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The realization of different structural focus conditions in Saudi Arabic dialects

Aljawharah Alzamil, Sam Hellmuth

University of York

aia518@york.ac.uk, sam.hellmuth@york.ac.uk

Abstract

Production data from speakers of three varieties of Saudi Arabic (Najdi/Hijazi/Jizani), in two age groups, are used to explore whether generalizations about prosodic focus marking in Urban Hijazi Arabic reported by Alzaidi et al. [1] are i) shared with other Saudi dialects, ii) stable across generations of speakers, and iii) maintained in the context of other focus strategies. Data was elicited using a question-and-answer reading task (cf. [1]) but also a picture description task which gives speakers freedom to express focus by all grammatical means available. In both paradigms, parallel target words were presented in different contexts to elicit broad focus versus two types of narrow focus. Quantitative analysis of acoustic properties in the stressed syllable of target words across conditions is reported, alongside visualization of the F0 contour and qualitative analysis of alternative focus marking strategies. Results show some differences between dialects in the type and degree of acoustic cues observed in on-focus positions. Off-focus cues, in both pre-focus and post-focus positions, are similar across dialects. All three dialects display alternative focus marking strategies, with indications of a potential trade-off between non-prosodic strategies versus on-focus prosodic marking.

Index Terms: Saudi Arabic, focus, dialectal variation, post-focal compression

1. Introduction

Different grammatical means are used to mark focus across different languages, including syntactic, morphological, or prosodic markers [2]. For Arabic spoken varieties, there are indications of variation in the prosodic effects of focus both within [3], and between [4], Arabic dialects. In the case of differences between dialects, the variation in [4] comprised both differences in the type and degree of prosodic marking (e.g. presence or absence of post-focal de-accenting), and in the use of alternative focus marking strategies such as elision of arguments and/or insertion of phrase boundaries after a focus.

2. Background

Languages differ in how focus is marked prosodically or whether it is marked at all [5-7], and prosodic focus can be realized differently in closely related varieties (e.g. [8, 9]). There are also competing definitions of focus. In this study we assume a distinction in scope between broad focus (in which the whole utterance is new to the discourse) and narrow focus (in which some part(s) of the utterance is new and other part(s) are given); we allow also for a possible distinction between information focus (where the item is new to the discourse) versus contrastive focus (contrast with overt alternatives). A key observation in prior work on prosodic focus is that acoustic cues may be realized in both on-focus and off-focus domains [10], and cues employed may differ across languages.

2.1. Focus in Arabic

Arabic uses both prosodic and non-prosodic marking of focus, in both formal [11] and regional spoken varieties (e.g. [12]).

Acoustic cues to focus have been investigated in a number of regional spoken Arabic dialects. In Egyptian Arabic, focus is marked with on-focus expanded and/or higher F0 and post-focal F0 compression, but pre-focal effects have not been reported [13-16]. For Lebanese Arabic, [17] showed on-focus effects in the form of higher F0, longer duration, increased intensity, and more peripheral F1/F2 in vowels, as well as optional insertion of post-focus phrasal boundaries; pre- and post-focus domains show F0 compression. For Moroccan Arabic [18] reports speaker variation in focus marking via F0 and/or duration, which interacts closely with syllable structure. In one of the few comparative studies in the Arabic focus literature to date [19], with speakers of Moroccan, Yemeni and Kuwaiti dialects, all three dialects used duration to differentiate contrastive focus from its broad focus counterpart. Although only Moroccan speakers showed pre-focal deaccenting, all three dialects showed post-focal F0 compression. Crucially, for our purposes here, on-focus use of F0 expansion varied: pitch range under contrastive focus was significantly more expanded than in counterpart broad focus utterances in Moroccan and Kuwaiti Arabic than in Yemeni Arabic. This is of interest for the present study since we investigate a Saudi dialect from the Jizan region which is close to the border with Yemen.

