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### Highlights

- We presents findings of the first systematic acoustic analysis of focus in Hijazi Arabic (HA), an under-researched Arabic dialect.
- A question-answer paradigm was used to elicit information focus and contrastive focus at different sentence locations in comparison with their neutral focus counterparts.
- Focused words have significantly expanded excursion size, higher maximum F0 and longer duration.
- Post-focus words have significantly lowered F0 (except in the case of penultimate focus).
- Pre-focus words, in contrast, lack systematic changes.
- These patterns are consistent with previously reported prosodic patterns of focus in other Arabic dialects.
- Arabic appears to belong to a group of languages that all exhibit post-focus compression (PFC), as opposed to languages that lack PFC.
- The results also show evidence of prosodic differences between contrastive focus and information focus.

# Prosodic Encoding of Focus in Hijazi Arabic

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## Abstract

This paper presents findings of the first systematic acoustic analysis of focus prosody in Hijazi Arabic (HA), an under-researched Arabic dialect. A question-answer paradigm was used to elicit information and contrastive focus at different sentence locations in comparison with their neutral focus counterparts. Systematic acoustic analyses were performed to compare all the focus conditions, in terms of both continuous  $F_0$  trajectories and specific acoustic measurements. Results show that focused words have significantly expanded excursion size, higher maximum  $F_0$  and longer duration. Post-focus words have significantly lowered  $F_0$  (except in the case of penultimate focus). Pre-focus words, in contrast, lack systematic changes. These patterns are consistent with previously reported prosodic patterns of focus in other Arabic dialects. They are also consistent with a number of other languages that have also been applied similar systematic acoustic analyses. Thus Arabic appears to belong to a group of languages that all exhibit post-focus compression (PFC), as opposed to languages that lack PFC. In addition, the results also show evidence of prosodic differences between contrastive focus and information focus. This difference, however, is interpreted as due to a methodological feature that allowed elicitation of incredulity related to contrastive focus, rather than as a language-specific property. It is also argued that the possible involvement of incredulity in focus marking needs further research.

**keywords:** prosodic focus post-focus compression Hijazi Arabic

## 1. Introduction

It has long been proposed that focus plays a major role in shaping the prosody of many languages (Bolinger, 1989; Lambrecht, 1994). Recently, evidence has emerged, however, that languages differ substantially in how focus is marked prosodically or not marked at all (Face, 2002; Lee et al., 2007; Patil et al., 2008; Zerbian et al., 2010; Xu, 2011a; Féry, 2013, and among others). Though Arabic has a large number of spoken dialects alongside Modern Standard Arabic (MSA) (e.g., Egyptian, Lebanese, Moroccan, Najdi and Hijazi), little research has been carried out on the interaction between focus and other functions of prosody in these varieties. Recent empirical studies on Lebanese Arabic (Chahal, 2001) and Egyptian Arabic (Hellmuth, 2006; Cangemi et al., 2016) are notable exceptions, as will be reviewed in §1.1. These studies have shown prosodic effects of focus in some varieties of Arabic. However, their results also suggest that the prosodic effects of focus are not the same across the Arabic dialects. To obtain a clearer picture of focus prosody in Arabic, more systematic investigations are needed. The current study is an effort to examine the phonetic realisation of focus in Hijazi Arabic (HA), whose intonation system has not yet been carefully studied. Before presenting the study, it is necessary to provide some background information on the definition of focus and focus types (§1.1), and the Arabic language in general and Hijazi Arabic in particular (§1.2).

### 1.1. Definition of focus and focus types

A major tradition in focus research is to define it as the informative, unpredictable, and newsy part of a proposition (Cooper et al., 1985; Vallduví, 1992; Lambrecht, 1994; Vallduví and Engdahl, 1996; Kiss, 1998; Pell, 2001; Féry and Kügler, 2008). As such, focus is to contrast with ‘givenness/ground’ in the non-informative part of the proposition; i.e., the knowledge the speakers already share in the discourse (Lambrecht, 1994). But as pointed out by Krifka (2008), although some cases of focus do coincide with newness, many others do not. In (1), for example, *Jane* is not new information but is likely focused (indicated by the subscript F). In (2), once *mother* is focused, *got sick* is likely to be deemphasized or deaccented despite carrying new information. There have also been neural studies that show that focus is associated

with attention allocation during discourse comprehension, while newness is associated only with memory retrieval.

- (1) a. Who had a fever, Jane or Adam?  
b. [JANE]<sub>F</sub> had a fever.
- (2) a. Why did you miss the party?  
b. My *mother* got sick.

A more sophisticated account is to define focus as evoking a set of alternatives that are relevant for the interpretation of the focused constituent (Rooth, 1985, 1992; Krifka, 2008). In (3), for example, the *wh*-element in (3a) is said to instantiate an unlimited set of alternatives to the focused constituent (Hamblin, 1973), from which a true answer is selected - the focus element here, *Lina*. Krifka (2008) treats a question like (3a) as having a ‘common-ground management function’ in determining what the truth-conditional information ought to be added to the common-ground content of the discourse (i.e., the truth-conditional information shared among speakers in the discourse).

- (3) a. Who did Peter meet yesterday?  
b. Peter met [Lina]<sub>F</sub> yesterday.

But the alternative-based definition also cannot always predict focus correctly, because it is not the case that focus must occur whenever there is an alternative, or it is obligatorily signalled in all languages, or it has to apply only to individual words (Xu et al., 2012; Zerbian et al., 2010). In fact, we are not aware of any theoretical definition that is precise enough to predict all and only actual occurrences of focus. Instead, there are only empirical paradigms that are known to reliably elicit focus, e.g., mini-dialogues that involve *wh*-questions or correction-triggering statements (Cooper et al., 1985; Pell, 2001; Féry and Kügler, 2008; Liu and Xu, 2005; Wang and Xu, 2011; Xu, 1999; Xu and Xu, 2005). Thus a theoretical working definition of focus can be derived as one that can reliably predict a given type of focus. For an empirical study like the present one, a working definition would actually be preferable, since it would leave little ambiguity in terms of the actual occurrence of focus.

In term of focus type, the one directly elicited by a *wh*-question is often referred to as information (or presentational) focus, as in (3), where the focused element *Lina* is a piece of new information requested by the hearer (Kiss, 1998; Selkirk, 2002; Krifka, 2008; Ladd, 2008). And the one in (4) is said to be a contrastive (or corrective) focus, where the second speaker rejects a fact presented by the first speaker (Halliday, 1967; Chafe, 1976; Rooth, 1992; Kiss, 1998).

- (4) a. Who did Peter meet yesterday? Rana?  
b. Peter met [Lina]<sub>CF</sub> yesterday.

In Vallduví’s (1993) ‘informational’ approach, the contrastive focus *Lina* in (4) does not only add but also replace a piece of knowledge in the hearer’s knowledge store. In a different line of research, Zimmermann (2007, 2008) proposes that cases like (4) should be defined in terms of speaker’s assumptions about the hearer’s expectations on what is part of the Common Ground and what is not. But empirical research has so far shown mixed results in terms of acoustic differences between contrastive and information focus (House and Sityaev, 2003; Hanssen et al., 2008; He et al., 2011; Katz and Selkirk, 2011; Hwang, 2012; Kügler and Genzel, 2014). There is therefore a need for further investigations on the prosodic differences between the two types of focus.

A further division of focus type has often been made on the basis of the size of the focus constituent: broad versus narrow (Gussenhoven, 2007a; Krifka, 2008). In a broad focus (5), all the information is new, and so the focus domain is the entire utterance (Ladd, 2008). In a narrow focus (3), a single constituent in the utterance is highlighted. However, the idea that an entire sentence is focused is at odds with the idea of focus as selective highlighting, whether for the sake of pointing out the existence of alternatives (Krifka, 2008; Rooth, 1992) or directing listener’s attention (Chen et al., 2014). In the present study, therefore, cases like (5) will be treated as neutral focus (Bruce, 1982; Eady and Cooper, 1986; Gussenhoven, 2007b; Xu, 1999; Xu and Xu, 2005) that contrasts with both information and contrastive focus.

- (5) a. What happened?  
b. [Peter met Lina yesterday]<sub>BF</sub>

In the following section, we will present a brief overview of Hijazi Arabic (HA), including how both information focus and contrastive focus are reflected in HA word order, and how stress is assigned in this Arabic vernacular.

## 1.2. Hijazi Arabic

HA is one of the major dialects spoken in Saudi Arabia (Omar, 1975). *Hijazi* is a geographical term that denotes the area occupying the West and North-West of the Kingdom of Saudi Arabia, as shown in Figure 1.



Figure 1: Saudi Arabia. (The Hijazi region is highlighted in dark grey.)

In Hijazi region, there are two main dialects: Bedouin Hijazi Arabic, and Urban Hijazi Arabic (Sieny, 1978; Al-Mozainy, 1981; Jarrah, 1993; Al-Mohanna, 1998). Bedouin HA is spoken by those who live in the countryside. Urban HA is spoken in the cities of Makkah, Madinah, Jeddah and Taif. Since there is no ‘lingua franca’ of HA, this paper studies the urban HA variant that is spoken in Taif city.

To our knowledge, no study has examined the intonation system of either Bedouin HA or urban HA. The current study is therefore the first formal investigation of HA intonation, starting with focus prosody. Syntactically, information focus must be realized in-situ in HA, as in (6b). It cannot be expressed by left dislocation as in (6c), right dislocation as in (6d), focus preposing as in (6e), or a pseudo clefting as in (6f) (We use # symbol to indicate pragmatic oddness of sentences throughout the paper).

- (6) a. A: man Rāmi mar ams?  
who Rami visited yesterday  
‘Who did Rami visit yesterday?’  
b. B1: Rāmi mar [Līna]<sub>F</sub> ams.  
Rami visited Lina yesterday  
‘Rami visited Lina yesterday.’  
c. B2: # [Līna]<sub>NF</sub> Rāmi mar-aha ams. Left Dislocation  
Lina Rami visited.3SGM-her.3SGF yesterday  
‘Lina, Rami visited her yesterday.’  
d. B3: # Rāmi mar-aha ams [Līna]<sub>NF</sub>. Right Dislocation  
Rami visited.3SGM-her.3SGF yesterday Lina  
‘Rami visited her yesterday, Lina.’



Generally speaking, Arabic is a quantity-sensitive language. Syllables can be distinguished from each other in terms of their weight. In both Bedouin Hijazi Arabic (Al-Mozainy, 1981; Al-Mozainy et al., 1985) and urban Hijazi Arabic, there are two major factors determining the stress location in a word: syllable location, and syllable weight (i.e., light (CV), heavy (CVV, CVC) and superheavy (CVVC, CVCC)). Both variants of Hijazi Arabic share Rule 8(a), 8(b) and 8(c).

However, Rule 8(d) applies to urban Hijazi Arabic but not Bedouin Hijazi Arab. Bedouin Hijazi Arabic allows complex onsets in the syllable (Al-Mozainy, 1981), whereas urban Hijazi Arabic prohibits these onsets (Al-Mohanna, 1998). Another difference is that Urban Hijazi Arabic allows vowel epenthesis to be inserted into the final CC cluster. For example, /akl/ ‘food’ (CVCC) in bedouin Hijazi Arabic becomes /akil/ (CV.CVC) in urban Hijazi Arabic. There are also other differences between urban Hijazi Arabic and other Arabic dialects which cannot be discussed here for space limit. Curious readers are referred to Al-Mozainy (1981), Al-Mohanna (1998), AlQahtani (2014) and the references therein.

### 1.3. Cross-linguistic variation of focus

There have long been reports of diversity of focus realization across languages (Hartmann and Zimmermann, 2007b,a; Ladd, 1996; Féry, 2013). More recent findings show increasing evidence of a two-way distribution of focus prosody (Xu, 2011a). In one group of languages, focus seems to involve a tri-zone pitch range pattern (Bruce, 1982; Cooper et al., 1985; Eady et al., 1986). Compared to a neutral-focus sentence, the on-focus component show statistically significant increase of pitch range, the post-focus components show significantly lowered and compressed pitch range, and the pitch of pre-focus components remains largely unchanged. Additionally, on-focus components also exhibit increased amplitude and duration, while post-focus components often show decreased amplitude (but not duration) (Chen et al., 2009). Of these patterns, post-focus compression (PFC) of pitch range and amplitude (but not on-focus pitch range expansion) is found to be the most consistent (Cooper et al., 1985; Ipek, 2011). These languages include English (Cooper et al., 1985; Xu and Xu, 2005), Swedish (Bruce, 1982), German (Röhr and Baumann, 2010), Beijing Mandarin (Xu, 1999), Korean (Lee and Xu, 2010), Japanese (Ishihara, 2002; Lee and Xu, 2012), Turkish (Ipek, 2011), Tibetan (Wang et al., 2012), Hindi (Patil et al., 2008) and Uyghur (Wang et al., 2013). For these languages, there is also evidence that PFC is a highly useful cue for the perception of focus (Rump and Collier, 1996; Botinis et al., 1999; Mixdorff, 2004; Ipek, 2011; Xu et al., 2012). Among these “PFC languages”, however, there is evidence that PFC interacts with various language specific factors, which may reduce its effectiveness in various cases. For SOV languages like Turkish (Ipek, 2011), for example, PFC is weakly effective for both sentence-final and sentence-penultimate words; in Japanese, PFC is lacking in unaccented words (Ishihara, 2011; Lee and Xu, 2018); and in Mandarin, PFC become less effective for words with the Low tone (Lee et al., 2016).

In another group of languages, PFC is absent, which include Wolof (Rialland and Robert, 2001), Taiwanese/Southern Min (Pan, 2007; Chen et al., 2009), Chichewa, Hausa and Northern Sotho (Zerbian et al., 2010), Cantonese (Wu and Xu, 2010), Akan (Kügler and Genzel, 2012) as well as other languages (see Xu 2011a, and references therein). Despite the lack of PFC, however, for some of these languages, on-focus increase of  $F_0$ , intensity or duration has been found (Chen et al. 2009; Pan 2007 for Taiwanese, Wu and Xu 2010 for Cantonese), while for others, virtually no prosodic marking of focus can be identified (Zerbian et al. 2010 and Hartmann and Zimmermann 2007a for Wolof, Buli, Hausa, and Northern Sotho).

### 1.4. Prosodic Focus in Arabic Vernaculars

Relatively little work has investigated focus realization in Arabic dialects. Notable exceptions are Norlin (1989), Chahal (2001), Hellmuth (2006, 2011), Yeou et al. (2007) and Cangemi et al. (2016). Although these studies are small-scale and limited in terms of test materials used, speakers involved in the experiments and the number of focus types investigated, they provide interesting findings which provide initial evidence that focus is prosodically realized in Arabic.

