus condition & by speaker.*

In EA then, manipulation of pitch range is a reflex not of *focus* but of *FOCUS*, and this is manifested both as expansion of pitch range on items under *FOCUS* and as compression of pitch range in items occurring after a *FOCUS*. This matches Norlin's results, and suggests that his methodology probably elicited (identificational) *FOCUS*. The facts of F0 excursion in target words further reveal that in EA compression of F0 excursion is not a function of *focus* status at all, but only of post-*FOCUS* position.

3.3. Quantitative results: peak alignment & duration

It has been argued that in some intonational languages the distinction between *FOCUS* and *focus* is expressible by means of a difference in pitch accent alignment. In most analyses this difference is thought to be categorical and distinct phonological representations are proposed for the two accents. The surface distinction between the two accent types is usually a difference in peak alignment. For example in European Portuguese +F+f nuclear falls have an earlier peak than -F+f nuclear falls [8]; in Spanish, +F pre-nuclear rising accents have an earlier peak than their +f counterparts [9].

Comparison of trigger peak delay values shows no significant differences across focus conditions (Tamhane's post-hoc test: non-significant). This suggests that there is neither categorical nor gradient *FOCUS*-induced variation in pitch accent alignment on focussed items in EA.

In contrast, comparison of target peak delay across focus conditions shows variation in target peak delay values (ANOVA: $F=6.029$; $p= 0.001$). A post-hoc Tukey's HSD test divides the four focus-condition groups of target peak delay values into two homogenous subsets: [+F+f] and [+F-f], grouped separately from [-F+f] and [+F-f]. The peaks are aligned earlier in target words falling after a +F than in those falling after a -F. This suggests that there is an indirect focus-related effect on peak alignment in EA as a by-product of post-focal F0 compression: smaller peaks are realised more quickly. There appears to be no effect of *focus* status on peak alignment in target words.

4. Discussion

In summary then, the present study confirms the use in EA of gradient pitch range manipulation to mark items which bear identificational focus ('*FOCUS*'). This is not unexpected since similar effects in English have been known for some time. There is however ongoing debate as to whether the effect should be interpreted as phonologically categorical or gradient [13-15].

The finding that *FOCUS* induces not only F0 expansion on focussed items but also F0 compression on post-*FOCUS* items is consistent with a gradient interpretation of focus-related pitch range manipulation in EA, in which articulatory means are used to enhance the overall distinction between +F and -F items [14]. Similarly, parallel focus effects in Lebanese Arabic [6] have been argued to be a type of 'hyperarticulation' which extends to all prosodic cues and not only F0 excursion, with the distinction evident also in values of F1/F2, amplitude and duration.

The focus-related alignment facts of EA observed here reveal *FOCUS* effects on peak alignment in post-focal items only; peak alignment in +F words (i.e. triggers) is apparently unaffected, and peak alignment in post-focal words (targets) is not affected by their own given/new *focus* status. This is consistent with a hyperarticulation view of *FOCUS* effects: the phonologically relevant alignment properties of +F items are preserved, whilst those of post-focal items are less accurately conveyed.

5. Conclusions

This paper shows that pitch range manipulation is used in EA to express identificational/contrastive focus only, and argues that this effect is phonologically gradient: the effects emerge not only on focused items, as F0 expansion, but also on post-focal items, in the form of F0 compression and earlier peak alignment.

6. References

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