There has only been one prior detailed study of acoustic cues to focus in a Saudi dialect, by Alzaidi et al [1] who examine the Urban Hijazi variety. They report results from 16 speakers (8F/8M) aged 23-35 years from Taif city. Data was collected using a question-answer paradigm designed to elicit information and contrastive focus in different sentence positions for comparison with broad focus counterparts. The results for these young Hijazi speakers show on-focus effects in significantly expanded F0 excursion, higher maximum F0 and longer duration. Post-focal effects included lower F0 and shorter duration, but there were no pre-focal effects. An earlier study of Najdi Arabic [20] reported word order shifts whereby broad focus utterances are realized with VS order, pointing towards a potential role for non-prosodic strategies in focus marking in Saudi dialects also.

2.2. The present study

The present study explores whether the generalizations made about acoustic cues employed in prosodic marking of focus in Urban Hijazi Arabic by Alzaidi et al. [1] are i) shared with other Saudi dialects, and ii) stable across age generations. We achieve this through analysis of production data from speakers of three Saudi Arabic varieties (Najdi/Hijazi/Jizani), in two age groups. By eliciting production data with an unscripted task, as well as a scripted task, we also explore whether these acoustic cues are iii) maintained in the context of other focus strategies.

3. Methods

3.1. Materials

The target utterances were simple transitive expressions elicited – using two different methods – in five structural conditions: broad focus; information focus on subject; information focus on object; contrastive focus on subject; contrastive focus on object. Elicitation of these focus conditions is achieved by manipulation of the information status of arguments in a target transitive utterance as given or new. In the question-answer (*qa*) paradigm the relevant arguments are the subject and object, whereas in the picture description (*pd*) paradigm, the status of the agent/patient are manipulated, as shown in Table 1.

Table 1: Focus conditions investigated, by task.

Code	Question-Answer	Picture Description
nn	subject new	agent new
	object new	patient new
ng	subject new	agent new
	object given	patient given
gn	subject given	agent given
	object new	patient new
cg	subject contrasted	agent contrasted
	object given	patient given
gc	subject given	agent given
	object contrasted	patient contrasted

3.1.1. Question-answer paradigm

The question-answer [*qa*] paradigm is a partial replication of the methods used by Alzaidi et al [1], to elicit a single four-word declarative sentence in each of the five different focus conditions in Table 1. The target words occur in sentence-initial position (subject) and sentence-penultimate position (object). A sentence-final adverbial is built into the target sentence in order to distance the target object from potential phrase-final effects, such as final lengthening and/or final lowering. There are three lexical sets, shown in Table 2, elicited in each of the five desired focus conditions using tailored prompt questions such as those shown in Table 3 for the *qa2* lexical set. The *qa1* lexical set and prompt questions are a direct replication of one lexical set used in [1]. We adjusted the target sentences and prompts in our other two lexical sets in order to achieve better control of the syllable structure of target words across lexical sets. Target words were chosen to control syllable structure in the stressed syllable (all contain heavy syllables CVC or CVC). All target syllables and words contain voiced and/or sonorant sounds to minimize micro-prosodic effects on the F0 contour.

Table 2: Target utterances in question-answer task.

Lexical Set	Target Sentence
qa1	رامي مر لينا امس Rami visited Lina yesterday [ˈra.mi marr ˈli:na ʔams]
qa2	امي نومت هاني بالليل Mum put Hani to bed [ˈʔummi: ˈnawwamat ˈha:ni bi-l-ˈlajl]
qa3	ليلي علمت منيره البارح Laila told Munerah last night [ˈlajla ˈʕallammat mu:ˈni:ra l-ˈba:ri:h]

Table 3: Sample questions (used to elicit target *qa2*).