For Lebanese Arabic spoken in Tripoli, Chahal (2001) examines the prosodic encoding of information focus compared with its counterpart in neutral-focus utterances looking at three different sentential positions: initial, medial and final.<sup>1</sup>

<sup>1</sup>Chahal (2001) (reproduced in Chahal (2003)) uses the term ‘narrow focus’ in her experimental study; however, she unfortu-

Employing the question-answer paradigm to elicit information focus and neutral focus, she finds that a word in information focus is produced with raised pitch, higher  $F_0$  and higher intensity than its neutral focus counterpart. She also finds that the pre-focus region and post-focus word(s), if any, show pitch range compression.

For Cairene Arabic, Norlin (1989) investigated how ‘focus’ occurring in sentence-initial, sentence-medial, and sentence-final positions is encoded. Compared with their counterpart in the neutral-focus utterances, the pitch range of the focused item is expanded, its  $F_0$  is higher, the pitch range of the postfocus item(s) is compressed, and the pitch range and  $F_0$  of the prefocus item(s) remain neutral. These findings, while preliminary, suggest that focus is expressed prosodically in this vernacular. One major drawback of Norlin (1989) is that he does not define what is meant by ‘focus’, nor does he provide the test materials from which readers can see the exact type of focus studied.

Focus in Cairene Arabic is investigated further by Hellmuth (2006). She investigates whether the notions of ‘givenness’ and ‘contrast’ are prosodically encoded in Cairene Arabic. She uses two lexically distinct SVO target sentences embedded in short paragraphs. In each focus condition, two key words in the target sentences carry a discourse function (information/contrastive focus on the subject, and new/given information on the object). She finds that female participants expanded the pitch range of the contrastive focus and suppressed the postfocus item. However, taking male and female subjects together, there is no statistically significant difference between the contrastive-focused item and its information-focused counterpart in sentence-initial position. Furthermore, she finds that objects which are assigned new/given-information status do not show any acoustic differences.

Hellmuth (2011) conducts another experiment to investigate whether contrastive focus placed sentence-medially in Cairene Arabic is prosodically different from its information-focused counterpart. She finds that the pitch range of the contrastive focus is more expanded than its information-focused counterpart. In addition, the pitch range of post-focus items occurring after contrastive focus is more compressed than their counterparts occurring after information focus. Another experiment on EA prosodic focus<sup>2</sup> is conducted by Cangemi et al. (2016). They investigate whether and how narrow information focus in sentence-initial position is prosodically encoded, compared with its neutral focus counterpart. Their test materials contained 6 three-word sentences (transitive structure), embedded in question-answer contexts. Through the analysis of inter-speaker variations, they find that speakers varied in use of either alignment of  $F_0$  turning points, scaling of  $F_0$  turning points or both to encode focus. Briefly, they find that in speakers’ utterances, the alignments of high and of low turning points were earlier in information focus than in its neutral focus counterpart. In others’ utterances, they find that the high turning points were scaled higher in information focus than in its neutral focus counterpart. They conclude that focus is prosodically encoded in this dialect even though the prosodic cues to focus used by EA speakers are different.

Yeou et al. (2007) conducted an experiment to investigate the prosodic effects of contrastive focus placed in the sentence-penultimate position in Moroccan, Yemeni and Kuwaiti Arabic. The test material they use is of the form / abt m(a)<sup>c</sup>aha X lbarh/mbarih/ ‘She came with her X yesterday’ in which X is replaced with a proper name including /hali:m/, /sali:m/, /ami:n/, /mimu:n/, /gali:l/, /hali:ma/, /sal:ma/, /ami:na/, /mimu:na/, and /gali:la/. They use the question-answer context of the form ‘Did she come with Mohamed yesterday?’ to trigger contrastive focus on the sentence-penultimate item. They find that the pitch range of the contrastive focus is significantly more expanded than its counterpart in neutral-focus utterances in Moroccan and Kuwaiti Arabic. However, the difference between contrastive focus and its counterpart in neutral-focus utterances is not statistically significant in Yemeni. In all three Arabic dialects, Yeou et al.

nately does not define what is meant by this term. Based on the test materials she provided, the term ‘narrow focus’ probably refers to ‘information focus’ in the current study. Her test sentence is of /X hamet Y min Z/ ‘X protect Y from Z’. X, Y and Z are filled with proper names /lama/, /muna/, and /lima/. This test sentence is embedded in four question-answer contexts to elicit sentence-focus utterance (i.e., neutral focus), focus on subject, focus on direct object, and focus on indirect object, as displayed in the table below (Chahal, 2001, p. 144). Each answer in each focus condition was read three times in five recording sessions by three Lebanese subjects: two females and one male.

| Focus Condition   | Prompt Question      | Translation                        |
|-------------------|----------------------|------------------------------------|
| Broad Focus       | shuu Saarel yoom ?   | ‘What happened today?’             |
| Narrow focus on X | miin Hama Y min Z ?  | ‘ <b>Who</b> protected Y from Z?’  |
| Narrow focus on Y | X Hamet miin min Z ? | ‘X protected <b>whom</b> from Z?’  |
| Narrow focus on Z | X Hamet Y min miin ? | ‘X protected Y from <b>whom</b> ?’ |

<sup>2</sup>They recruited 18 native speakers of EA (11 females) who are from Cairo and Alexandria.

(2007) find that contrastive focus is significantly longer than its neutral-focus counterpart. Yeou et al. (2007) do not report any quantitative analyses concerning the post-focus region. However, visual inspections indicate that in Moroccan Arabic the pre-focus words occurring before the contrastive-focused word are deaccented, unlike what is visually observed in Yemeni, and Kuwaiti Arabic data investigated. In all the Arabic dialects investigated, the  $F_0$  trace of the post-focus region occurring after the contrastive-focus word is compressed.

To sum up, while previous studies show differences in their findings, they provide clear evidence that focus and its types have effects on the global intonational patterns of the Arabic sentence in general, as reviewed above. There are many possibilities for the differences in encoding focus prosodically across Arabic dialects. One possibility is that prosodic marking of focus does differ cross-dialectally, just like the cross-dialect differences between Taiwanese, Taiwan Mandarin and Beijing Mandarin (Xu et al., 2012). Another possibility is that the different findings are due to (i) experimental methodology (reading short paragraphs vs. question-answer paradigm), and (ii) phonetic parameters measured.

### 1.5. Research Questions

As explained in the preceding section, in HA the distinction between narrow information focus and narrow contrastive focus is not obligatorily reflected in syntax. As a result, the question of whether this distinction is reflected in prosody, to our knowledge, is still unanswered. Therefore, the overall goal of the current study is to investigate what acoustic features correlate most reliably with focus in HA.

We will examine the prosody of short (four-word) declarative sentences in HA said with narrow information focus and narrow contrastive focus at different positions (sentence-initial and sentence-penultimate) in comparison to neutral focus. Specifically, we want to find answers to the following research questions:

- (9) Does focus involve tri-zone prosodic adjustments? More specifically,
  - a. Is there on-focus expansion of  $F_0$  contours, intensity and duration?
  - b. Is there post-focus compression of  $F_0$  contours, intensity and duration?
  - c. Is there pre-focus compression of  $F_0$  contours, intensity and duration?
- (10) Are there prosodic differences between information and contrastive focus?

Given previous findings about other Arabic dialects as reviewed above, our prediction is that there will be both on-focus expansion and post-focus compression in HA. But given the inconsistent findings about the difference between information and contrastive focus (Hanssen et al., 2008; Sityaev and House, 2003; Hwang, 2012; Katz and Selkirk, 2011; Kügler and Genzel, 2014), we expect a low likelihood of clear difference between the prosodic markings of the two types of focus.

## 2. Method

Our method is to use the question-answer paradigm to elicit focus from native speakers of HA, and then perform detailed acoustic analysis of their utterances. We will restrict our stimuli to four-word declarative sentences spoken with information focus, contrastive focus and neutral focus on different words in two syntactic positions (i.e., sentence-initial and sentence-penultimate). We also limited the acoustic features to be investigated to maximum  $F_0$ , mean  $F_0$ , excursion size, intensity and duration, given the limitations of space.

### 2.1. Reading Materials

The reading materials consisted of three target sentences, as shown in (12)-(14). Each target sentence was preceded by a prompt question designed to trigger a specific type of focus on the target word. In order to create background contexts in the subject's mind so that the answer produced is as natural as possible, we prepared short anecdotes made up of four to nine short sentences. The HA lexical items and spelling conventions (i.e., HA has lost case ending which exist in MSA such as nominative and accusative case marking) were used as much as possible in the written prompts in order to both elicit the colloquial productions and keep the standardised register of Arabic (i.e., Modern Standard Arabic (MSA)) to a minimum (following

Hellmuth, 2006). Some examples of HA lexical items, and of spelling which are not correct in MSA but correct in HA are listed in Table (1) and (2) below.<sup>3</sup>

Table 1: Example of HA lexical items used in the datasets to elicit colloquial register (with their MSA equivalents).

| HA       | MSA                   | Gloss                 |
|----------|-----------------------|-----------------------|
| rāḥ      | dahab-a               | ‘go.PFV.3SM’          |
| baṭṭal   | tarak-a               | left.PFV.3SM          |
| sawwa    | ṣana <sup>c</sup> -a  | ‘make.PFV.3SM’        |
| waiš     | ma huwa               | what                  |
| ‘ašān    | min aḡl-i             | ‘because’             |
| yaštaḡil | ya <sup>c</sup> mal-u | ‘work.PFV.3SG’ (verb) |
| šugul    | <sup>c</sup> mal      | work (noun)           |
| šar ‘ala | ḥaṣal-li              | ‘happened-to’         |
| maryūl   | ṭawb                  | school-dress          |

Table 2: Example of HA lexical items lacking case markings which are present in MSA but not in HA (with their MSA equivalents).

| MSA Transliteration     | HA Transliteration    | MSA Gloss  | HA Gloss   |
|-------------------------|-----------------------|--|--|
| /marra/                 | /mar/                 | ‘visit-PFV.3SM’  | visit.PFV.3SM  |
| /hāḡara/                | /hāḡar/               | ‘emigrate/move-PFV’<br>reflexive pronoun<br>(for DU subject) | ‘emgrate/move.PFV’<br>reflexive pronoun<br>(for PL subjects) |
| /lah-uma/               | /lah-um/              | ‘school-dress-ACC’ (accusative)                              | ‘school-dress’   |
| /maryūl-an/             | /maryūl/              | ‘live-PFV.3DU’   | ‘live-3PL’   |
| /ya <sup>c</sup> iš-an/ | <sup>c</sup> ayiš-in/ | ‘apron.-ACC’   | ‘apron’  |
| /miryalat-an/           | /miryalah/            | ‘to-Lodon-GEN’   | ‘to-London’  |
| /li-landan-a/           | /li-landan/           | ‘yesterday’  | ‘yesterday’  |
| /amsin/                 | /ams/                 |  |  |

One anecdote at a time was projected onto the wall for the subject to read silently. Once the subjects finished reading the short anecdote, they were asked to read the target sentence as an answer to a prompt question asked by the researcher (a native speaker of HA). Subject and researcher sat side-by-side and worked in a pair. The prompt question and its answer were projected onto the wall and seen by both the subject and the researcher. A sample anecdote is shown in (11) (See Appendix A for all the scenarios used).

- (11) a. A sample of the type of ‘anecdotes’ in Arabic.

رامي و لينا أخوان. رامي عايش في الطائف و لينا عايشه في جده. لهم فترة طويلة ما زارو بعض. أمس رامي راح جده و مر لينا هناك.

- b. Glossing<sup>4</sup>

rāmi w lina ahān. rāmi ‘āyīš fi aṭ-ṭayif w lina ‘āyīš-ah fi ḡiddah.  
Rami and Lina brother Rami live.PFV.3SM in the-Taif and Lina live.PFV-3SF fi Jeddah  
lah-um fatrah ṭawīlah ma-zār-u ba‘aḍ. ams rāmi rāḥ ḡiddah  
them,REFP.PL period long NEG-visit.PFV-3PL them yesterday Rami go.PFV.3SM Jeddah  
w mar lina hināk.  
and visit.PFV.3SM Lina there

‘Rami and Lina are brothers. Rami has lived in Taif and Lina has lived in Jeddah. They had not visited each other for a long time. Yesterday, Rami went to Jeddah and visited Lina there.’

<sup>3</sup>PFV= perfective mood, 3SM= third singular masculine, 3PL= third plural, ACC= accusative case, and GEN= genitive case, and 3DU= third dual. Arabic dialects including HA lost case marking including dual form, accusative, genitive case and others. Curious readers are referred to Alotaibi (2014, ch. 2) to read more on general characteristics of MSA and Hijazi Arabic (i.e., spoken in Taif).

<sup>4</sup>REFP= Reflexive pronoun, NEG= Negative form (i.e., attached to a verb in either perfective form or imperfective form).

As seen in many previous studies, the question–answer paradigm allows reliable elicitation of focus at specific positions in each target sentence as well as neutral focus (Gussenhoven, 1983; Cooper et al., 1985; Birch and Clifton, 1995; Schwarzschild, 1999; Xu, 1999; Chahal, 2001; Xu and Xu, 2005; Baumann et al., 2006; Zerbian, 2006; Hanssen et al., 2008; Beyssade et al., 2009; Chen et al., 2009; Lee and Xu, 2010; Wu and Xu, 2010; Wang et al., 2011; Choudhury and Kaiser, 2012; Phillips-Bourass, 2012; Xu et al., 2012, among others). The use of anecdotes differs from previous studies, however. It was time consuming, but it enriched the background information, which helped to make the dialogue feel natural to the subject. In particular, it made the need for correction feel real in the case of contrastive focus.

The target sentences were made up mostly of sonorant sounds, as shown in (12)–(14). This was to guarantee continuous  $F_0$  contours (Himmelman and Ladd, 2008). The target sentences differ in one dimension. For each, the corresponding short anecdote and the prompt question would elicit three different focus structures: neutral focus (BF), information focus (NF), and contrastive-focus (CF). The key words that carry the focus functions are underlined in (12), (13) and (14). The stressed syllables are in boldface. Syllable boundaries are marked with a dot. The locations of the primary stress in the words are based on the rules in (8) in §1.2.

- (12) Rā.mi mar Lī.na ams.  
Rami visited Lina yesterday  
'Rami visited Lina yesterday.'

