F0 Peak Alignment, F0 Peak Location, and Focus Perception in Taif Arabic

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Abstract

The encoding of focus and its role in Taif Arabic has not been understood fully. A recent production study found significant acoustic differences between syntactically identical utterances with focus and without focus. The current study aims to investigate further F0 peak alignment, F0 peak location and (b) focus perception in Taif Arabic. The acoustic analyses of F0 peak alignment and F0 peak location show that only the F0 peak alignment of the post-focus words was realized earlier than that of their counterparts under neutral-focus condition, and the location of the F0 peak of the stressed syllable of the post-focus words was lower than that of their counterparts in neutral-focus utterances. In focus perception, correct focus identification was 85% for initial focus and 71% for penultimate focus. These findings have implications for both focus typology and language variations.

1. Introduction

Information focus and contrastive focus are two aspects of information structure related to new and contrastive/corrective information respectively (Halliday, 1967; Chafe, 1976; Vallduv í 1993). Through the analysis of the answers to the questions in (1) within information-structure domain, we can say that the answer in (1a) is all discourse-new by virtue of being an answer to the broad focus question "What happened?". The information structure of the answer in (1b) is different. That is, the item /Peter/ carries new information in the discourse by virtue of being an item in the discourse that replaces the wh-phrase in /Whom did John meet?/. Therefore, this item is information-focused by virtue of being the only item that is under focus, whereas the remaining items carry given information by virtue of being stated previously in the relevant question. Contrastive/corrective focus is

exemplified in (1c). The information structure of the answer in (1c) is similar to the utterance in (1b); however, the item /Peter / is, additionally, in a contrastive/corrective relation to another item /George/ stated in the previous discourse. As a result, this item is termed contrastive focus. The focused entity is between the square brackets.

1) a. *Neutral focus*

   What happened?   [John met Peter].

   b. *Information focus*

   Whom did John meet?   John met [Peter].

   c. *Contrastive/corrective focus*

   Whom did John meet? George?   John met [Peter].

Focus has received different definitions in the literature (Rooth, 1985, 1992; Kiss, 1998; Molnár, 2002; Krifka, 2008; Zimmermann, 2008). However, some of these definitions are not supported empirically. Following Xu et al. (2012); Zerbian et al. (2010); Alzaidi et al. (2019) and among others, we adopt the definitions of focus presented above by virtue of being empirically successful in eliciting the two types of focus under investigation: information focus and contrastive/corrective focus.

These two focus types have been shown to be encoded prosodically in many languages (Ladd, 2008; Xu et al., 2012; Chahal and Hellmuth, 2014; Jun, 2014). They have been found that focused item is associated with prosodic cues. One of the prosodic cue is the F0 peak alignment and location (Ladd, 2008; Féry, Niebuhr et al., 2011; 2013; Jun, 2014). Several studies have observed changes in the F0 peak alignment and peak location in utterances with focus (Ladd, 2008). In Spanish, for example, the F0 peak of the focused word is aligned earlier than in neutral focus (Face, 2002). However, in European Portuguese the F0 peak of the focus is aligned later than in neutral focus (Frota, 2000). In English, Xu and Xu (2005) find that the F0 peak location is realized earlier in the stressed syllable of the focused word, compared to their neutral-focus counterpart. Studies including Niebuhr et al. (2011) found that F0 alignment can be varied cross-speakers. Not only that, but also segmental structure of the word may have an effect on the F0 alignment as well (Barnes et al., 2012).

The findings of such studies indicate a need to understand the effect of focus on the F0 peak alignment and location in languages. The analysis of F0 peak alignment and F0 peak location are important for pitch accent type identification, which is related to tune-text association; i.e., one of the central questions in Autosegmental-Metrical (AM) framework (Pierrehumbert, 1980; Ladd, 2008).

To our knowledge, the only studies on the F0 peak alignment in Arabic are Hellmuth (2006*a*) and Cangemi et al. (2016). Hellmuth (2006*a*) finds in Egyptian Arabic the peak of the word following contrastive focus is aligned earlier i than in utterances with narrow information focus. Cangemi et al. (2016) find that the alignment of peaks and valleys within the focused word is earlier than their counterpart in topic-comment utterance. To our knowledge, whether

and how focus has an effect on F0 peak alignment and peak location in Taif Arabic is still not investigated. Therefore, one of the two aims of the current study is to investigate the effect of focus on the F0 peak alignment and location in Taif Arabic.