Code	Prompt Question
nn	وش سويتو؟ What did you do? [wiʃ saˈwajtu:]
ng	هاني نام زين بالليل. من نومته؟ Hani slept well last night. Who put him to bed? [ˈha:ni na:m zajn bi-l-ˈlajl, min ˈnawwamuh]
gn	من امي نومت بالليل؟ Whom did Mum put to bed last night? [min ˈʔummi: ˈnawwamat bi-l-ˈlajl]
cg	من نوم هاني بالليل؟ امي ولا لامى؟ Who put Hani to bed last night, Mum or Lama? [min ˈnawwam ˈha:ni bil ˈlajl ˈʔummi: willa ˈla:ma]
gc	من امي نومت بالليل؟ منى؟ Whom did Mum put to bed last night, Muna? [min ˈʔummi: ˈnawwamat bi-l-ˈlajl ˈmuna]

Table 4: Target utterances in picture description task.

Lexical Set	Target Sentence
pd1	رجال شاييل كرسي A man carries a chair. [raˈdʒa:l ʃajl ˈkirsi:]
pd2	حرمة تضرب بقره A women hits a cow. [ˈhirma ˈtidˈrib ˈbqara]

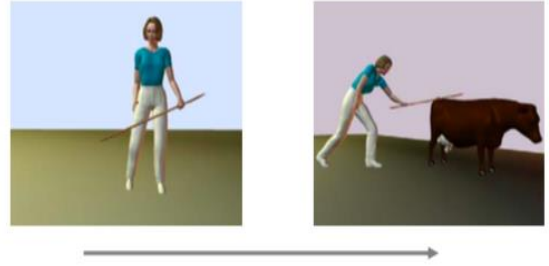


Figure 1: Pictures used to elicit *pd2* in *ng* condition (reproduced from Skopeteas et al [2] p79).

3.1.2. Picture description task

The picture description [*pd*] paradigm uses the Sequences task from QUIS [2] to elicit semi-spontaneous descriptions of an agent-patient transitive action, in the same five focus conditions shown in Table 1. A single picture is used to elicit the target transitive action in ‘all new’ condition. To elicit focus, the participant is asked to describe a context picture, then a second picture (depicting the target transitive action) appears on screen. In all cases the participant was asked to describe the picture(s) in response to the question “what is going on in this scene?”. The *pd* task has two lexical sets, expected to elicit utterances such as those shown in Table 4. A sample pair of pictures used to elicit new focus on the agent are shown in Figure 1. The *pd* paradigm gives speakers freedom to express focus by all and any grammatical means available in their variety. The syllable structure and sonorant content of target words cannot be controlled, due to use of pre-existing target picture stimuli. Lack of control of target words is balanced against the advantage of eliciting unscripted utterances for comparison with results from the scripted *qa* task.

3.2. Participants

Data were collected with 72 speakers of three urban Saudi varieties: Najdi (*sanu*), Hijazi (*sahu*) and Jizani (*saju*). In each dialect there were two age groups, split evenly by gender: 6 female/6 male aged 18-30, plus 6 female/6 male aged 40-60. Young participants were recruited among university students. Older participants were recruited among university staff, community members, friends, and relatives. Due to security issues at time of recording, Jizani speakers were recruited among the Jizani community in Riyadh, with the criterion that participants had moved to Riyadh in the previous two years.

3.3. Procedure

Data for the *qa* and *pd* tasks were elicited in combination: stimuli from the five focus conditions and five lexical sets were pseudo-randomized across five blocks, so each condition and lexical set appeared once per block. Each block comprised five tokens, with lexical sets presented in the same fixed order in all blocks (*qa1/pd1/qa2/pd2/qa3*). Up to 25 tokens were elicited from each participant across all five blocks, with no repetitions. The five focus blocks were interspersed evenly through a longer recording session, between scripted and unscripted tasks collected for other purposes. Focus stimuli were presented on screen, in Arabic script using colloquial spelling conventions (*qa*) or as picture prompt(s) (*pd*). For *qa* stimuli, participants read the sentence after listening to a prompt question recorded by the first author who is an L1 Najdi speaker. Prompt questions were pre-recorded to avoid variation in prosodic realization of questions across participants. The focus experiment was self-paced and took 15-20 minutes total. Recordings were made in quiet meeting rooms in wav 44.1 KHz 16bit with a Marantz PMD660 data recorder and headset Shure SM10 microphone.