Table 3: Target sentences with their translations.

| Prompt Question                       | Target Answer                               |
|---------------------------------------|---|
| waš šār?                              | [Rāmi mar Līna ams.] <sub>BF</sub>          |
| 'What happened?'                      | 'Rami visited Lina yesterday.'              |
| man mar Līna ams?                     | [ <u>Rāmi</u> ] <sub>NF</sub> mar Līna ams. |
| 'Who visited Lina yesterday?'         | 'Rami visited Lina yesterday.'              |
| man mar Līna ams? Marwān?             | [ <u>Rāmi</u> ] <sub>CF</sub> mar Līna ams. |
| 'Who visited Lina yesterday? Marwan?' | 'Rami visited Lina yesterday.'              |
| man Rāmi mar ams?                     | Rāmi mar [ <u>Līna</u> ] <sub>NF</sub> ams. |
| 'Who did Rami visit yesterday?'       | 'Rami visited Lina yesterday.'              |
| man Rāmi mar ams? Rāna?               | Rāmi mar [ <u>Līna</u> ] <sub>CF</sub> ams. |
| 'Who did Rami visit yesterday? Rana?' | 'Rami visited Lina yesterday.'              |

- (13) Ra.na saw.wat mar.yūl li-Ma.nāl.  
Rana made school-dress for-Manāl  
'Rana made a school dress for Manal.'

Table 4: Target sentences with their translations.

| Prompt Question                             | Target Answer   |
|---|---|
| waš al-mawdū?                               | [Rana sawwat maryūl li-Manāl.] <sub>BF</sub>          |
| 'What is the topic?'                        | 'Rana made a school dress for Manal.'                 |
| man sawwat maryūl li-Manāl?                 | [ <u>Rana</u> ] <sub>NF</sub> sawwat maryūl li-Manāl. |
| 'Who made a school dress for Manal?'        | 'Rana made a school dress for Manal.'                 |
| man sawwat maryūl li-Manāl? Nawāl?          | [ <u>Rana</u> ] <sub>CF</sub> sawwat maryūl li-Manāl. |
| 'Who made a school dress for Manal? Nawal?' | 'Rana made a school dress for Manal.'                 |
| waš sawwat Rana li-Manāl?                   | Rana sawwat [ <u>maryūl</u> ] <sub>NF</sub> li-Manāl. |
| 'What did Rana make for Manal?'             | 'Rana made a school dress for Manal.'                 |
| waš sawwat Rana li-Manāl? miryalah?         | Rana sawwat [ <u>maryūl</u> ] <sub>CF</sub> li-Manāl. |
| 'What did Rana make for Manal? An apron?'   | 'Rana made a school dress for Manal.'                 |

- (14) **Rā.mi** hā.jar **li-landan**.dan al-bā.riḥ.  
 Rāmi moved to-London last-night  
 ‘Rami moved to London last night.’

Table 5: Target sentences with their translations.

| Prompt Question   | Target Answer   |
|---|---|
| waš šār?<br>‘What happened?’  | [Rāmi hājar li-landan al-bariḥ.] <sub>BF</sub><br>‘Rami moved to London last night.’          |
| man hājar li-landan al-bāriḥ?<br>‘Who moved to London last night?’                          | [ <b>Rāmi</b> ] <sub>NF</sub> hājar li-landan al-bariḥ.<br>‘Rami moved to London last night.’ |
| man hājar li-landan al-bāriḥ? Marwān?<br>‘Who moved to London last night? Marwan?’          | [ <b>Rāmi</b> ] <sub>CF</sub> hājar li-landan al-bariḥ.<br>‘Rami moved to London last night.’ |
| wein hājar Rāmi al-bāriḥ?<br>‘Where did Rami move to last night?’                           | Rāmi hājar [ <b>li-landan</b> ] <sub>NF</sub> al-bariḥ.<br>‘Rami moved to London last night.’ |
| wein hājar Rāmi al-bāriḥ? li-as-su‘ūdiah?<br>‘Where did Rami move to last night? To Saudi?’ | Rāmi hājar [ <b>li-landan</b> ] <sub>CF</sub> al-bariḥ.<br>‘Rami moved to London last night.’ |

Each subject (8 males + 8 females = 16) recorded each target sentence in each focus condition five times on three different occasions. The total number of tokens to be examined was 1200 (3 sentences x 5 foci (i.e., 3 focus conditions + 2 sentential positions) x 5 repetitions x 16 speakers = 1200 sentences).

## 2.2. Participants

Eight female and eight male native speakers of urban Hijazi Arabic (Taif dialect), aged 23-35, participated in the experiment. All participants attended all the recording sessions (i.e., three recording sessions on three different occasions). They did not self-report any speech or hearing disorders. All the participants are monolinguals, as they do not speak any language apart from urban HA.<sup>5</sup>

## 2.3. Recording Procedure

Since there is no recording laboratory in Taif, the recordings were made in a quiet room in the homes of the participants, which yielded a relaxing and familiar speaking environment for them. They were recorded individually. The recording was done using a fronted internal microphone on a Zoom H2 recorder with 44.1 kHz sampling frequency, a 16 bit resolutions, and at distance of 0.5 meter from the speaker’s mouth. The entire set of data were saved as WAV files and transferred immediately to a laptop Mac for analysis. Materials were presented in PowerPoint, with one short anecdote per slide. After reading the projected anecdote, a question on a factual point in the anecdote with its answer were presented on another slide. Participants were asked to read a target sentence as an answer to a prompt question asked by the researcher.

Moving between projected slides was done by the experimenter. During each trial, the experimenter asked the participant whether the projected material is legible while they were sitting in order to make sure that they were able to see the projected material clearly. The participants were asked to say the projected material in a natural way at a normal speech rate. An entire trial, including the experimenter’s question, was repeated if there was any hesitation in the participant’s answer. Each participant went through a number of practice trials until they were familiar with the procedure. The test materials were presented in random order, and a different order was used for each subject. This full randomization was especially critical for controlling intensity when head-worn microphones were not used, as it made sure that small variations in the distance between the speaker and the microphone were randomly distributed across the experimental conditions, thus preventing potential confounding. Only one question-answer pair was projected at a time. To prevent order effects, we added 35 mini-dialogues as fillers.

<sup>5</sup>They reported that they studied the grammar of Modern Standard Arabic (MSA) in their school years. However, they are reported that they forgot most of the grammar they learned in their school years and hence they do not use it either in writing or in speech.

## 2.4. Acoustic Measurement

ProsodyPro (Xu, 2013), a script running under PRAAT (Boersma and Weenink, 1992–2011), was used to take acoustic measurements for the prosodic analysis. This script has been used in many previous studies of focus (e.g., Liu, 2010; Wang and Xu, 2011; Ambrazaitis and Frid, 2012; Choudhury and Kaiser, 2012).

All measurements were taken from the stressed syllable of each target word. Acoustically, we took the syllable to start with the beginning of consonant closure (i.e. the syllable onset) and to end with the end of the release of the coda, or the offset of the vowel when there was no coda. In cases like “maryūl li-Manāl” in the target sentence (13), the geminate /l/ is treated as consisting of coda of the previous syllable plus the onset of the following syllable, with the syllable boundary in between, following Xu (1998). We excluded the aperiodic waveforms when measuring the  $F_0$  at the glottal stop in the word /ams/ in target sentence (12). We also made use of ProsodyPro’s ability to allow users to manually correct errors in vocal period markings. This allowed us to get continuous  $F_0$  contours from all the utterances.

Once the syllable boundaries were marked by PRAAT and hand checked for errors, ProsodyPro automatically generated the measurements, as defined in (15).<sup>6</sup>

- (15) a. **Max  $F_0$  (Hz)**: highest  $F_0$  in the stressed syllable of the key words.
- b. **Mean  $F_0$  (Hz)**: average of all  $F_0$  points in the stressed syllable of the key words.
- c. **Excursion Size (st.)**: the  $F_0$  distance in semitones between the lowest pitch and highest pitch in the stressed syllable of the key words.<sup>7</sup>
- d. **Intensity (dB)**: the mean of the intensity values in the stressed syllable of the key words.
- e. **Duration (ms)**: duration of the stressed syllable of the key words.

In addition, ProsodyPro generated time-normalized  $F_0$  contours (10 points per syllable) which were used in plotting the continuous  $F_0$  trajectories presented in this paper. The time-normalization allowed us to average across the 80 repetitions by the 16 speakers for each focus condition of each target sentence. This made it possible to make direct comparison of continuous  $F_0$  contours. It also helped to smooth out random perturbations unintended by the speaker, as well as individual differences, thus bringing out clearly the key differences of interest in the study, namely, those due to focus conditions. The  $F_0$  measurements in (15), however, were not taken from the time-normalized  $F_0$  contours, but directly from the non-time-normalized  $F_0$  tracks.

## 3. Analysis and Results

We will present the results of our analysis in two steps. First, we will present the qualitative results of the time-normalized mean  $F_0$  plots for all the sentences under the three focus conditions in two different sentential positions: sentence-initial, and sentence-penultimate position in §3.1. Second, in §3.2 we will present the acoustic analyses of the HA data.

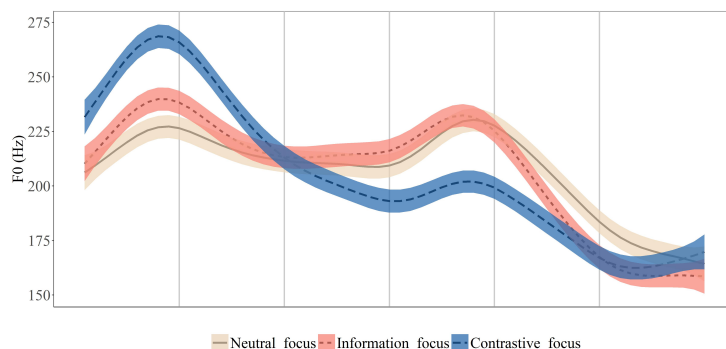
### 3.1. Focus Realization: Graphical Analysis

Figures in (2) display the time normalized  $F_0$  contours of all the sentences, separately for sentences (12), (13), and (14). Each curve in a plot is that of one of the focus conditions: neutral focus, sentence-Initial and sentence-penultimate information focus, and sentence-Initial and sentence-penultimate contrastive focus. Smoothing Spline Analysis of Variance (SSANOVA model) was applied to the time normalized  $F_0$  using the gss package (Gu, 2014) in R (R Core Team, 2018). For each sentence type, we included focus conditions, normalized time and their interaction as predictors of the dependent variable, i.e.,  $F_0 \sim \text{focus condition} * \text{normalized time}$ . In all SSANOVA figures,  $F_0$  means are displayed by lines and 95% confidence

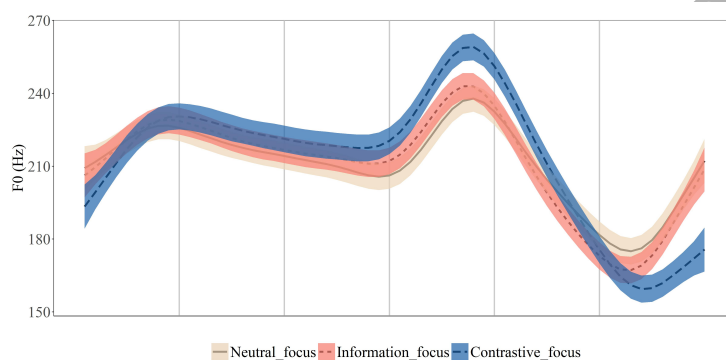
<sup>6</sup>We did not make statistical comparisons of minimum  $F_0$ ,  $F_0$  slope or peak alignment, because their differences across the focus conditions appear similar to but smaller than those of maximum  $F_0$  and mean  $F_0$ . As a result, they are unlikely to provide additional information.

<sup>7</sup>The excursion size is measured in st because it varies heavily with absolute  $F_0$ , due to the logarithmic nature of pitch, just as in music. For example, female speakers have much larger value of excursion-size than male speakers if measured in Hz. Other measurements are affected much less by the use of Hz. See detailed discussion in Xu (2011b).

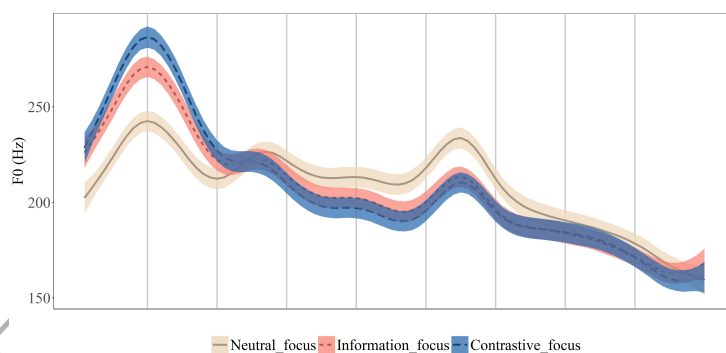
intervals are displayed by transparent ribbons. Where the ribbons do not overlap, the difference between their represented conditions are statistically significant.



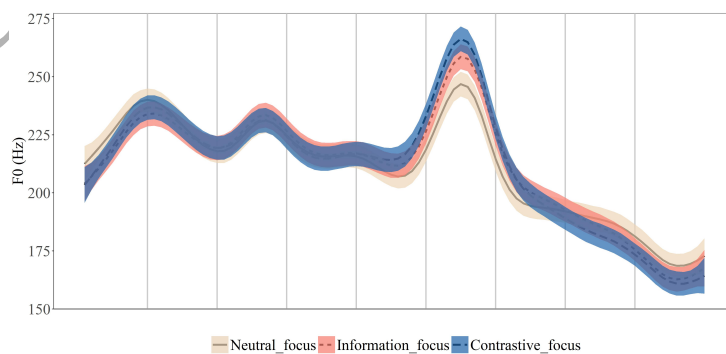
(a) /Rā.mi mar Lī.na ams/



(b) /Rā.mi mar Lī.na ams/



(c) /Ra.na saw.wat mar.yūl li-Ma.nāl/



(d) /Ra.na saw.wat mar.yūl li-Ma.nāl/

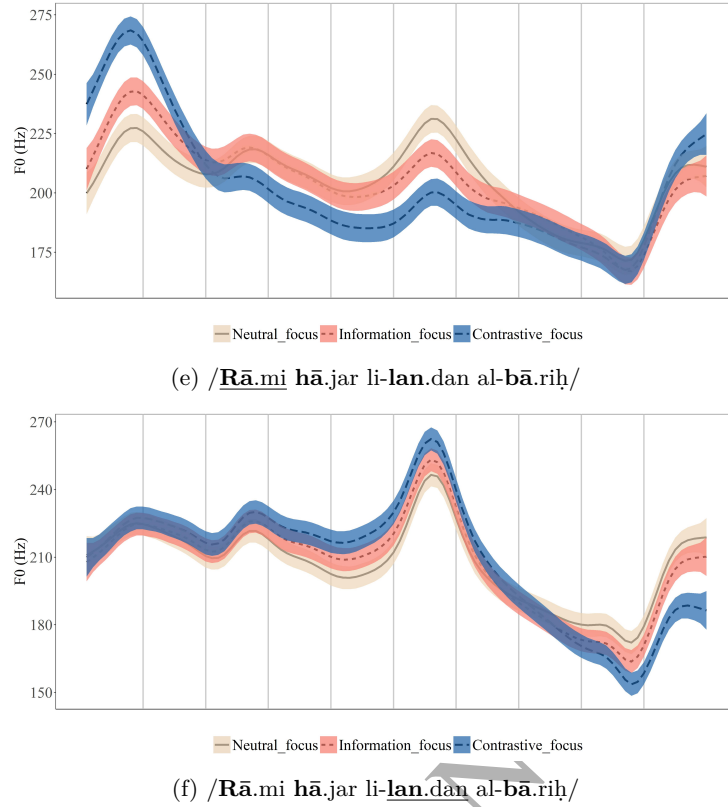


Figure 2: SS-ANOVA plots of time-normalized  $F_0$  contours: The lines display  $F_0$  means and the surrounding ribbons display 95% confidence intervals. The vertical lines mark the syllable boundaries. Stressed syllables are in bold. The word in focus is underlined.