Another prosodic cue to focus is post-focus compression (PFC) in which words following focused item are compressed in F0 and/or intensity (Chen et al., 2009; Xu, 2011). In English (Eady and Cooper, 1986; 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), Hindi (Patil et al., 2008), Uygur (Wang et al., 2013), Egyptian Arabic (Hellmuth, 2006*b*), Lebanese Arabic (Chahal, 2001) and Taif Arabic (Alzaidi et al., 2019), PFC is present. However, it is absent in Wolof (Rialland and Robert, 2001), Taiwanese/southern Min (Pan, 2008), Chichewa and Hausa and Northern Sotho (Zerbian, 2006) and Cantonese (Gu and Lee, 2007). Furthermore, recent studies find that the post-focus compression (PFC) is an effective prosodic cue to focus perception in languages in which PFC is present such as Beijing Mandarin Chen et al. (2009). However, this is not the case in Egyptian Arabic in which some speakers detected prosodic focus (Hellmuth, 2005; EL Zarka and Hödl, 2021).

The current study aims to investigate the F0 peak alignment, F0 peak location and focus perception in Taif Arabic by using Alzaidi et al.'s (2019) test materials. The paper is structured as follows. Section 2 presents a brief background of those relevant grammatical aspects in the Arabic dialect under investigation, related to the scope of the paper. Section 3 presents the production experiment and the acoustic analysis of F0 peak alignment and F0 peak location. Section 4 presents the perception experiment. Section (5) discusses the findings of the current study. Section (6) concludes the paper.

2. Taif Arabic

Taif Arabic refers to the urban Hijazi Arabic dialect spoken in Taif city, located in the western region of Kingdom of Saudi Arabia. Taif Arabic differs from other Arabic dialects included Modern Standard Arabic (MSA). For example, Taif Arabic, like modern Arabic dialects, lost structural cases such as nominative, accusative and genitive cases as in MSA (Alotaibi, 2014). Three grammatical aspects, discussed in this section, are of relevance to the current paper. They are stress assignment, focus structure and intonation in Taif Arabic.

Stress in Arabic is generally used at the lexical level in which one syllable is more prominent that another. The acoustic correlates of the stressed syllables in Arabic are not yet clear (Mitchell, 1960; de Jong and Zawaydeh, 1999; Al-Ani, 1992; Hellmuth, 2006*b*). Stress assignment in Arabic is predictable. Below is the rules that determine the stressed-syllable location in urban Hijazi Arabic in general.

2)   a. Stress a final superheavy syllable. If no final superheavey syllable, then

   b. stress a heavy penult. If no heavy penult, then

   c. stress a heavy antepenult. Otherwise

   d. stress the penult or the antepenult.

In Taif Arabic, focus is not always encoded in syntax as in other languages such as Romance languages (Kiss, 1995, 1998). An item carrying either information focus (NF) or contrastive focus (CF) can be realized in-situ as exemplified in (3) below. NF and CF stand for information focus and contrastive/corrective focus respectively.

3)   a. *Information focus*

      Khaled zār   mīn?

      Khaled visited   who

      "Whom did Khaled visit?"

    b. Khaled zār   faisal$_{NF}$

     Khaled visited   Faisal

     "Khaled visited Faisal."

4) a. *Contrastive/corrective focus*

   Khaled zār   mīn? Ali?

    Khaled visited   who Ali?

    "Whom did Khaled visit? Ali?"

    b. Khaled zār   faisal$_{CF}$

      Khaled visited   Faisal

      "Khaled visited Faisal."