3.4. Analysis

Audio data were segmented in Praat [21] and the expected target string force-aligned to the signal using ProsodyLab Aligner [22]. Alignments were manually checked and corrected by the first author. During checking, a number of tokens were identified as ‘non-verbatim’ (i.e. produced without one or both arguments): *qa* N=100; *pd* N=223. These non-verbatim tokens were excluded from quantitative acoustic analysis but were examined auditorily to identify alternative focus marking strategies, such as elision of subject/agent or of object/patient or of both arguments. F0 was extracted at 10 points within each target word using a Praat script to produce time-normalized visualizations of contours across focus conditions in ggplot2 [23]. F0 contours are shown here for a subset of the *qa* verbatim data (excluding responses with overt arguments but extra words added), due to space limitations, and visualize F0 contours in the first three words (excluding final adverbials). In the interests of comparison, the main acoustic analysis reported here follows the approach of [1], in which acoustic measurements in target words are compared across focus conditions. All *qa* (N=994) and *pd* (N= 485) tokens in which both target arguments were produced were submitted to acoustic analysis, even if other parts of the target utterance were not produced as scripted. A Praat script was used to extract F0 excursion, max F0, mean F0, duration and intensity in the stressed syllable of target words. Linear mixed effects models (LMM) were used to explore the effect of dialect *group* and focus *condition* (and the interaction between them) on each acoustic cue in turn, along with fixed factors for *age* and *gender*, and random intercepts for *speaker* and *item* using lme4 [24] in R [25].

4. Results

4.1. Visualization of whole F0 contours (in *qa* data subset)

The time-normalized F0 contours in Figure 2 show a general trend of declination throughout the utterance, regardless of focus condition; this differs from the pattern reported by [1] for Hijazi in which F0 peaks on pre-focal subjects were lower than those on following focused objects. However, a property shared with [1] is that in the present data both subject and object (i.e. the first and last words in Figure 2) bear an F0 peak regardless of focus condition, indicating a lack of de-accenting; this holds for objects produced in post-focal position after a focused subject (in the upper panel), and suggests that in this scripted data post-focal arguments were not typically fully de-accented. (The flatter contour for Hijazi and Jizani males is due to the small number of target-like tokens that they produced; see 4.3).

Turning to differences between focus conditions, we can see indications in this data subset of post-focal compression after a focused subject in all dialects, for one or both focus types (new versus contrastive focus), but a great degree of overlap of contours across conditions also. Investigation of all acoustic cues, in all responses with overt arguments, is thus necessary.

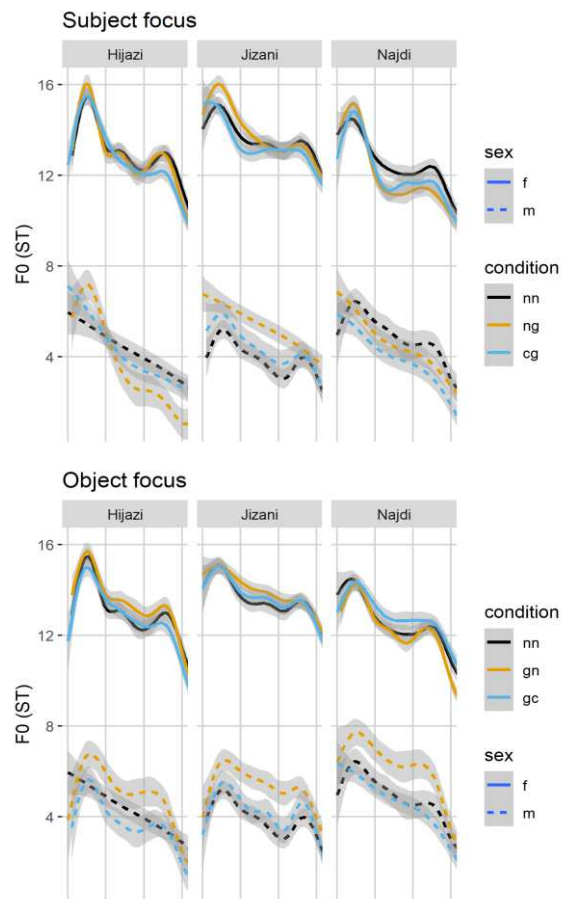


Figure 2: Time-normalized GAM (REML)-smoothed *f*₀ contour in first three words of *qa* target-like items (N=719) for all speakers and lexical sets, by gender (line type) and focus condition (line colour), for subject (upper panel) and object (lower panel) focus; each vertical section = one word.