From these figures, we can observe the following global intonational patterns under all focus conditions.

1. Every word in all the sentences uttered with narrow information focus, with narrow contrastive focus and without information/contrastive focus has a local  $F_0$  peak, with notable exceptions /mār/ ‘visited’ and /ams/ ‘yesterday’ in Figure 2a and 2b. Why this is the case is an issue that is largely irrelevant for the purpose of the present study, as the lowering occurred in all focus conditions as seen clearly in Figure 2a and 2b.
2. The  $F_0$  peak is placed within the lexically stressed syllable in every word in all the sentences uttered with narrow information, narrow contrastive focus or without information/contrastive focus. The  $F_0$  peak of /Rāmi/, /Līna/, /Rana/, /sawwat/, and /hājar/, whose stressed syllables occur first, occurs within the first syllable.
3. The  $F_0$  peaks of the information-focused word and of the contrastive-focused word occurring in the sentence-initial and the sentence-medial position are higher than those of the same words in the neutral focus structure. This is clearly seen in all the graphs.
4. The  $F_0$  peaks of the contrastive-focused word occurring in the sentence-initial and sentence-medial position are higher than the  $F_0$  peaks of its information-focused counterpart.
5. The  $F_0$  peaks of the post-focus words occurring after the focused word (i.e., information focus and contrastive focus) are lower and more compressed than those of the same words in the neutral sentence. As shown clearly in the graphs above, when the word in focus is sentence-initial, the  $F_0$  peaks of the post-focus region is visually lower than that of their neutral counterpart.
6. The  $F_0$  peaks of the post-focus words occurring after the contrastive-focused word are lower than those of the same words occurring after the information-focused word. This is more visible when the focus word is sentence-initial.

7. The domains of the pitch accent (defined here as local  $F_0$  maxima associated with a stressed syllable) on the stressed syllables are very local with narrow information focus, with narrow contrastive focus or without information/contrastive focus. That is, the  $F_0$  starts rising from the onset of the stressed syllable to reach the highest point, and then starts lowering until the end of the stressed syllable, without spanning across the entire word.
8. The entire  $F_0$  of the sentences uttered with narrow information focus, with contrastive focus and without information/contrastive focus ends low (see Liberman and Pierrehumbert, 1984, for English).

To verify the visual observations, a series of Linear Mixed-Effects models were performed on the Max  $F_0$  (15a), Mean  $F_0$  (15b), excursion size (15c), intensity (15d), and duration (15e) using the lme4 package (Bates et al., 2015) in R (R Core Team, 2018). We started with the simplest model, which included only the random intercepts for speaker and sentence type. Firstly, by-speaker, by-sentence type and speaker-by-sentence type random slopes for main effects were introduced maximally, if it achieved convergence and judged to be superior to less fully specified model. Focus condition (neutral-focus, information-focus, in-situ contrastive focus) and sex of the speaker (female, male) were included as potential fixed effect. P values were obtained by likelihood ratio tests. For a significant main effect, the post-hoc comparisons were conducted by the lsmeans package (Lenth, 2016) in R (R Core Team, 2018). All statistical effects will be reported at a significance level of 0.05. The main effect of gender was significant on the maximum  $F_0$  and mean  $F_0$  in all target syllables with female voice having fundamental frequency than male voice. The duration of target syllables uttered by female is sometimes longer than that of male (refer to Appendix B). As the effect of sex on the realization of prosodic focus is not our main interest, the following analysis only included focus condition as fixed effect.

### 3.2. Quantitative results

#### 3.2.1. Sentence-Initial Focus

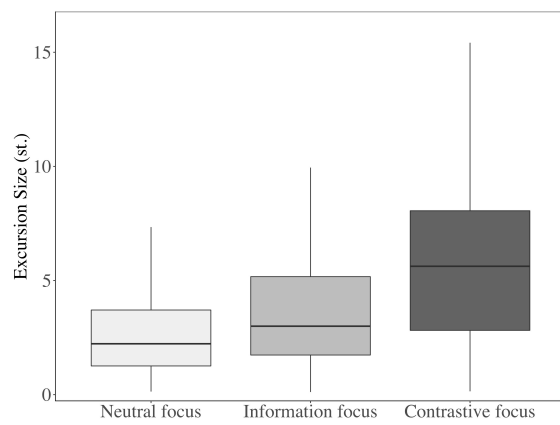
##### A. The on-focus region

Table 6 displays excursion size, Max  $F_0$ , Mean  $F_0$ , intensity, and duration of stressed syllables broken down according to focus (neutral focus, information focus, and contrastive focus). Also displayed in the table are the results of Linear Mixed Models.

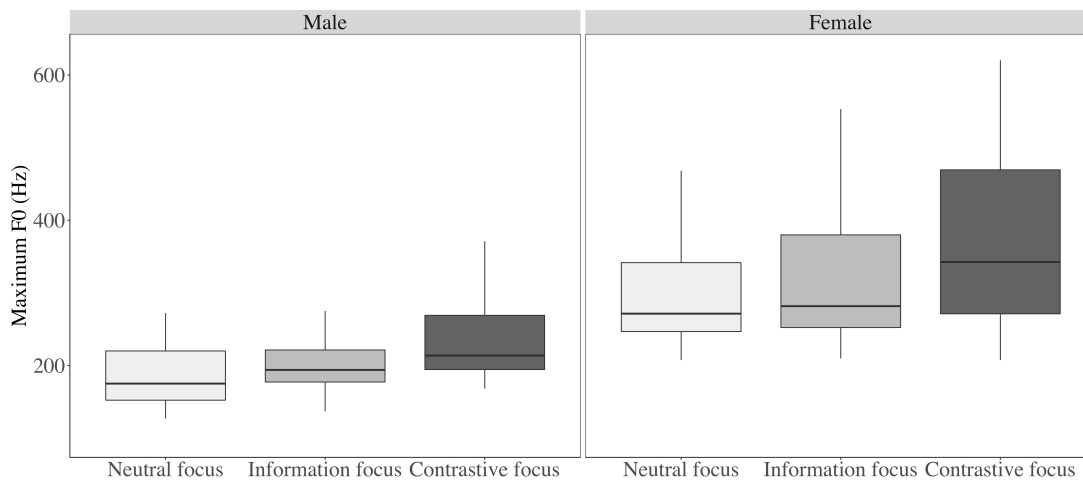
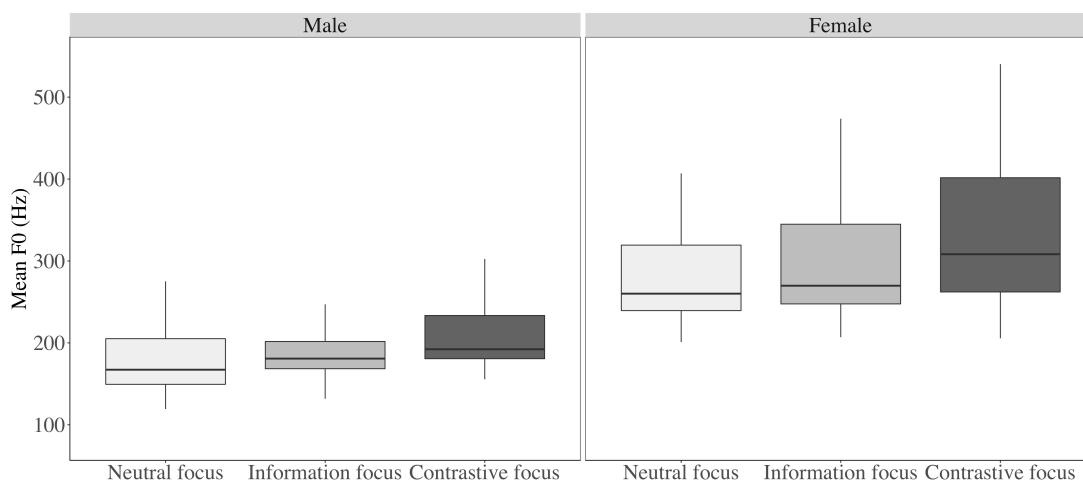
Table 6: Mean values of various measurements under the effect of focus, together with results of Linear Mixed Models. P values smaller than 0.05 are printed in boldface.

|                      | Focus Condition  |                            |                            |
|----------------------|--|----------------------------|----------------------------|
|                      | Neutral-focus  | Information-focus          | Contrastive-focus          |
| Excursion size (st.) | $M=3.009$ , $SD=1.305$<br>$\chi^2 = 13.983$ , $df = 2$ , $p < .001$    | $M=3.936$ , $SD=1.844$     | $M=5.760$ , $SD=2.845$     |
| Max $F_0$ (Hz)       | $M=244.160$ , $SD=65.138$<br>$\chi^2 = 12.036$ , $df = 2$ , $p = .002$ | $M=262.444$ , $SD=86.993$  | $M=302.819$ , $SD=112.036$ |
| Mean $F_0$ (Hz)      | $M=226.512$ , $SD=63.249$<br>$\chi^2 = 12.485$ , $df = 2$ , $p = .002$ | $M=243.328$ , $SD=75.599$  | $M=268.566$ , $SD=89.459$  |
| Intensity (dB)       | $M=66.258$ , $SD=4.236$<br>$\chi^2 = 12.566$ , $df = 2$ , $p = .002$   | $M=66.862$ , $SD=4.179$    | $M=68.478$ , $SD=4.365$    |
| Duration (ms)        | $M=164.018$ , $SD=31.157$<br>$\chi^2 = 14.658$ , $df = 2$ , $p < .001$ | $M=174.766$ , $SD= 25.909$ | $M=192.007$ , $SD=25.364$  |

As can be seen in Table 6, the main effect of focus is highly significant for all the outcome variables. As shown in the boxplots in 3, the mean values of all the acoustic measurements are higher in contrastive focus than in information focus and their neutral focus counterparts.



(a) Excursion Size

(b) Max  $F_0$ (c) Mean  $F_0$

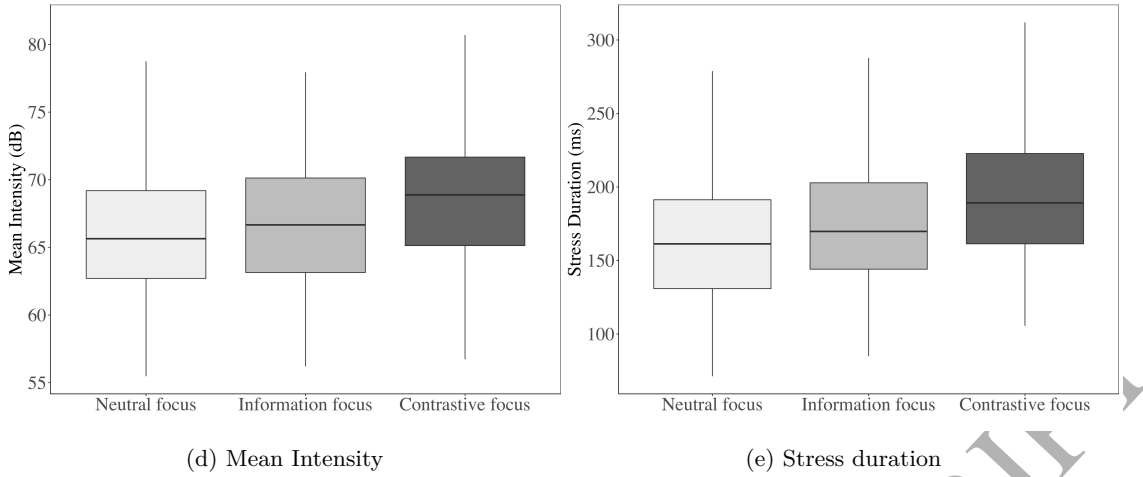


Figure 3: Boxplot of values of stressed syllables of the on-focus region, broken down by focus.

The post-hoc comparisons of the three focus conditions are displayed in Table 7. As can be seen, the excursion size and mean  $F_0$  of the contrastive focus are higher than its neutral focus and information focus counterparts. Further, the excursion size and mean  $F_0$  in information focus is greater than that of its neutral focus counterpart. In addition, the Max  $F_0$  intensity and duration of stressed syllables under contrastive focus is longer than its counterparts under neutral focus as well as information focus. However, information focus is not significantly different from neutral focus in these three dimensions.

Table 7: Post-hoc comparisons of effect of initial focus on the stressed syllables of on-focus words, after Tukey's adjustment. P values smaller than 0.05 are in boldface.

|                      | Focus Condition            |                            |                               |
|----------------------|----------------------------|----------------------------|-------------------------------|
|                      | Neutral vs. Information    | Neutral vs. Contrastive    | Information vs. Contrastive   |
| Excursion Size (st.) | <b><math>p=.034</math></b> | <b><math>p=.001</math></b> | <b><math>p=.008</math></b>    |
| Max $F_0$ (Hz)       | $p=.060$                   | <b><math>p=.004</math></b> | <b><math>p=.003</math></b>    |
| Mean $F_0$ (Hz)      | <b><math>p=.010</math></b> | <b><math>p=.002</math></b> | <b><math>p=.004</math></b>    |
| Intensity (dB)       | $p=.079$                   | <b><math>p=.002</math></b> | <b><math>p=.003</math></b>    |
| Duration $F_0$ (ms)  | $p=.085$                   | <b><math>p=.003</math></b> | <b><math>p&lt;.001</math></b> |

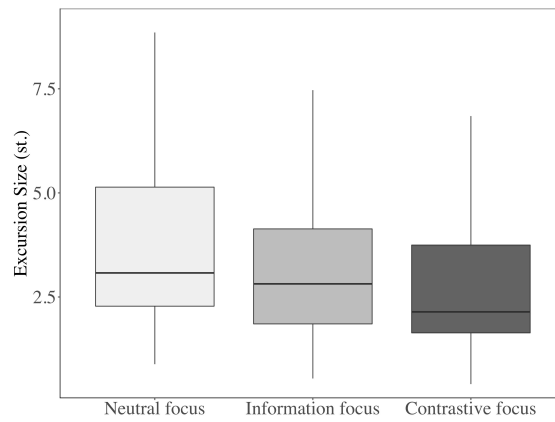
In short, excursion size, maximum  $F_0$ , mean  $F_0$ , intensity and duration of the stressed syllable of the on-focus region increases significantly across the three focus conditions: neutral < informational < contrastive.