Alzaidi et al. (2019) investigate the acoustic cues to focus in Taif Arabic. They investigated the excursion size, maximum F0, mean F0, duration and mean intensity of the focused word and the words following and preceding the focused word. They find that the scores of excursion size, maximum F0, mean F0, duration and mean intensity of the focused word are higher than that of its neutral counterpart. Moreover, the scores of the excursion size, maximum F0, mean F0, duration and mean intensity of the words following focused words are lower than that of their neutral counterparts. This indicates that focus in Taif Arabic is encoded by the acoustic enhancement of the focused words and the post-focus compression realized in the post-focus region in which the words following focused words (if any) occur. These acoustic observation is clear in the plots in Figure 1 below. The stressed syllable is in bold, the syllable boundary is indicated by a dot, and the target word is underlined.
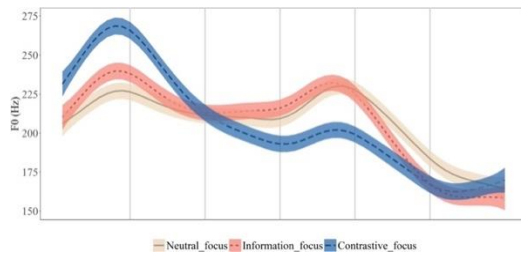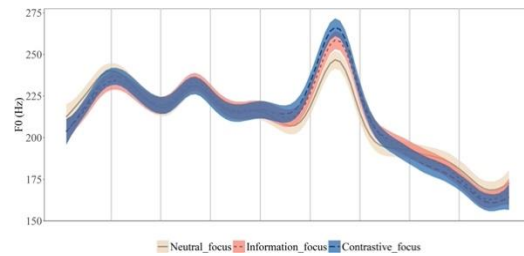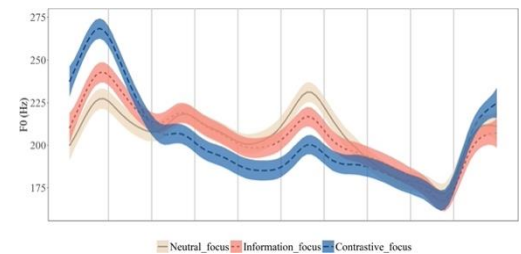
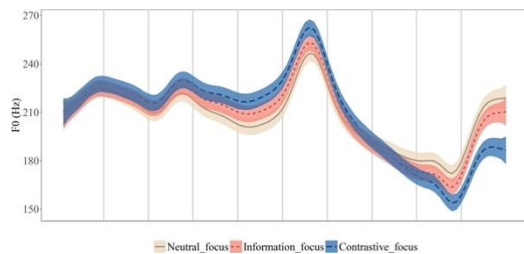(a) (**a**) /**Rā**.mi **mar Lī**.na ?**ams**/
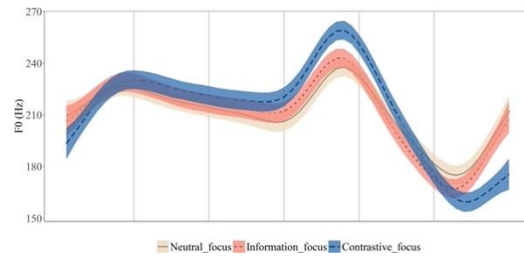
(**b**) /**Rā**.mi **mar Lī**.na ?**ams**/
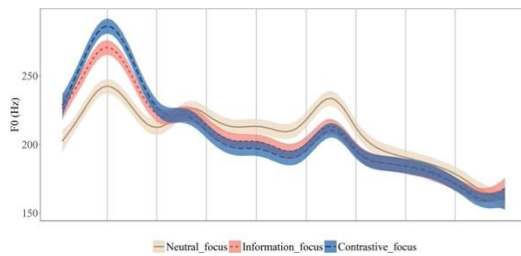
(a) (**c**) /**Ra**.na **saw**.wat mar.**yūl** li-Ma.**nāl**/

(**b**) /**Ra**.na **saw**.wat mar.**yūl** li-Ma.**nāl**/

(**a**) /**Rā**.mi **hā**.jar li-**lan**.dan al-**bā**.rih/

(**b**) /**Rā**.mi **hā**.jar li-**lan**.dan al-**bā**.rih/

Figure 1. SS–ANOVA plots of time-normalized F0 contours: The lines display F0 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. These plots are adopted from Alzaidi et al. (2019, p. 134).

The current study has two aims. First, it provides an acoustic analysis of F0 peak alignment and location to determine whether F0 peak alignment and location are further acoustic cues to focus as found empirically in other languages, as reviewed in Section 1. Second, it presents results from focus perception experiment to determine whether native speakers of Taif Arabic are able to detect focus location.

3. Production Experiment

The basic methodology of the production experiment is based on systematic comparisons between morpho-syntactically identical sentences. The section presents the methodology adopted in the production experiment, followed by the results of the experiment.