4.2. Acoustic cues in all overtly produced target arguments

LMMs were run on a dataset comprising all *qa* (N=994) and *pd* (N=485) responses with both arguments produced. Following [1], for each acoustic cue, these results compare across focus conditions in four position-based subsets: on-focus subjects, on-focus objects, pre-focal subjects and post-focal objects. In total 20 models were run (4 positions x 5 cues) and we report here only significant main effects or interactions. Expected main effects of *age* on F0 excursion in all positions (older speakers produce wider F0 excursion) and of *gender* on max F0 and mean F0 in all positions (females show higher values of max F0/mean F0) were found but are not discussed further.

In on-focus subjects we found a main effect of focus condition regardless of dialect group for information focus on F0 excursion ($\beta=0.446$; SE=0.145; $t=3.076$) and for contrastive focus on duration ($\beta=11.484$; SE=4.716; $t=2.435$). There was a main effect of group regardless of focus condition on duration ($\beta=-14.966$; SE=6.905; $t=-2.167$) such that Jizani speakers show shorter duration against mean regardless of focus. Most relevant for our purposes, we found a *group*condition* interaction on max F0 ($\beta=-0.504$; SE=0.215; $t=-2.342$): in information focus condition (only) Jizani speakers show lower values of max F0 against mean in on-focus subjects.

In on-focus objects we found a main effect of information focus condition regardless of dialect group on mean intensity ($\beta=0.946$; SE=0.302; $t=3.128$): new objects were realized with greater intensity against mean in all dialects. Crucially, for our purposes, we found a series of *group*condition* interactions on maxF0: Jizani speakers showed lower values of max F0 against mean under both information focus ($\beta=-0.991$; SE=0.276; $t=-3.586$) and contrastive focus ($\beta=-0.595$; SE=0.267; $t=-2.227$); in addition, Najdi speakers showed higher values of max F0 against mean under both information focus ($\beta=0.591$; SE=0.270; $t=2.189$) and contrastive focus ($\beta=0.553$; SE=0.261; $t=2.117$). We also found a *group*condition* interaction on mean F0 under information focus ($\beta=-0.660$ SE=0.225; $t=-2.924$): Jizani speakers also show lower mean F0 values against mean.

In pre-focal subjects there was a main effect of dialect group regardless of focus condition on duration ($\beta=-14.565$; SE=6.683; $t=-2.179$) and F0 excursion ($\beta=-0.456$; SE=0.222; $t=-2.048$): Jizani speakers show shorter duration and reduced F0 excursion against mean in pre-focal subjects regardless of focus condition; note that Jizanis showed reduced duration also in on-focus subjects (see 4.2.1). More pertinently, we see a main effect of focus *condition*, under contrastive focus (only) regardless of dialect *group*, on max F0 ($\beta=-0.461$; SE=0.147; $t=-3.134$), mean F0 ($\beta=-0.494$; SE=0.117; $t=-4.202$) and mean intensity ($\beta=-0.668$; SE=0.317; $t=-2.103$), such that both F0 and intensity are reduced on pre-focal subjects in all dialects.