### B. The post-focus region

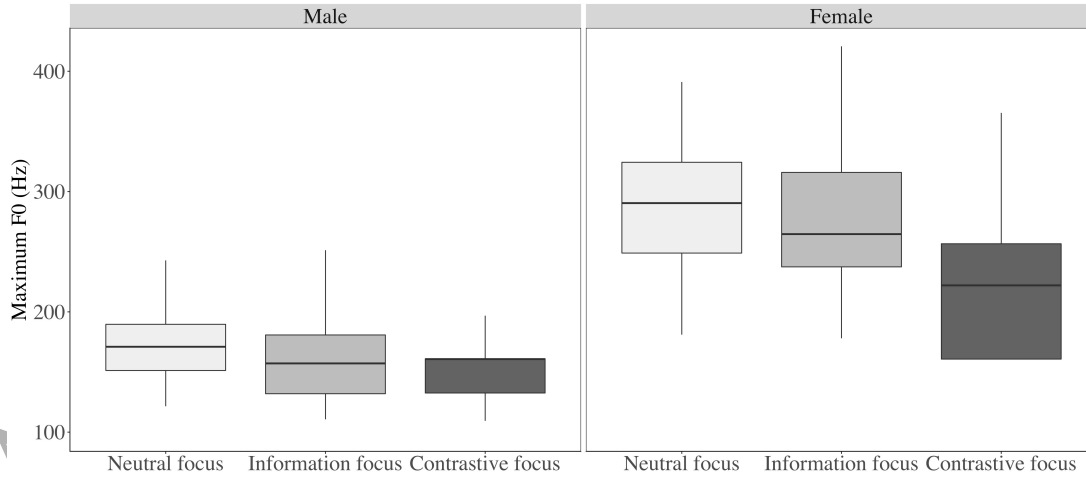
Table 8 shows a data summary and statistical results of the excursion size, Max  $F_0$  and Mean  $F_0$  intensity and duration of the stressed syllables in the post-focus region. As can be seen in Table 8, the effect of focus is significant on the Excursion size, Mean  $F_0$  intensity and duration but not on Max  $F_0$ . In the boxplot graphs in Figure 4, the differences in the mean scores are shown clearly.

Table 8: Mean values of various measurements under the effect of focus, together with results of Linear Mixed Models. P values smaller than 0.05 are printed in boldface.

|                      | Focus Condition   |                           |                           |
|----------------------|---|---------------------------|---------------------------|
|                      | Neutral-focus   | Information-focus         | Contrastive-focus         |
| Excursion size (st.) | $M=3.966$ , $SD=0.737$<br>$\chi^2 = 15.464$ , $df = 2$ , <b><math>p&lt;.001</math></b>    | $M=3.488$ , $SD=0.732$    | $M=3.092$ , $SD=0.683$    |
| Max $F_0$ (Hz.)      | $M=234.456$ , $SD=64.210$<br>$\chi^2 = 4.957$ , $df = 2$ , $p=.083$                       | $M=223.984$ , $SD=67.771$ | $M=190.608$ , $SD=37.095$ |
| Mean $F_0$ (Hz.)     | $M=211.812$ , $SD=58.253$<br>$\chi^2 = 15.889$ , $df = 2$ , <b><math>p&lt;.001</math></b> | $M=202.461$ , $SD=62.420$ | $M=190.510$ , $SD=56.812$ |
| Intensity (dB)       | $M=58.470$ , $SD=3.682$<br>$\chi^2 = 8.469$ , $df = 2$ , <b><math>p=.014</math></b>       | $M=57.190$ , $SD=4.118$   | $M=56.920$ , $SD=4.323$   |
| Duration (ms)        | $M=216.537$ , $SD=30.211$<br>$\chi^2 = 20.302$ , $df = 2$ , <b><math>p&lt;.001</math></b> | $M=208.448$ , $SD=28.745$ | $M=210.761$ , $SD=28.606$ |



(a) Excursion Size



(b) Max  $F_0$

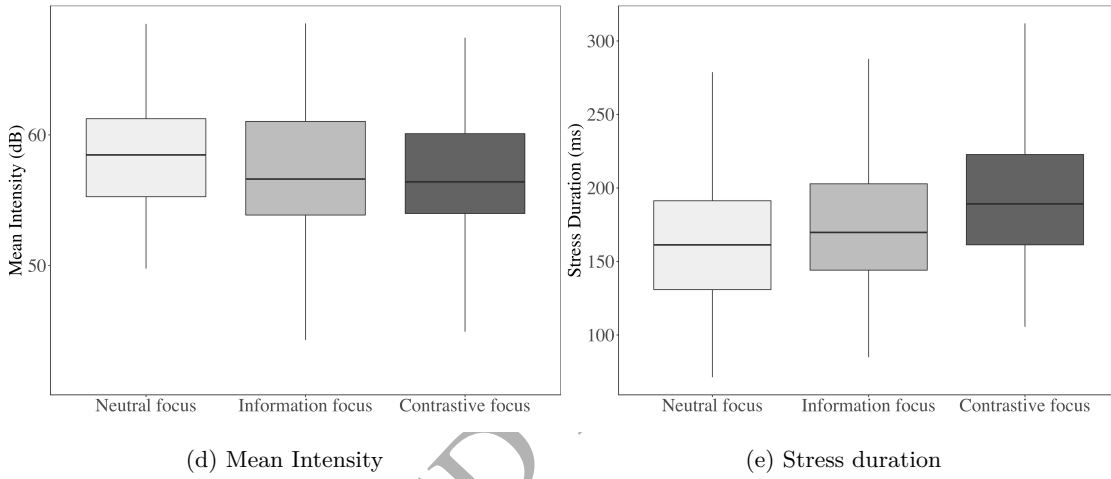
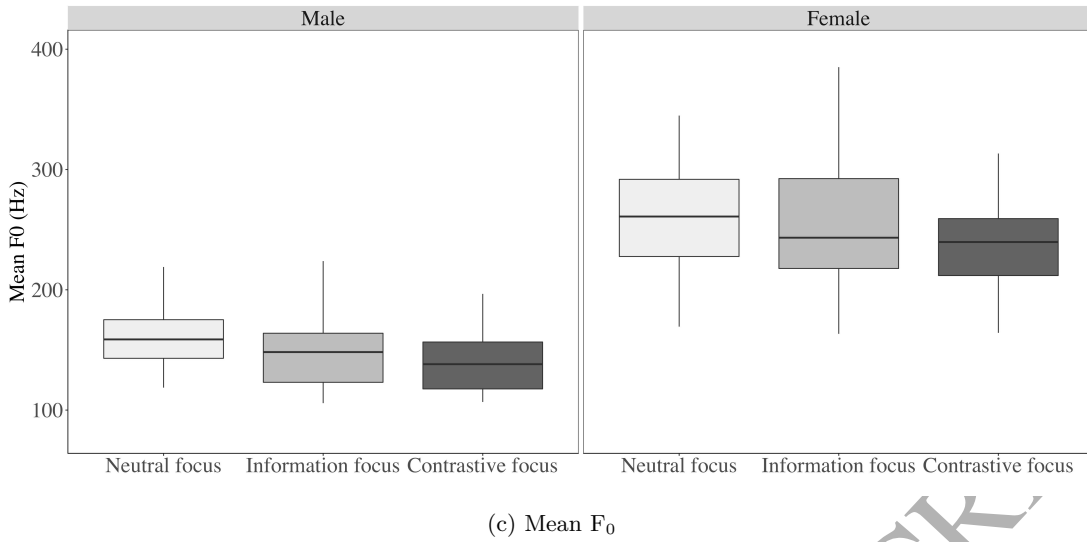


Figure 4: Boxplot of values of stressed syllables of the post-focus region, broken down by focus. Points indicate the means.

Table 9 shows that post-focus excursion size and intensity of contrastive focus is significantly smaller than that of neutral focus, whereas under information focus it is not lowered. Also, the Mean  $F_0$  of post-focus region significantly decreases across the three focus conditions: neutral focus < information focus < contrastive focus. As for the duration, syllables under information focus and contrastive focus are significantly lower than that their counterpart under neutral focus, which the two conditions do not differ statistically.

Table 9: Post-hoc comparisons of effect of initial focus on the stressed syllables of post-focus words, after Tukey's adjustment. P values smaller than 0.05 are in boldface.

|                      | Focus Condition               |                               |                             |
|----------------------|-------------------------------|-------------------------------|-----------------------------|
|                      | Neutral vs. Information       | Neutral vs. Contrastive       | Information vs. Contrastive |
| Excursion Size (st.) | $p=.080$                      | <b><math>p&lt;.001</math></b> | $p=.174$                    |
| Mean $F_0$ (Hz)      | <b><math>p=.022</math></b>    | <b><math>p&lt;.001</math></b> | <b><math>p=.005</math></b>  |
| Intensity (dB)       | $p=.280$                      | <b><math>p=.009</math></b>    | $p=.906$                    |
| Duration (ms)        | <b><math>p&lt;.001</math></b> | <b><math>p=.005</math></b>    | $p=.420$                    |

To summarise, there is a post-focus compression of the excursion size, Mean  $F_0$  intensity and duration in contrastive focus and information focus. The reduction is more salient in contrastive focus than information focus in Mean  $F_0$ .

## 3.2.2. Sentence-Penultimate Focus

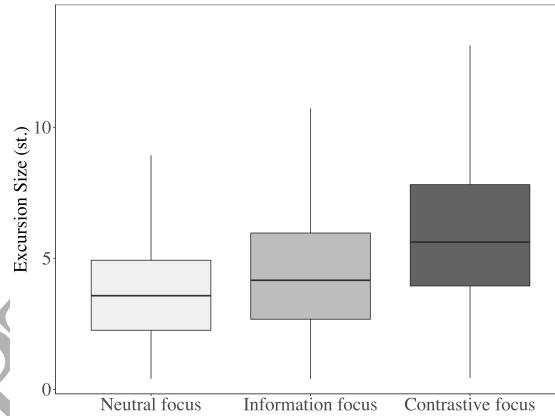
## A. The on-focus region

As can be seen in Table 10, focus has a significant effect on excursion size, maximum  $F_0$ , mean  $F_0$ , intensity, and duration of the stressed syllable of the word under focus in penultimate position.

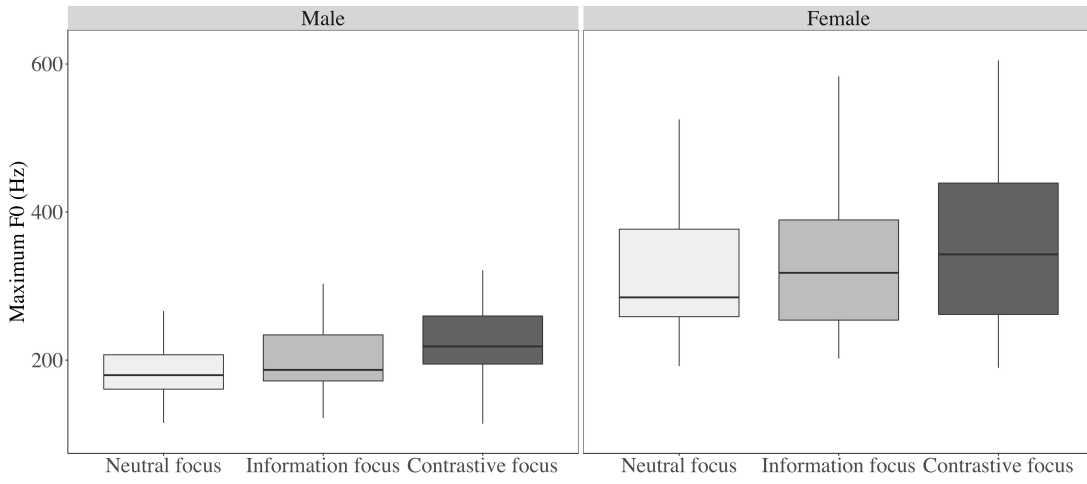
Table 10: Mean values of various measurements under the effect of focus, together with results of Linear Mixed Models. P values smaller than 0.05 are printed in boldface.

|                      | Focus Condition   |                           |                           |
|----------------------|---|---------------------------|---------------------------|
|                      | Neutral-focus   | Information-focus         | Contrastive-focus         |
| Excursion size (st.) | $M=3.963$ , $SD=1.641$<br>$\chi^2 = 13.741$ , $df = 2$ , <b><math>p &lt; .001</math></b>    | $M=4.567$ , $SD=1.714$    | $M=5.961$ , $SD=2.366$    |
| Max $F_0$ (Hz.)      | $M=251.503$ , $SD=86.008$<br>$\chi^2 = 15.734$ , $df = 2$ , <b><math>p &lt; .001</math></b> | $M=264.904$ , $SD=89.149$ | $M=291.539$ , $SD=96.097$ |
| Mean $F_0$ (Hz.)     | $M=231.839$ , $SD=74.644$<br>$\chi^2 = 15.201$ , $df = 2$ , <b><math>p &lt; .001</math></b> | $M=242.603$ , $SD=77.187$ | $M=260.713$ , $SD=81.658$ |
| Intensity (dB)       | $M=60.289$ , $SD=4.107$<br>$\chi^2 = 7.889$ , $df = 2$ , <b><math>p &lt; .019</math></b>    | $M=60.825$ , $SD=4.641$   | $M=61.989$ , $SD=5.073$   |
| Duration (ms)        | $M=178.737$ , $SD=21.023$<br>$\chi^2 = 4.721$ , $df = 2$ , <b><math>p &lt; .094</math></b>  | $M=188.589$ , $SD=25.095$ | $M=203.758$ , $SD=27.696$ |

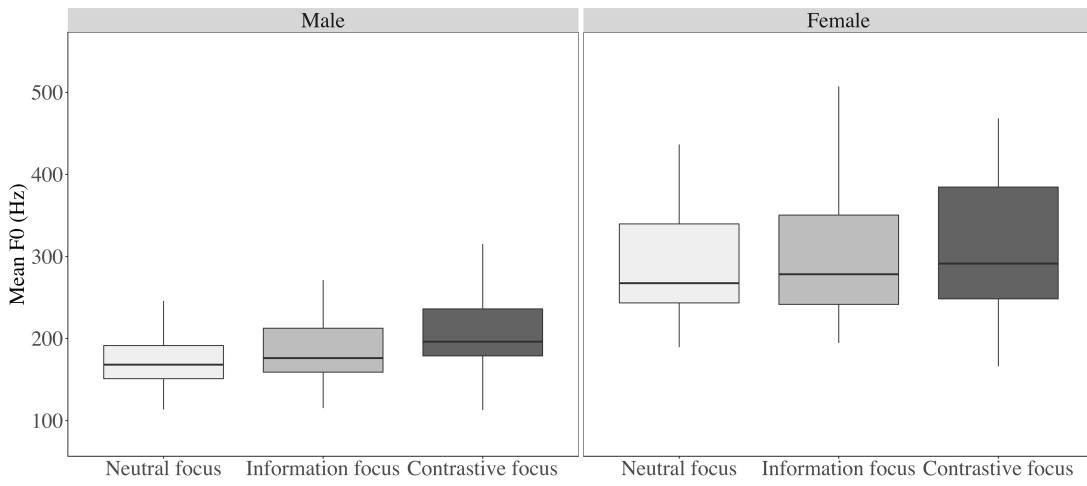
Table 10 shows an increase in the mean score for excursion size, max  $F_0$ , mean  $F_0$ , mean intensity and duration of stressed syllables across the three focus conditions: neutral focus < information focus < contrastive focus. The increase in the mean scores is clearly shown in the boxplots in Figure 5 below.