3.1 Methods

3.1.1 Test Materials

We used three four-word declaratives in (4) below, embedded in five focus contexts: neutral-focus, initial information-focus, initial contrastive-focus, penultimate information-focus and penultimate contrastive/corrective-focus context, as displayed in exemplified in Table (1) below. All the test materials used in the production experiment are in Appendix A. Stressed syllables are in bald and syllable boundaries are indicated by a dot.

(4) (a) **Rā̲.**mi **mar**   **Lī̲.**na **?ams**

      Rami visited Lina yesterday

    "Rami visited Lina yesterday."

  (b) **Ra**.na   **saw**.wat mar.**yū̲**l l   i-Ma.**nā̲l**

     Rana   made   school-dress   for-Manal

     "Rana made a school dress for Manal."

  (c) **Rā̲**.mi **hā̲**.jer   li-**lan**.dan al-**bā̲**.riħ

     Rami emigrated to-London yesterday

     "Rami emigrated to London yesterday."

Table 1. Target sentences with their translations. BF stands for neutral focus, NF stands for information focus and CF stands for contrastive/corrective focus

Prompt Question	Target Answer
Waiʃ sˤaːr? 'What happened?'	[Rā̲mi mar Līna ?ams]_{BF} 'Rami visited Lina yesterday'
man mar Līna ?ams? 'Who visited Lina yesterday?'	[Rā̲mi]_{NF} mar Līna ?ams 'Rami visited Lina yesterday'
man mar Līna ?ams? Marwaːn? 'Who visited Lina yesterday? Marwan?'	[Rā̲mi]_{CF} mar Līna ?ams 'Rami visited Lina yesterday'

man Rāmi mar ʔams?	Rāmi mar [Līna]_{NF} ʔams
'Who did Rami visit yesterday?'	'Rami visited Lina yesterday'
man Rāmi mar ʔams? Rana?	Rāmi mar [Līna]_{CF} ʔams
'Who did Rami visit yesterday? Rana?'	'Rami visited Lina yesterday'

3.1.2 Participants

16 native speakers (8 females + 8 males = total 16) participated in the experiment (mean age = 28.06, SD = 4.85 years). All participants are raised and born in Taif. They are monolingual. They did not self-report any speech or hearing disorders.

3.1.3 Recording Procedures

The recordings were made in a quiet. 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 was used. The entire set of data were saved as WAV files and transferred immediately to a MacBook Pro laptop for analysis. Materials were presented in slides, with one short anecdote per slide. After reading the projected anecdote (see Appendix A), 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. The test materials were presented in random order, and a different order was used for each subject. Only one question–answer pair was projected at a time. We added 35 mini–dialogues as fillers to prevent order effects.

We used three four-word declaratives in (4) below, embedded in five focus contexts: neutral-focus, initial information-focus, initial contrastive-focus, penultimate information-focus and penultimate contrastive/corrective-focus context, as displayed in exemplified in Table (1) below. All the test materials used in the production experiment are in Appendix A. Stressed syllables are in bald and syllable boundaries are indicated by a dot.

3.1.4 Acoustic Measurements

We used ProsodyPro script (Xu, 2013), running under PRAAT (Boersma and Weenink, 1992), to extract the F0 peak alignment and the F0 peak location defined in (5) below

5) a. **F0 Peak Alignment (ms):** Time of the F0 peak relative to the onset of a stressed syllable in milliseconds.

  b. **Location (ratio):** Relative location of the F0 peak as a proportion to the duration of a stressed syllable.

The measurements in (5) 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 (4b), 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). Once the syllable boundaries were marked by PRAAT and hand checked for errors, ProsodyPro automatically generated the measurements in (5).

3.2 Results

To examine whether focus has an effect on the F0 peak alignment and the F0 peak location, a series of Linear Mixed-Effects model were performed on F0 peak alignment (5a) and F0 peak location (5b) using the lme4 package (Bates et al., 2015) in R (R Core Team, 2019). We started with the simplest model that includes only the random intercepts for speakers and sentence type. By-speaker, by-sentence type and speaker-by-sentence type random slopes for main effects were first introduced maximally if it achieved convergence and judged to be Superior to less fully specified model. Focus condition (neutral focus, information focus and contrastive focus) was 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. All statistical effects are reported at a significance level of 0.05. As for the effect of sex on the F0 peak alignment and the F0 peak location is not our main interest, the following analysis only included focus condition as fixed effect.