In post-focal objects we found a main effect of dialect *group* regardless of focus *condition* on max F0 ($\beta=-0.890$; SE=0.431; $t=-2.065$): Najdis show lower max F0 values against mean compared to other dialects regardless of focus. Of greatest relevance for our purposes, we found evidence of post-focal compression in the form of a main effect of focus *condition* regardless of dialect *group* for contrastive focus on max F0 ($\beta=-0.712$; SE=0.220; $t=-3.229$), mean F0 ($\beta=-0.614$; SE=0.164; $t=-3.73$), mean intensity ($\beta=-1.299$; SE=0.290; $t=-4.469$) and duration ($\beta=-8.136$; SE=3.505; $t=-2.321$), and for information focus on mean intensity ($\beta=-0.920$; SE=0.300; $t=-3.063$) and duration ($\beta=-10.797$; SE=3.617; $t=-2.985$).

4.3. Qualitative analysis of non-verbatim responses

Analysis of non-verbatim responses in both tasks (N=323) revealed that given arguments are more frequently elided than new arguments, across both tasks and all dialects. Figure 3 shows that subject drop is much more common for Jizanis, though also frequent for Hijazi men, but Jizani males tended to elide subjects in the *pd* task regardless of information structure. Clefting was also common for Hijazi speakers in contrastive focus regardless of task and information structure.

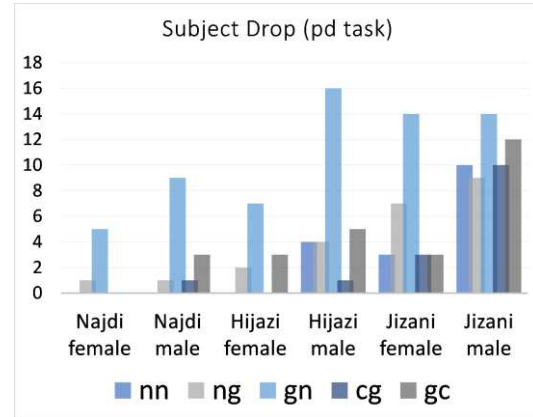


Figure 3: Count of elided subjects (out of 18) in *pd* task.

5. Discussion and Conclusion

The results show similarities and differences across Saudi dialects in focus realization. All three dialects use other focus strategies alongside prosody, but the most frequent of these – elision of arguments – was itself more common (or more frequently elicited) among Jizanis and among Hijazi men.

Off-focus prosodic focus realization is similar in all three dialects, with post-focal reduction of F0/intensity/duration in objects after contrastive and/or information focus, and reduction of F0/intensity in pre-focal subjects. Differences between dialects in focus realization are found in on-focus positions and affect F0 only. The Jizani speakers show reduced or no on-focus F0 cues, as well as generally reduced prominence in subjects, which may be correlated with increased tendency to elide given subjects (cf. [26]); this also parallels reduced on-focus F0 cues among Yemeni speakers in [19]. No effects of age or gender, that might indicate changes in progress within dialects, were shown by the analysis approach used here.

The results show some shared generalizations with [1], confirming post-focal compression of max F0, mean F0, and mean intensity in post-focal objects. We found some pre-focal reduction of F0 and intensity, in contrast to [1], though, and the paradigms used here have not elicited consistent differences in marking of contrastive and information focus. Future work will involve further exploration of non-verbatim strategies, with comparison to spontaneous data from the same speakers, as well as acoustic investigation of vowel quality (F1/F2) and overall register and prominence across utterances.