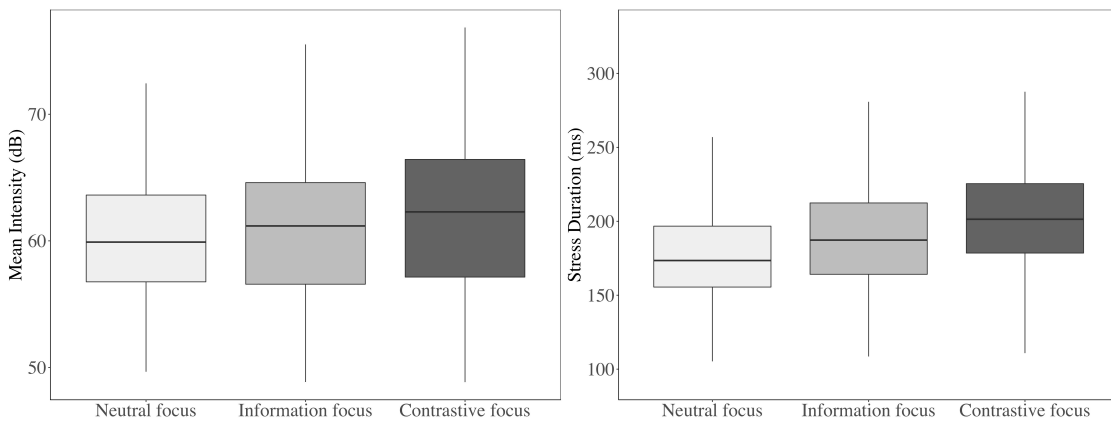
(a) Excursion Size



(b) Max F<sub>0</sub>



(c) Mean F<sub>0</sub>



(d) Mean Intensity

(e) Stress duration

Figure 5: Boxplot of values of stressed syllables of the on-focus region, broken down by focus. Points indicate the means.

Table 11 shows that excursion size of information focus and contrastive focus is significantly more expanded

than their neutral focus counterpart, and excursion size of the contrastive focus is significantly greater than that of information focus. The table also shows that maximum  $F_0$  and mean  $F_0$  of the stressed syllables of the on-focus region under information focus and contrastive focus is significantly higher than in neutral focus. In addition, maximum and mean  $F_0$  of the stressed syllables of the on-focus region under contrastive focus is higher than under information-focus. Also duration of stressed syllables of the information and contrastive focus is significantly longer than that of neutral focus. In addition, duration of stressed syllables of contrastive focus is significantly longer than that of information focus. However, mean intensity under contrastive focus is only significantly higher than that of information focused.

Table 11: Post-hoc comparisons of effect of penultimate focus on the stressed syllables of on-focus words, after Tukey's adjustment. P values smaller than 0.05 are in boldface.

|                      | Focus Condition               |                               |                               |
|----------------------|-------------------------------|-------------------------------|-------------------------------|
|                      | Neutral vs. Information       | Neutral vs. Contrastive       | Information vs. Contrastive   |
| Excursion Size (st.) | <b><math>p=.048</math></b>    | <b><math>p=.001</math></b>    | <b><math>p=.002</math></b>    |
| Max $F_0$ (Hz)       | <b><math>p=.012</math></b>    | <b><math>p&lt;.001</math></b> | <b><math>p&lt;.001</math></b> |
| Mean $F_0$ (Hz)      | <b><math>p&lt;.012</math></b> | <b><math>p&lt;.001</math></b> | <b><math>p&lt;.001</math></b> |
| Intensity (dB)       | $p=.173$                      | <b><math>p&lt;.019</math></b> | <b><math>p&lt;.040</math></b> |

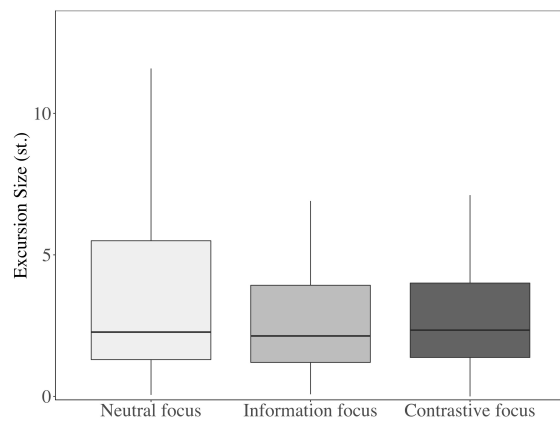
In short, the results show that focus has an effect on the excursion size, Max  $F_0$ , Mean  $F_0$ , and intensity of stressed syllables of the on-focus region in penultimate focus. Excursion size, Max  $F_0$  and Mean  $F_0$  of stressed syllables all significantly increase across the three focus conditions: neutral focus < information focus < contrastive focus. However, compared with neutral focus, the increase in mean intensity is significant under contrastive focus but not under information focus.

### B. The post-focus region

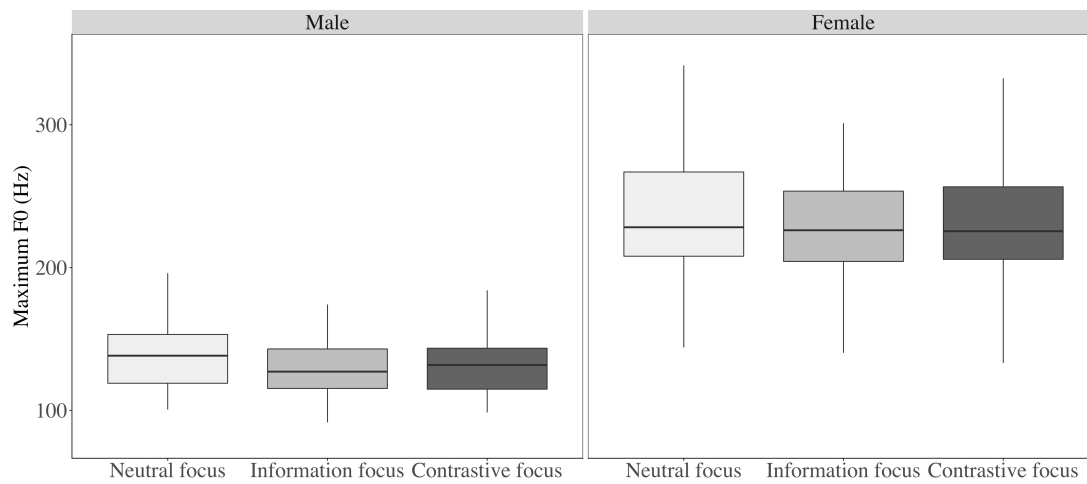
Table 12 shows that focus has a significant effect on the Max  $F_0$  and Mean  $F_0$  of the stressed syllables in the post-focus region. The table also shows that there are no systematic changes across the mean scores of all the variables, except the Mean  $F_0$  and Max  $F_0$  of the stressed syllables of the post-focus region. This is shown in Figure 6 below.

Table 12: Mean values of various measurements under the effect of focus, together with results of Linear Mixed Models. P values smaller than 0.05 are printed in boldface.

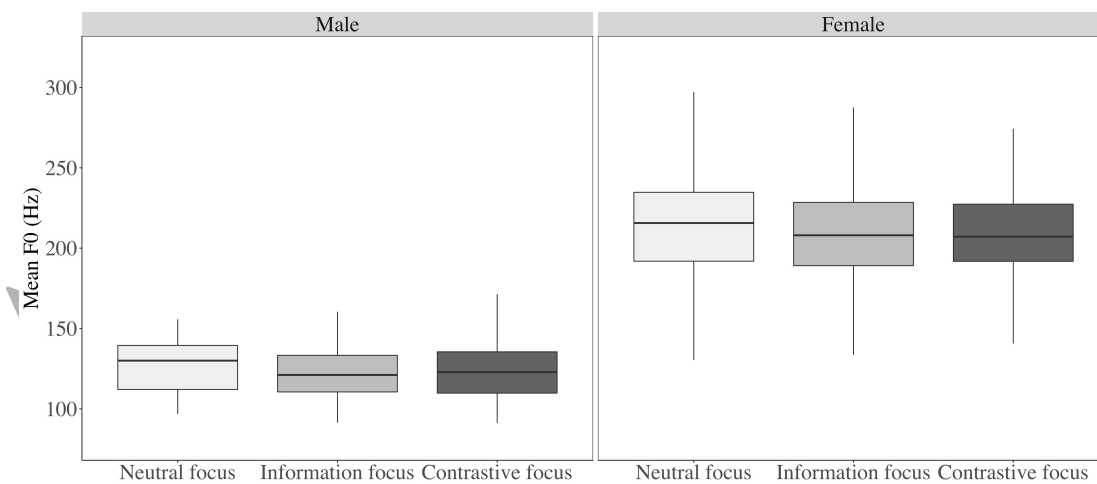
|                      | Focus Condition   |                        |                        |
|----------------------|---|------------------------|------------------------|
|                      | Neutral-focus   | Information-focus      | Contrastive-focus      |
| Excursion size (st.) | $M=5.550, SD=2.369$<br>$\chi^2 = 3.308, df = 2, p = .191$     | $M=5.049, SD=2.292$    | $M=4.469, SD=1.989$    |
| Max $F_0$ (Hz.)      | $M=218.635, SD=52.739$<br>$\chi^2 = 8.592, df = 2, p = .014$  | $M=203.736, SD=50.597$ | $M=193.965, SD=52.834$ |
| Mean $F_0$ (Hz)      | $M=184.885, SD=46.011$<br>$\chi^2 = 10.907, df = 2, p = .004$ | $M=174.837, SD=44.833$ | $M=169.137, SD=46.629$ |
| Intensity (dB)       | $M=54.219, SD=3.806$<br>$\chi^2 = 5.751, df = 2, p = .056$    | $M=53.065, SD=4.251$   | $M=54.360, SD=4.096$   |
| Duration (ms)        | $M=272.3572, SD=42.177$<br>$\chi^2 = 5.223, df = 2, p = .073$ | $M=281.243, SD=51.349$ | $M=276.863, SD=46.628$ |



(a) Excursion Size



(b) Max  $F_0$



(c) Mean  $F_0$

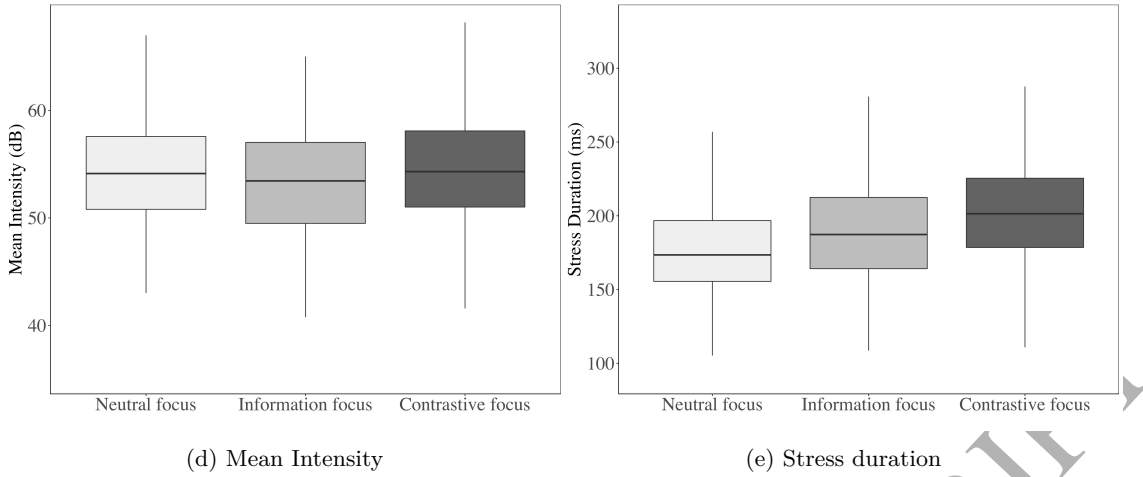


Figure 6: Boxplot of values of stressed syllable of the post-focus region, broken down by focus. Points indicate the means.

As shown in the post-hoc tests in Table 13, the Mean  $F_0$  and Max  $F_0$  are lowered in contrastive focus when compared with neutral context, but not for information focus.

Table 13: Pairwise comparisons of effect of penultimate focus on the stressed syllables of post-focus words, Tukey's adjustment. P values smaller than 0.05 are in boldface.