Table 2 shows that focus has a significant effect only on the F0 peak alignment and the F0 peak location of the post-focus words. The mean scores show that the F0 peak alignment of the post-focus words following focus was realized earlier than that of their counterparts under neutral-focus condition. Furthermore, the location of the F0 peak of the stressed syllable of the post-focus words occurring after focus is earlier than that of their counterparts in neutral-focus utterances. This is shown clearly in Figure 2 below.

Table 2. Mean values of F0 peak alignment and it relative location under the effect of focus, together with results of Linear Mixed Models. *P* values smaller than 0.05 are in boldface.

Focus Region	Measurements	Sentence-initial focus		
		Focus conditions		
		Neutral focus	**Information focus**	**Contrastive focus**
on	**Alignment (ms)**	*M* = 130.81, *SD*= 38.29	*M* = 126.32, *SD*= 28.25	*M* = 130.81, *SD*= 38.29
		χ^2 = 3.08, *df* = 2, *p*= 0.21		
	Location (ratio)	*M* = 0.59, *SD*= 0.18	*M* = 0.67, *SD*= 0.13	*M* = 0.67, *SD*= 0.18

		$\chi^2 = 4.61$, $df = 2$, $p = 0.1$		
post	**Alignment (ms)**	$M = 112.67$, $SD = 25.98$	$M = 93.68$, $SD = 27.58$	$M = 93.56$, $SD = 32.94$
		$\chi^2 = 8.51$, $df = 2$, $p < 0.01$		
	Location (ratio)	$M = 0.57$, $SD = 0.052$	$M = 0.49$, $SD = 0.10$	$M = 0.45$, $SD = 0.12$
		$\chi^2 = 9.54$, $df = 2$, $p = 0.01$		

Focus Region	Measurements	Sentence-penultimate focus		
on	**Alignment (ms)**	$M = 104.11$, $SD = 40.57$	$M = 102.77$, $SD = 40.06$	$M = 115.00$, $SD = 39.88$
		$\chi^2 = 5.77$, $df = 2$, $p = 0.06$		
	Location (ratio)	$M = 0.53$, $SD = 0.14$	$M = 0.50$, $SD = 0.12$	$M = 0.51$, $SD = 0.13$
		$\chi^2 = 0.77$, $df = 2$, $p = 0.68$		
pre	**Alignment (ms)**	$M = 118.61$, $SD = 25.19$	$M = 117.06$, $SD = 21.56$	$M = 120.88$, $SD = 21.34$
		$\chi^2 = 0.71$, $df = 2$, $p = 0.70$		
	Location (ratio)	$M = 0.63$, $SD = 0.10$	$M = 0.62$, $SD = 0.10$	$M = 0.63$, $SD = 0.13$
		$\chi^2 = . 0.06$, $df = 2$, $p = 0.97$		
post	**Alignment (ms)**	$M = 58.23$, $SD = 28.92$	$M = 58.19$, $SD = 39.36$	$M = 48.39$, $SD = 18.73$
		$\chi^2 = 0.65$, $df = 2$, $p = 0.72$		
	Location (ratio)	$M = 0.23$, $SD = 0.12$	$M = 0.22$, $SD = 0.15$	$M = 0.19$, $SD = 0.07$
		$\chi^2 = 0.86$, $df = 2$, $p = 0.65$		