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7. References

- [1] Alzaidi, M.S., Y. Xu, and A. Xu. 2019. Prosodic Encoding of Focus in Hijazi Arabic. *Speech Communication*, **106**: p. 127-149.
- [2] Skopeteas, S., et al. 2006. Questionnaire on Information Structure (QUIS). *Interdisciplinary Studies on Information Structure (ISIS): Working Papers of SFB632 University of Potsdam.*, **4**
- [3] Cangemi, F., et al. 2016. Speaker-specific intonational marking of narrow focus in Egyptian Arabic. *Proceedings of Speech Prosody 2016, Boston*.
- [4] Chahal, D. and S. Hellmuth. 2015. Comparing the Intonational Phonology of Lebanese and Egyptian Arabic, in *Prosodic Typology II*, S.-A. Jun, Editor. Oxford University Press. p. 365-404.
- [5] Ladd, D.R. 2008. *Intonational phonology* Second ed. Cambridge: Cambridge University Press.
- [6] Féry, C. 2017. *Intonation and prosodic structure*. Cambridge University Press.
- [7] Kügler, F. and S. Calhoun. 2021. Prosodic encoding of information structure: A typological perspective, in *The Oxford handbook of language prosody.*, C. Gussenhoven and A. Chen, Editors. Oxford University Press: Oxford. p. 454-467.
- [8] Dorn, A. and A.N. Chasaide. *Effects of Focus on f0 across Four Varieties of Donegal Irish*. in *Proc. 9th International Conference on Speech Prosody 2018*. 2018.
- [9] Xu, Y., S.-W. Chen, and B. Wang. 2012. Prosodic focus with and without post-focus compression: A typological divide within the same language family? *The Linguistic Review*, **29**(1): p. 131-147.
- [10] Xu, Y. *Post-focus Compression: Cross-linguistic Distribution and Historical Origin*. in *ICPhS*. 2011.
- [11] Moutouakil, A. 1989. *Pragmatic functions in a functional grammar of Arabic*. Dordrecht Foris.
- [12] Hellmuth, S. 2010. Functional complementarity is only skin deep: evidence from Egyptian Arabic for the autonomy of syntax and phonology in the expression of focus, in *The sound patterns of syntax*, N. Erteschik-Shir and L. Rochman, Editors. Oxford University Press: Oxford. p. 247-270.
- [13] Norlin, K. 1989. A preliminary description of Cairo Arabic intonation of statements and questions. *Speech Transmission Quarterly Progress and Status Report*, **1** p. 47-49.
- [14] Hellmuth, S. 2011. Acoustic cues to focus and givenness in Egyptian Arabic, in *Instrumental Studies in Arabic Phonetics. [CILT319]*, B. Heselwood and Z.M. Hassan, Editors. John Benjamins: Amsterdam. p. 299-324.
- [15] El Zarka, D., A. Kelterer, and B. Schuppler. *An Analysis of Prosodic Prominence Cues to Information Structure in Egyptian Arabic*. in *INTERSPEECH*. 2020.
- [16] El Zarka, D. and P. Hödl. 2021. A study on the perception of prosodic cues to focus by Egyptian listeners: Some make use of them, but most of them don't. *Speech Communication*, **132**: p. 55-69.
- [17] Chahal, D. 2001. Modeling the intonation of Lebanese Arabic using the autosegmental-metrical framework: a comparison with English. PhD dissertation, University of Melbourne
- [18] Yeou, M. *Variability of F0 peak alignment in moroccan Arabic accentual focus*. in *Proc. Interspeech 2005*. 2005.
- [19] Yeou, M., M. Embarki, and S. Al-Maqtari. 2007. Contrastive focus and F0 patterns in three Arabic dialects. *Nouveaux cahiers de linguistique française*, **28**: p. 317-326.
- [20] Ingham, B. 2013. Information structure in the Najdi dialects, in *Information structure in spoken Arabic*, J. Owens and A. Elgibali, Editors. Routledge. p. 93-110.
- [21] Boersma, P. and D. Weenink. 1992-2018. Praat: doing phonetics by computer.
- [22] Gorman, K., J. Howell, and M. Wagner. 2011. Prosodylab-Aligner: A tool for forced alignment of laboratory speech. *Journal of the Canadian Acoustical Association*, **39**(3): p. 192-193.
- [23] Wickham, H. 2010. ggplot2: Elegant graphics for data analysis. *J Stat Softw*, **35**(1): p. 65-88.
- [24] Bates, D., et al. 2015. Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, **67**(1): p. 1-48.
- [25] Core Team, R. 2014. R: A language and environment for statistical computing. R Foundation for Statistical Computing: Vienna, Austria.
- [26] Jelinek, E. 2002. Agreement, clitics and focus in Egyptian Arabic, in *Themes in Arabic and Hebrew Syntax*, J. Ouhalla and U. Shlonsky, Editors. Springer: Berlin. p. 71-105.