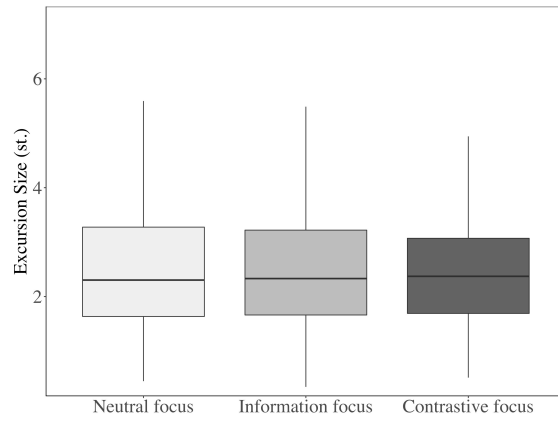
|                | Focus Condition         |                               |                             |
|----------------|-------------------------|-------------------------------|-----------------------------|
|                | Neutral vs. Information | Neutral vs. Contrastive       | Information vs. Contrastive |
| Max $F_0$ (Hz) | $p=.184$                | <b><math>p&lt;.010</math></b> | $p=.481$                    |
| Mean $F_0$     | $p<.093$                | <b><math>p&lt;.003</math></b> | $p=.464$                    |

### C. The pre-focus region

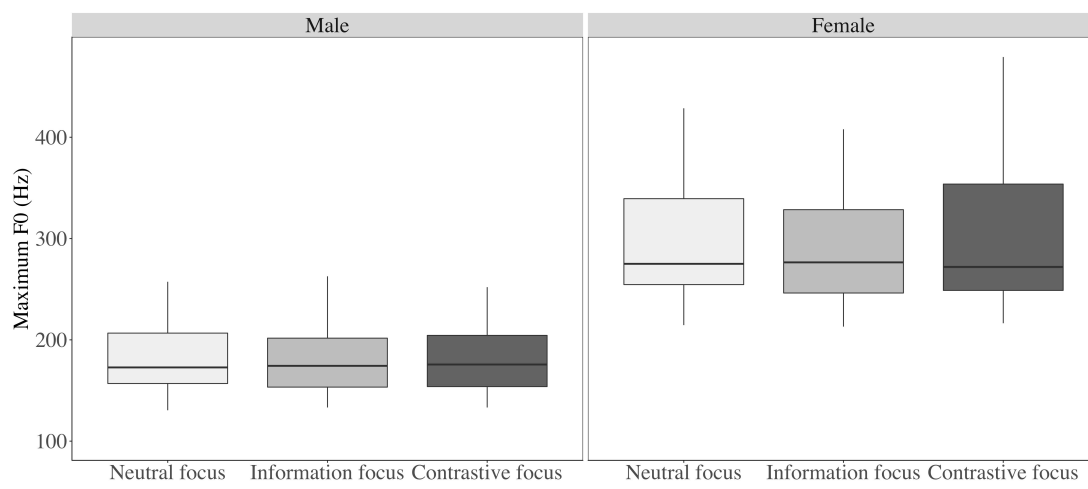
Table 14 shows that focus has a significant effect only on the mean intensity of the stressed syllables of pre-focus region. The mean score of mean intensity of the stressed syllable of pre-focus region under neutral focus is higher than that of its counterpart under information focus and contrastive focus. This is shown clearly in Figure 7. As displayed in Table 15, the post-hoc comparisons confirms that compared with neutral focus there is a pre-focus lowering in the intensity for both contrastive focus and information focus.

Table 14: Mean values of various measurements under the effect of focus, together with results of Linear Mixed Models. P values smaller than 0.05 are printed in boldface.

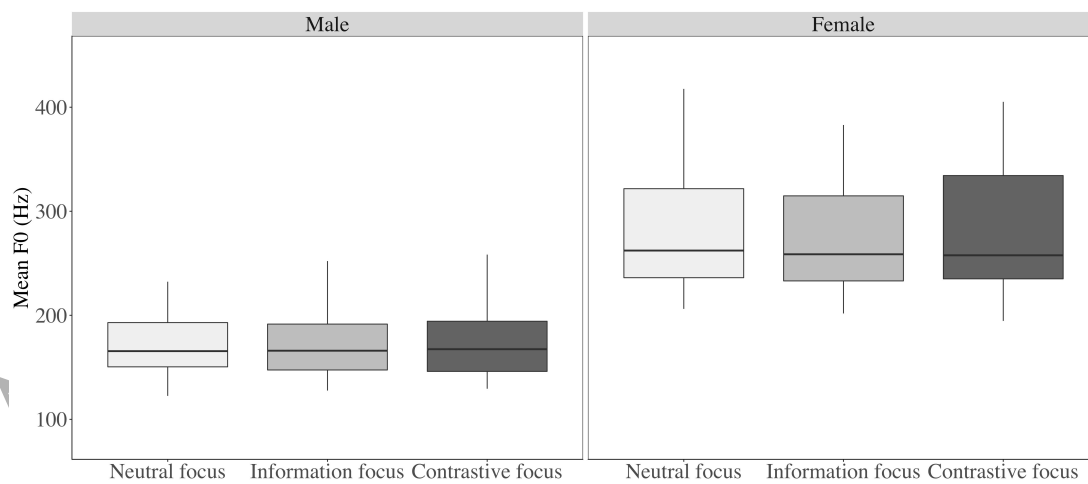
|                      | Focus Condition   |                        |                        |
|----------------------|---|------------------------|------------------------|
|                      | Neutral-focus   | Information-focus      | Contrastive-focus      |
| Excursion size (st.) | $M=2.699, SD=0.889$<br>$\chi^2 = .030, df = 2, p= .985$     | $M=2.682, SD=0.823$    | $M=2.706, SD=0.681$    |
| Max $F_0$ (Hz.)      | $M=238.695, SD=67.876$<br>$\chi^2 = 5.200, df = 2, p= .074$ | $M=234.472, SD=68.779$ | $M=239.669, SD=73.555$ |
| Mean $F_0$ (Hz)      | $M=222.591, SD=63.754$<br>$\chi^2 = 3.670, df = 2, p= .158$ | $M=220.767, SD=63.524$ | $M=224.870, SD=69.138$ |
| Intensity (dB)       | $M=63.579, SD=3.973$<br>$\chi^2 = 10.200, df = 2, p= .006$  | $M=63.033, SD=4.305$   | $M=63.161, SD=4.441$   |
| Duration (ms)        | $M=181.267, SD=29.686$<br>$\chi^2 = 4.463, df = 2, p= .107$ | $M=180.094, SD=26.545$ | $M=177.308, SD=27.251$ |



(a) Excursion Size



(b) Max  $F_0$



(c) Mean  $F_0$

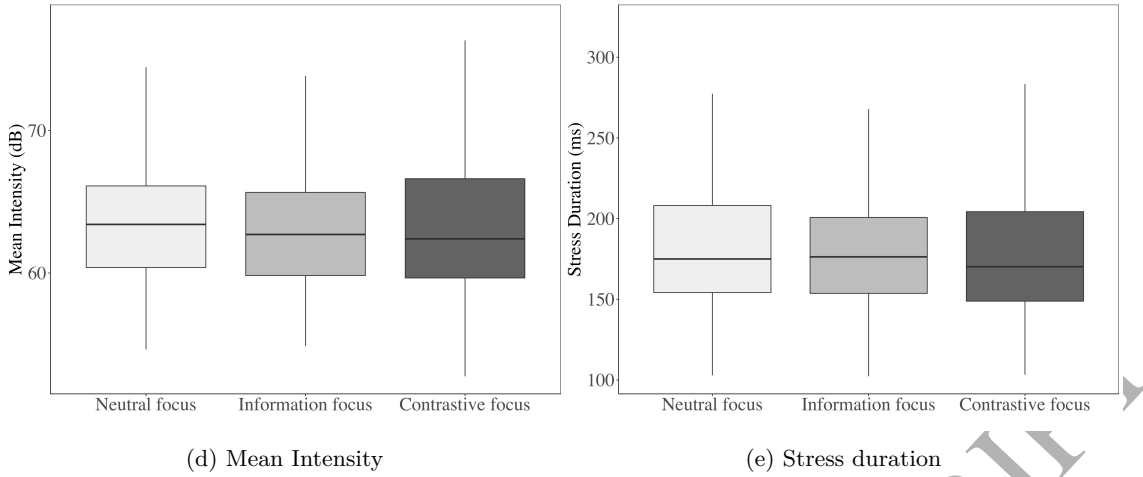


Figure 7: Boxplot of values of stressed syllable of the pre-focus region, broken down by focus. Points indicate the means.

Table 15: Pairwise comparisons of effect of penultimate focus on the stressed syllables of per-focus words, Tukey's adjustment. P values smaller than 0.05 are in boldface.

|                | Focus Condition                 |                              |                             |
|----------------|---------------------------------|------------------------------|-----------------------------|
|                | Neutral vs. Information         | Neutral vs. Contrastive      | Information vs. Contrastive |
| Intensity (dB) | <b><math>p &lt; .033</math></b> | <b><math>p = .051</math></b> | $p = .755$                  |

#### 4. Discussion

Overall, our acoustic analysis has shown that focus in HA manifests multiple prosody properties, as summarized in Table 16. Of the values reported in the table, maximum  $F_0$ , excursion size and mean  $F_0$  are all measurements of the magnitude of  $F_0$  movement in the stressed syllables. In the on-focus region, when focus is either sentence-initial or sentence-penultimate, the excursion size of the stressed syllable is increasingly larger across the three focus conditions: neutral focus < information focus < contrastive focus; maximum  $F_0$  and mean  $F_0$  of the stressed syllable are higher in both information and contrastive focus than in neutral focus, but they are both higher in contrastive focus than in information focus. In terms of duration, on-focus stressed syllables are longer in both information and contrastive focus than in neutral focus, but also they are longer in contrastive focus than in information focus. Finally, when focus is sentence-initial, the intensity of the stressed syllable increases across the three focus conditions; but when focus is sentence-penultimate, only the intensity of contrastive focus is higher than that of both information and neutral focus.

In the post-focus region, when focus is sentence-initial, maximum  $F_0$  significantly decreased across the three focus conditions. However, when focus is sentence-penultimate, maximum  $F_0$  does not show any statistical differences across the three focus conditions. Mean  $F_0$  is lower in information and contrastive focus than in neutral focus. But when focus is sentence penultimate, there is no statistical difference across the three focus conditions. Excursion size is smaller in information and contrastive focus than in neutral focus only when focus is sentence initial. Post-focus intensity is lower in sentence-initial information and contrastive focus than in neutral focus. However, when focus is sentence penultimate, it is only lower in information focus than in contrastive focus. Duration of post-focus stressed syllables is shorter in sentence-initial information and contrastive focus than in neutral focus, but there is no difference across the three focus conditions when focus is sentence penultimate.

The acoustic analyses have therefore provided answers to the research questions raised in §1.5:

- (16) a. Is there on-focus expansion of  $F_0$  contours? Yes, there is.
- b. Is there post-focus compression of  $F_0$  contours? Yes, there is, but only when focus is sentence initial.
- c. Is there pre-focus compression of  $F_0$  contours? No, there isn't.

- d. Are there prosodic differences between information and contrastive focus? Yes, but ...

The present results are consistent with the findings of Hellmuth (2006, 2011) that, in Egyptian Arabic, the pitch accent of a focused word in the sentence-initial position in a four-word declarative sentence is acoustically more expanded than its non-focused counterpart, and that post-focus words are more compressed in pitch range than their counterparts in neutral focus. This makes HA another Arabic dialect that exhibits both on-focus pitch range expansion and post-focus pitch range compression. The post-focus compression, in particular, makes HA one of the PFC languages. Note that, however, as mentioned in the literature review in the Introduction, it is not the case that a PFC languages would exhibit post-focus compression in all focus conditions. In some of these languages PFC is not evident in some focus conditions (Ipek, 2011; Lee and Xu, 2012; Wang et al., 2012, 2013). The key difference between PFC and non-PFC languages is the presence of PFC, even if only in some focus locations, versus total absence of PFC in any focus conditions (Xu, 2011a). There are various reasons why PFC does not occur in all focus locations in some languages, of course, as reviewed in Xu (in press), which is worthy of further research.

Another major finding of the present study is the clear differences between the three focus conditions, as summarized in Table 16. But interestingly, this is mainly seen in on-focus words: All the measurements analyzed showed significant greater values in contrastive focus than in information focus. Post-focally, only maximum  $F_0$  in initial focus and mean intensity in penultimate focus show significant differences between the two types of focus. And no difference is seen in the pre-focus region. The finding of clear differences between the contrastive and information focus conditions stands in contrast with many previous studies that made similar comparisons but failed to find significant differences: English (House and Sityaev, 2003), Dutch (Hanssen et al., 2008; He et al., 2011), Japanese (Hwang, 2012), Estonian (Heete Sahkai, 2013) and Mandarin (Kügler and Genzel, 2014).

The main reason for this finding we can think of is that in the present study, as described in §2.1, speakers were briefed with a carefully designed anecdote before engaging in a mini-dialogue in which they answered the experimenter's question. Those anecdotes, plus the mini-dialogues, may have brought out a likely connotation of contrastive focus, namely, a sense of incredulity. Such incredulity may have made the subjects speak more forcibly when trying to correct the experimenter, thus leading to an exaggerated realization of focus. An exaggeration is to more fully realize what is already there, however. As can be clearly seen in Figure 2 when the word in focus is in sentence-initial position, both on-focus  $F_0$  raising and post-focus  $F_0$  lowering already occurs in information focus. Contrastive focus only goes further in the realization of both aspects of focus. As such, contrastive focus is unlikely to constitute a prosodic category distinct from information focus, as no categorical prosodic means is used to make the distinction, as has also been pointed by Baumann et al. (2006). This can probably explain why many studies mentioned above failed to find clear prosodic distinction between these two types of focus. It seems that unless methods are used to bring out the incredulity connotation of contrastive focus, the chance of seeing it as significant different from information focus is not high.

Table 16: Summary of the quantitative analyses of the data presented in §3.2. An arrow indicates that there is a significant focus effect on the measurement relative to the neutral-focus condition in the direction of the arrow.

| Focus Region | Variables      | Focus Location       | Neu. vs. Info. | Neu. vs. Cont. | Info. vs. Cont. |
|--------------|----------------|----------------------|----------------|----------------|-----------------|
| On-Focus     | Excursion Size | Sentence-Initial     | ↑expanded      | ↑expanded      | ↑expanded       |
|              |                | Sentence-Penultimate | ↑expanded      | ↑expanded      | ↑expanded       |
|              | Maximum $F_0$  | Sentence-Initial     | <i>NS</i>      | ↑higher        | ↑higher         |
|              |                | Sentence-Penultimate | ↑higher        | ↑higher        | ↑higher         |
|              | Mean $F_0$     | Sentence-Initial     | ↑higher        | ↑higher        | ↑higher         |
|              |                | Sentence-Penultimate | ↑higher        | ↑higher        | ↑higher         |
|              | Mean Intensity | Sentence-Initial     | <i>NS</i>      | ↑higher        | ↑higher         |
|              |                | Sentence-Penultimate | <i>NS</i>      | ↑higher        | ↑higher         |
|              | Duration       | Sentence-Initial     | <i>NS</i>      | ↑longer        | ↑longer         |
|              |                | Sentence-Penultimate | <i>NS</i>      | ↑longer        | ↑longer         |
| Post-Focus   | Excursion Size | Sentence-Initial     | <i>NS</i>      | ↓less expanded | <i>NS</i>       |
|              | Maximum $F_0$  | Sentence-Penultimate | <i>NS</i>      | ↓lower         | <i>NS</i>       |
|              | Mean $F_0$     | Sentence-Initial     | ↓lower         | ↓lower         | ↓lower          |
|              |                | Sentence-Penultimate | <i>NS</i>      | ↓lower         | <i>NS</i>       |
|              | Mean Intensity | Sentence-Initial     | <i>NS</i>      | ↓lower         | <i>NS</i>       |
|              | Duration       | Sentence-Initial     | ↓shorter       | ↓shorter       | <i>NS</i>       |
| Pre-Focus    | Mean Intensity | Sentence-Penultimate | ↓lower         | ↓lower         | <i>NS</i>       |

Incredulity, however, is different in meaning from attention allocation (Chen, Li and Yang, 2012; Chen, Wang and Yang, 2014; Kristensen et al., 2013) or common-ground management (Krifka, 2008; Pierrehumbert and Hirschberg, 1990) as the likely core function of focus, because it is an emotional or attitudinal function (Mitchell and Ross, 2013). There is already some evidence for the involvement of emotional or attitudinal connotations in focus prosody. Greif (2010, 2012) has found that contrastive focus can be prosodically more salient than information focus if a high degree of naturalness in experimenter–subject interaction is achieved. Liu and Xu (2016) examined the differential perception of surprise and focus. They found that to perceive surprise, at least 3 semitones beyond what is sufficient for focus perception is needed. Nevertheless, focus continued to be perceived despite the perception of surprise. Thus a paralinguistic function such as surprise can be encoded by using additional pitch ranges beyond that used by lower-level functions such as focus and lexical tone, without harming the encoding of the linguistic functions. The use of anecdotes to enrich the background information for the focus-triggering mini-dialogues in the present study was only intended to achieve high naturalness. So the potential contribution of incredulity is an accidental finding. But it nevertheless points to a new direction for future research on prosodic focus.