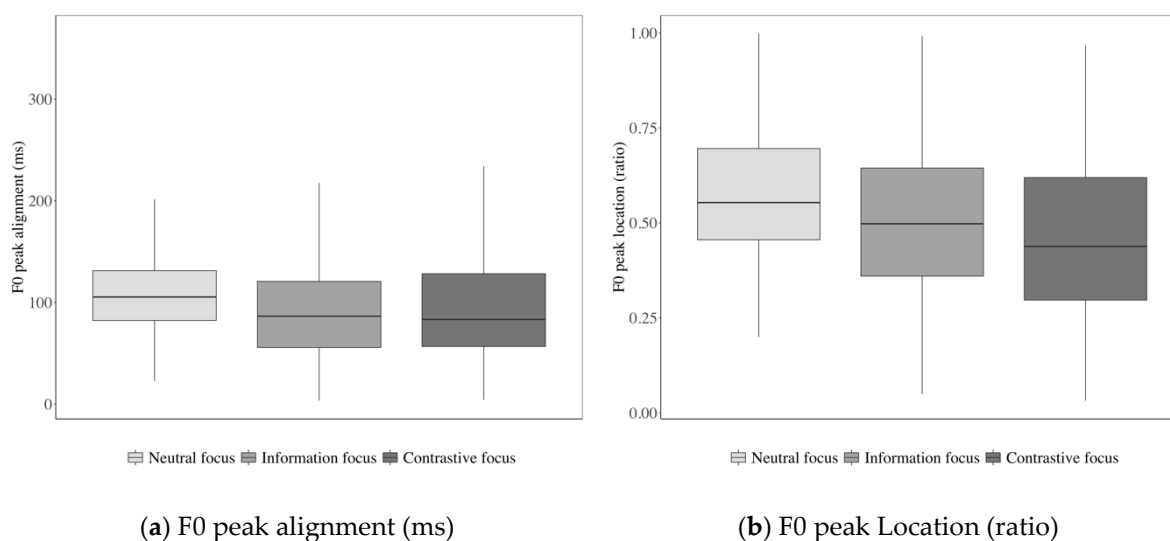(**a**) F0 peak alignment (ms)   (**b**) F0 peak Location (ratio)

Figure 2. Boxplot of values of stressed syllables of the post-focus region (i.e., when focus is sentence-initial), broken down by focus

Table 3 displays the results from the post-hoc comparisons. It confirms that there is a statistically significant post-focus lowering in F0 peak alignment and F0 peak location for peak location for both information focus and contrastive focus. Furthermore, the difference between information focus and contrastive focus in terms of the F0 peak alignment and location was not found to be significant.

Table 3. Post–hoc comparisons after Turkey adjustments. *P* values smaller than 0.05 are in boldface.

Measurements	Neutral vs. Information	Neutral vs. Contrastive	Information vs. Contrastive
Alignment (ms)	**p < 0.01**	**p < 0.01**	p $= 0.99$
Location (ratio)	**p < 0.004**	**p < 0.001**	p $= 0.15$

The measurements in (5) 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 (4b), 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). Once the syllable boundaries were marked by PRAAT and hand checked for errors, ProsodyPro automatically generated the measurements in (5).

4. Perception Experiment

4.1 Methods

4.1.1 Test Materials

The stimuli used in the perception experiment are from the production experiment presented above in Section 3.1. The stimuli included 300 utterances from four speakers (two females and two males, 3 target sentences x 5 foci x 5 repetitions x 4 speakers = 300 sentences) selected from the total of 16 speakers, using the mean score of the mean F0 across all focus conditions and all repetitions as an arbitrary criterion. The male speakers had the lowest mean F0 across all repetitions, and the female speakers had the highest mean F0 across all repetitions.

4.1.2 Participants

Twenty one native speakers of Taif Arabic participated in the experiment. They were all born and raised in Taif. They had no self-reported speech and hearing disorders and their ages ranged from 18 to 23 (*mean age* = 23.81, *SD* = 1.57 years). None of them served as a speaker in the production experiment. Participants were tested online using the Gorilla Experiment Builder (https://gorilla.sc/).

4.1.3 Procedures

Twenty one native speakers of Taif Arabic participated in the experiment. They were all born and raised in Taif. They had no self-reported speech and hearing disorders and their ages ranged from 18 to 23 (*mean age* = 23.81, *SD* = 1.57 years). None of them served as a speaker in the production experiment. Participants were tested online using the Gorilla Experiment Builder (https://gorilla.sc/).

4.2 Results

Table 4 displaces the confusion matrix of focus perception. It shows clearly that focus was identified by the native listeners of Taif Arabic correctly. The highest recognition rate of focus perception is associated with initial focus, followed by penultimate focus and then followed by neutral focus. This is visually clear in Figure 3.

Table 4. Confusion matrix of focus perception (percent). Bold face indicates correct focus identification.

Focus	Focus conditions		
	None	**Initial**	**Penultimate**
Neutral	**53%**	28%	20%
Initial information	2%	**77%**	22%
Initial contrastive	0%	**93%**	7%
Penultimate information	1%	40%	**59%**
Penultimate contrastive	0%	17%	**83%**

Overall, the results of the perception experiment test show that listeners were able to identify focus. The rate of focus recognition for initial focus is higher than that for penultimate focus. This might be attributed to the presence of post-focus compression (PFC) in utterances with initial focus but not with penultimate focus as found in this dialect by Alzaidi et al. (2019).

5. General Discussion

The present study investigated the F0 peak alignment and location and focus perception in Taif Arabic. We found only that focus had a significant effect on the F0 peak alignment and the F0 peak location on the post-focus words. That is, the F0 peak of words following focus was realized earlier than that of their counterparts in neutral focus utterances. In addition, the F0 peak location of the post-focus words were found to be higher than their neutral-focus counterparts. These findings are in line with Hellmuth (2006*a*) who found in Egyptian Arabic that the peak is aligned earlier in the post-focus words following contrastive focus than that of their counterpart occurring after information focus. This prosodic effect of focus on alignment in HA is likely to be as a result of post-focus compression, as found empirically by Alzaidi et al. (2019).

The present study also investigated focus perception. The results from the perception experiment showed that native listeners of Taif Arabic identified focus correctly. It showed that when focus is sentence-initial, the focus recognition rate was higher than when focus is sentence-penultimate (85% vs. 71%). That difference can be attributed to the presence of post-focus compression. As presented in §2, Alzaidi et al. (2019) find that post-focus compression in HA is present only when the focused word is sentence-initial. The finding of the present study supports the effectiveness of post-focus compression in focus perception,

discussed in §**??** earlier. This is demonstrated by the low rate of focus recognition obtained when focus is sentence-penultimate although there were the phonetic enhancements of on focus in excursion size, maximum F0, mean F0, mean intensity and duration as found by Alzaidi et al. (2019). Comparing the results of the present study with the results of previous studies in other languages including Beijing Mandarin, Taiwanese, Taiwan Mandarin (Xu et al., 2012) and Egyptian Arabic (Hellmuth, 2005; El Zarka and Hödl, 2021), we find the focus recognition rate in HA (59% - 93%) is quite similar to the what has been found in Beijing Mandarin (66.7%-90.9%), but is substantially higher than in Taiwanese (45.3% - 59.3%) and in Taiwan Mandarin (63.3% - 73.3%). Comparing our results from the results from Hellmuth (2005) and El Zarka and Hödl (2021), we see that native speakers of Taif Arabic detected the focus prosody in a higher percentage than what is found by Hellmuth (2005) and El Zarka and Hödl (2021) in Egyptian Arabic. The finding of the present study adds another piece of evidence demonstrating the possibility of effectiveness of PFC for effective encoding of focus (Xu, 2011; Xu et al., 2012).

6. Conclusion

The contributions of the present study are summarized as follows. First, the present study showed that focus had a statistically significant effect on the F0 peak alignment and the F0 peak location only in the post-focus region, similar to what is found in Egyptian Arabic by (Hellmuth, 2006*a*). Second, the results of the perception experiment presented in the present study demonstrated the effectiveness of PFC in focus perception; i.e., its presence in initial focus lead to over 93% focus recognition, whereas the lack of it in penultimate focus lead to less than 83%.

These findings, when considered in conjunction with other recent findings, suggest that information focus and contrastive focus in Arabic dialects studied so far are not distinguished based on the peak alignment and location. Moreover, PFC is possibly a useful prosodic cue to focus perception. We hope that this paper shed light on the F0 peak alignment and peak location and the effectiveness of PFC for focus perception in HA, which future studies on Arabic dialects, that have not investigated yet, will be able to examine the effect of focus on F0 peak alignment and location and also the perception of focus to verify the importance of prosodic cues to focus found in the recent production experiments.

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Appendix A. Test Materials

A.1 Neutral Focus

Scenario 1:

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.

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:

1) Ra:mi   mar   Li:na   ʔams

    Rami   visited   Lina   yesterday

    `Rami visited Lina yesterday.'