## 5. Conclusion

The present study has made two major findings about the prosody of HA. The first is that, like in the Arabic dialects studied previously, focus in HA is realized with both on-focus increase of  $F_0$ , duration and intensity and post-focus compression of  $F_0$ , intensity and duration. This provides further evidence that Arabic belongs to a large group of languages that encode focus with PFC. The second finding is that clear prosodic differences can be seen between the contrastive and information focus conditions with a recording

paradigm that can bring out an incredulity connotation of the former. This suggests that certain types of focus may involve emotional connotations that can be considered as separate from the core meaning of focus.

## Acknowledgements

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## Appendix A: Test Materials

### 5.1. Neutral Focus

- رامي ولينا أخوان. رامي عايش في الطائف و لينا عايشه في جده. لهم فترة طويلة ما زارو بعض . أمس رامي راح جده و مر لينا هناك.

Rami and Lina are brothers. Rami lives in Taif and Lina lives in Jeddah. They had not visited each other for a long time. Yesterday, Rami went to Jeddah and visited Lina there.

Target sentence:

- (17) Rāmi mar Līna ams.  
Rami visited Lina yesterday  
'Rami visited Lina yesterday.'

- رنا و منال أخوات . رنا أكبر من منال . أبوهما مات وأمه مريضة متنومة في المستشفى. بسبب فقرهم، رنا بطلت الدراسة. و اشتغلت خياطه حتى تصرف على البيت. منال توها بتجلبت في المدرسة. المدرسة طالبة مريول مخصص. لذلك رنا سوت مريول لمنال.

Rana and Manal are sisters. Rana is older than Manal. Their father died and their mother is ill and she is in hospital. Because of being poor, Rana dropped from school and works as a tailor in order to have money. Manal has just enrolled in school. The school requires a specific school dress. Therefore, Rana made a school dress for Manal.

Target Sentence:

- (18) Rana sawwat maryūl li-Manāl.  
Rana made school-dress for-Manāl  
'Rana made a school dress for Manal'.

- رامي كان عايش في مصر لمدة طويلة. وكان يشتغل هناك. كانت وظيفته حلوه. و يجيله راتب حلوه. لكن قبل شهر فصل من وظيفته. و هاجر للندن البارح.

Rami was living in Egypt. He was working there. His job was good and he got good salary. But one month ago, he quitted his job. He moved to London yesterday.

Target Sentence:

- (19) Rāmi hājar li-london al-bāriḥ.  
Rāmi moved to-London last-night  
'Rami moved to London last night'.

### 5.2. "Narrow" Information Focus (Focus on sentence-initial word)

- رامي و رنا و لينا أخوان. رامي عايش في الطائف. و لينا و رنا عايشين في جده. كل وحده فيهم في بيت مستقل. رامي يحب رنا كثير. بس لينا رامي يكرها نوعا ما. لذلك رامي لما يزور جده ما يمر على لينا. مروان و رنا بينهم زيارات و تواصل مع بعض بإستمرار. لكن أمس وبدون محد يتوقع رامي راح جده و مر لينا هناك.

Rami, Rana and Lina are brothers. Rami lives in Taif. Lina and Rana live in Jeddah and each one of them lives in a separate house. Rami likes Rana a lot. But Lina, Rami does not like. So when Rami visits Jeddah, he never visits Lina. Rami and Rana visit each other and contact each other continuously. But yesterday, without anyone expected, Rami went to Jeddah, visited and spent time with Lina there.

Target Sentence:

- (20) [Rāmi]<sub>NF</sub> mar Līna ams.  
Rami visited Lina yesterday  
'Rami visited Lina yesterday.'

• رنا خياطة ماهرة. كثير ناس تفصل عندها فساتين. منال طالبة ثانوية. قبل بدء الدراسة راحت لي رنا عشان تفصل لها مريول. وبتالي رنا سوتلها مريول.

Rana is a clever tailor. A lot of people ask her to make dresses for the. Manal is a secondary school student. Before the school year started, she went to Rana and asked her to make a school dress for her. Rana made a school dress for her.

Target Sentence:

- (21) [Rana]<sub>NF</sub> sawwat maryūl li-Manāl.  
Rana made school-dress for-Manāl  
'Rana made a school dress for Manal.'

• رامي و مروان أخوان. وكلهم كانوا مدرسين لغة عربية في مصر. رامي فصل من وظيفته و هاجر للندن البارح. أما مروان فصل من وظيفته و راح يشتغل في مصنع.

Rami and Marwan are brothers. All of them were teachers of Arabic language in Egypt. Rami quitted his job and moved to London yesterday. As for Rami, he quitted his job and works in a factory.

Target Sentence:

- (22) [Rāmi]<sub>NF</sub> hājar li-london al-bāriḥ.  
Rāmi moved to-London last-night  
'Rami moved to London last night.'

### 5.3. "Narrow" Information Focus (Focus on sentence-penultimate word)

• رامي عنده أخت إسمها لينا. رامي عايش في الطائف و لينا عايشه في جده. لهم فترة طويلة ما يتواصلوا مع بعض. أمس رامي راح جده و مر لينا هناك.

Rami has one sister whose name is Lina. Rami lives in Taif and Lina lives in Jeddah. They had not visited each other for a long time. Yesterday, Rami went to Jeddah and visited Lina there.

Target Sentence:

- (23) Rāmi mar [Līna]<sub>NF</sub> ams.  
Rami visited Lina yesterday  
'Rami visited Lina yesterday.'

• رنا خياطة ماهرة. وناس كثير تطلب منها تسوي لها فساتين. منال طالبة ثانوية. قبل ما تبدأ المدرسة طلبت من رنا تسويها مريول للمدرسة. وبتالي رنا سوت مريول لمنال.

Rana is a clever tailor. A lot of people ask her to make dresses for them. Manal is a secondary school student. Before the school year started, Manal asked Rana to make a school dress for her. Therefore, Rana made a school dress for Manal.

Target Sentence:

- (24) Rana sawwat [maryūl]<sub>NF</sub> li-Manāl.  
Rana made school-dress for-Manāl  
'Rana made a school dress for Manal'.

• رامي كان عايش في مصر. كان شغال مدرس لغة عربية. وكان راتبه حلو. لكن قبل شهر رامي فصل من وظيفته و هاجر للندن البارح.  
Rami was living in Egypt. He was a teacher of Arabic language. A month ago, he quitted his job and he moved to London yesterday.

Target Sentence:

- (25) Rāmi hājar [li-london]<sub>NF</sub> al-bāriḥ.  
Rāmi moved to-London last-night  
'Rami moved to London last night'.

#### 5.4. "Narrow" Contrastive Focus (Focus on sentence-initial word)

• رامي و رنا و لينا أخوان. رامي عايش في الطائف. و لينا و رنا عايشين في جده. كل وحده فيهم في بيت مستقل. رامي يحب رنا كثير. بس لينا رامي يكرها نوعا ما. لذلك رامي لما يزور جده ما يمر على لينا. مروان و رنا بينهم زيارات و تواصل مع بعض باستمرار. لكن أمس وبدون محد يتوقع رامي راح جده و مر لينا هناك.

Rami, Rana and Lina are brothers. Rami lives in Taif. Lina and Rana live in Jeddah and each one of them lives in a separate house. Rami likes Rana a lot. But Lina, Rami does not like. So when Rami visits Jeddah, he never visits Lina. Rami and Rana visit each other and contact each other continuously. But yesterday, without anyone expected, Rami went to Jeddah, visited and spent time with Lina there.

Target Sentence:

- (26) [Rāmi]<sub>CF</sub> mar Līna ams.  
Rami visited Lina yesterday  
'Rami visited Lina yesterday.'

• لينا و منال أخوات. كلهم طالبات في الثانوية العامة. كل وحده فيهم راحت خياطة تخط لها مريول. لينا راحت لي نوال تخط لها مريول. أما منال راحت عند رنا تخط لها مريول.

Lina and Manal are sisters. All of them are secondary school students. Each one of them went to a tailor to make a school dress. Lina went to Nawal to make her a school dress. As for Manal, she went to Rana to make a school dress for her.

Target Sentence:

- (27) [Rana]<sub>CF</sub> sawwat maryūl li-Manāl.  
Rana made school-dress for-Manāl  
'Rana made a school dress for Manal'.

• رامي و مروان كانوا يشتغلون في مصر. وكانت رواتبهم حلوة. ولكن بعد الثورة فصلوا من وظائفهم. وبتالي رامي هاجر للندن البارح و مروان لسعودية.

Rami and Marwan were working in Egypt. Their salary was good. But after the revolution, They quitted from their job. Therefore, Rami moved to London yesterday and Marwan to Saudi.

Target Sentence:

- (28) [Rāmi]<sub>CF</sub> hājar li-london al-bāriḥ.  
Rāmi moved to-London last-night  
'Rami moved to London last night'.

### 5.5. “Narrow” Contrastive Focus (Focus on penultimate-sentence word)

- رامي و مروان و لينا أخوان. رامي عايش في الطائف. و مروان و لينا عايشين في جدة. كل واحد فيهم في بيت مستقل. رامي و مروان يتبادلوا الزيارات مع بعض. لكن رامي ما يزور لينا بسبب لينا تسوي مشاكل كثير. لذلك رامي ما يزورها لما يروح جدة. لكن أمس و بدون محد يتوقع رامي راح جدة و مر لينا و جلس معها هناك.

Rami, Marwan and Lina are brothers. Rami lives in Taif. Marwan and Lina live in Jeddah. Each one of them lives in a separate house. Rami and Marwan exchange visits. But Rami does not visit Lina because Lina makes troubles a lot. Due to that, Rami does not visit her when we goes to Jeddah. But yesterday and without one's knowledge, Rami went to Jeddah and visited Lina and spent time with her there.

Target Sentence:

- (29) Rāmi mar [Līna]<sub>CF</sub> ams.  
Rami visited Lina yesterday  
'Rami visited Lina yesterday.'

- منال طالبة ثانوية. طلبت من أمها إنها تفصل مريول و مرييلة عند رنا الخياطة. أمها وافقت إنها تفصل مريول عند رنا. لكنها رفضت إنها تحلي رنا تفصلها مرييلة. وبتالي رنا سوت مريول لمنال بس.

Manal is a secondary school student. She asked her mother for the tailor Rana to make a school dress and an apron for her. Her mother accepted that Rana made a school dress for her but she refused to let Rana to make an apron for Manal. Therefore, Rana made a school dress for Manal only.

Target Sentence:

- (30) Rana sawwat [maryūl]<sub>CF</sub> li-Manāl.  
Rana made school-dress for-Manāl  
'Rana made a school dress for Manal.'

- رامي و مروان كانوا يشتغلون في مصر. وكانت رواتبهم حلوة. ولكن قبل شهر فصلوا من وظائفهم. وبتالي رامي هاجر للندن البارح و مروان لسعودية.

Rami and Marwan were working in Egypt. Their salary was good. But one month ago, they quitted from their job. Therefore, Rami moved to London yesterday and Marwan to Saudi.

Target Sentence:

- (31) Rāmi hājar [li-london]<sub>CF</sub> al-bāriḥ.  
Rāmi moved to-London last-night  
'Rami moved to London last night.'

### Appendix B: Test Materials

Linear mixed model results: The effect of speaker sex on the excursion size, Max F<sub>0</sub> Mean F<sub>0</sub> intensity, and duration of stressed syllables in the on-focus region, post-focus region and pre-focus region in initial focus position and penultimate position.

| Initial focus            |            |    |       | Penultimate focus |    |       |  |
|--------------------------|------------|----|-------|-------------------|----|-------|--|
| On-focus region          |            |    |       |                   |    |       |  |
|                          | Chi-square | df | p     | Chi-square        | df | p     |  |
| Excursion size (st.)     | .442       | 1  | .506  | .055              | 1  | .815  |  |
| Max F <sub>0</sub> (Hz)  | 13.737     | 1  | <.001 | 18.342            | 1  | <.001 |  |
| Mean F <sub>0</sub> (Hz) | 13.653     | 1  | <.001 | 16.166            | 1  | <.001 |  |
| Mean intensity (dB)      | .305       | 1  | .581  | .002              | 1  | .966  |  |
| Duration (ms)            | .317       | 1  | .574  | 5.771             | 1  | .016  |  |

| Initial focus            |            |    |       | Penultimate focus |    |       |
|--------------------------|------------|----|-------|-------------------|----|-------|
|                          | Chi-square | df | p     | Chi-square        | df | p     |
| <b>Post-focus region</b> |            |    |       |                   |    |       |
| Excursion size (st.)     | 1.782      | 1  | .182  | .573              | 1  | .449  |
| Max F <sub>0</sub> (Hz)  | 9.530      | 1  | .002  | 21.999            | 1  | <.001 |
| Mean F <sub>0</sub> (Hz) | 13.982     | 1  | <.001 | 22.129            | 1  | <.001 |
| Mean intensity (dB)      | .110       | 1  | .741  | .195              | 1  | .659  |
| Duration (ms)            | 6.877      | 1  | .009  | 11.353            | 1  | <.001 |
| <b>Pre-focus region</b>  |            |    |       |                   |    |       |
| Excursion size (st.)     |            |    |       | 1.405             | 1  | .236  |
| Max F <sub>0</sub> (Hz)  |            |    |       | 14.632            | 1  | <.001 |
| Mean F <sub>0</sub> (Hz) |            |    |       | 18.647            | 1  | <.001 |
| Mean intensity (dB)      |            |    |       | .077              | 1  | .782  |
| Duration (ms)            |            |    |       | 5.553             | 1  | .018  |

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