Scenario 2:

رنا و منال أخوات   . رنا أكبر من منال . أبوهم مات و أمهم مريضة متنومة   في المستشفى. بسبب فقرهم، رنا بطلت الدراسة. و اشتغلت خياطه حتى تصرف على البيت . منال توها سجلت في المدرسة. المدرسة طالبه| 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:

2) <u>Rana</u> sawwat   maryuu:l li-Mana:l

Rana   made   school-dress   for-Manal

"Rana made a school dress for Manal."

Scenario 3:

رامي كان عايش في مصر لمدة طويلة. وكان يشتغل هناك . كانت وظيفته حلوه . و يجيله راتب حلو . 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 emigrated to London yesterday.

Target sentence:

3) Ra:mi   ha:jerli-lan.dan   al-ba:.riħ

Rami   emigrated to-London yesterday

'Rami emigrated to London yesterday.'

A.2. "Narrow" Information Focus (Focus on sentence-initial word)

Scenario 1:

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:

4) Ra:mi   mar   Li:na   ʔams

    Rami   visited   Lina   yesterday

    `Rami visited Lina yesterday.'

Scenario 2:

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:

5) <u>Rana</u> sawwat   maryuu:l li-Mana:l

    Rana   made   school-dress   for-Manal

    "Rana made a school dress for Manal."

Scenario 3:

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 emigrated to London yesterday. As for Rami, he quitted his job and works in a factory.

Target sentence:

6) Ra:mi   ha:jerli-lan.dan   al-ba:.riħ

    Rami   emigrated to-London yesterday

    'Rami emigrated to London yesterday.'

A.3 "Narrow" Information Focus (Focus on sentence-penultimate word)

Scenario 1:

رامي عنده أخت اسمها لينا. رامي عايش في الطائف و لينا عايشه في جده. لهم فترة طولية 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:

7) Ra:mi   mar   Li:na   ʔams

Rami   visited   Lina   yesterday

`   Rami visited Lina yesterday.'

Scenario 2:

رنا خياطة ماهرة. وناس كثير تطلب منها تسوي لها فساتين. منال طالبة ثانوية. قبل ما تبدأ المدرسة طلبت من رنا تسويلها 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:

8) <u>Rana</u> sawwat   maryuu:1 li-Mana:l

Rana   made   school-dress for-Manal

"Rana made a school dress for Manal."

Scenario 3:

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 emigrated to London yesterday.

Target sentence:

9) Ra:mi   ha:jerli-lan.dan   al-ba:.riħ

Rami   emigrated to-London yesterday

'Rami emigrated to London yesterday.'

A.4 "Narrow" Contrastive Focus (Focus on sentence-initial word)

Scenario 1:

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:

10) Ra:mi   mar   Li:na   ʔams

Rami   visited Lina   yesterday

`Rami visited Lina yesterday.'

Scenario 2:

<div dir="rtl">

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

</div>

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:

11) <u>Rana</u> sawwat   maryuu:l li-Mana:l

   Rana   made   school-dress for-Manal

   "Rana made a school dress for Manal."

Scenario 3:

<div dir="rtl">

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

</div>

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

Target sentence:

12) Ra:mi   ha:jerli-lan.dan   al-ba:.riħ

   Rami   emigrated to-London yesterday

   'Rami emigrated to London yesterday.'

A.5 "Narrow" Contrastive Focus (Focus on sentence-penultimate word)

Scenario 1:

<div dir="rtl">

رامي و مروان و لينا أخوان. رامي عايش في الطائف. و مرون ولينا عايشين في جده. 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 جده. لكن أمس و بدون محد يتوقع رامي راح جده و مر لينا و جلس معها هناك.

</div>

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:

13) Ra:mi   mar   Li:na   ?ams

   Rami   visited Lina   yesterday

`Rami visited Lina yesterday.'

Scenario 2:

منال طالبة ثانوية. طلبت من أمها إنها تفصل مريول و مريلة عند رنا الخياطة. أمها وافقت إنها تفصل مريول عند رنا. لكنها رفضت إنها تخلي رنا تفصلها مريلة. 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:

14) <u>Rana</u> sawwat   maryuu:l li-Mana:l

    Rana   made   school-dress for-Manal

    "Rana made a school dress for Manal."

Scenario 3:

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 emigrated to London yesterday and Marwan to Saudi.

Target sentence:

15) Ra:mi   ha:jerli-lan.dan   al-ba:.riħ

    Rami   emigrated to-London yesterday

    'Rami emigrated to London yesterday.'

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