Do Persian Native Speakers Prosodically Mark Wh-in-situ Questions?

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Abstract
It has been shown that prosody contributes to the contrast between declarativity and interrogativity, notably in interrogative utterances lacking lexico-syntactic features of interrogativity. Accordingly, it may be proposed that prosody plays a role in marking wh-in-situ questions in which the interrogativity feature (the wh-phrase) does not move to sentence-initial position, as, for example, in Persian. This paper examines whether prosody distinguishes Persian wh-in-situ questions from declaratives in the absence of the interrogativity feature in the sentence-initial position. To answer this question, a production experiment was designed in which wh-questions and declaratives were elicited from Persian native speakers. On the basis of the results of previous studies, we hypothesize that prosodic features mark wh-in-situ questions as opposed to declaratives at both the local (pre- and post-wh part) and global level (complete sentence). The results of the current study confirm our hypothesis that prosodic correlates mark the pre-wh part as well as the complete sentence in wh-in-situ questions. The results support theoretical concepts such as the frequency code, the universal dichotomous association between relaxation and declarativity on the one hand and tension and interrogativity on the other, the relation between prosody and pragmatics, and the relation between prosody and encoding and decoding of sentence type.

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Introduction

Wh-questions are expressions that use wh-phrases to enquire about desired information. There are two types of wh-questions: fronted wh-questions and wh-in-situ questions. In fronted wh-questions, which occur in languages such as English, the wh-phrase moves to the beginning of the sentence to form a wh-question (Carnie, 2007; Chomsky, 1977; see example 1):

(1)   a. Mary carries a book.
      b. What does Mary carry?

On the other hand, there are languages, including Persian, in which the wh-phrase is not required to move to sentence-initial position to form a wh-question. In Persian, wh-questions are in situ by default (Abedi, Moinzadeh, & Gharaei, 2012; Adli, 2010; Gorjian, Naghizadeh, & Shahramiri, 2012; Kahnemuyipour, 2009; Karimi, 2005; Karimi & Taleghani, 2007; Lotfi, 2003; Megerdoomian & Ganjavi, 2000; Mirsaeedi, 2006; Toosarvandani, 2008).[1] In wh-in-situ questions, the wh-phrase occurs at the same site as its declarative counterpart is expected to occur (2).

(2)   a.
      mærjæm   diruz   ketɑb   xærid.
      Maryam   yesterday book   buy.PAST.3SG.
      "Maryam bought a book yesterday."
      b.
      mærjæm   diruz   tʃi   xærid?
      Maryam   yesterday what   buy.PAST.3SG.
      "What did Maryam buy yesterday?"

In fronted wh-questions (1b), the fronted wh-element indicates the clause type at the very beginning of the sentence. In this way, the syntactic structure reveals the sentence type once the first word of the fronted wh-question is uttered. However, in the case of wh-in-situ questions (2b), the syntactic structure does not designate the clause type at the beginning of the sentence.

According to Van Heuven and Haan (2000), the hyper- and hypo-theory of speech production (Lindblom, 1990) suggests that prosodic interrogativity marking will be weaker when lexico-syntactic interrogativity markers are available in the sentence, whereas prosodic interrogativity cues will be stronger when lexico-syntactic features of interrogativity are absent or are fewer in the sentence. In addition, Ohala (1983, 1984), Bolinger (1978) and lately Gunlogson (2008) states that prosody is the defining property of a declarative question. Ohala's (1983, 1984), Bolinger's (1978), Gunlogson's (2008) and Lindblom's (1990) proposals can be applied to interrogatives where the lexico-syntactic interrogativity feature occurs later in the sentence, as in wh-in-situ questions. The absence of the wh-phrase in sentence-initial position in Persian wh-in-situ questions raises the question, therefore, as to whether or not the prosody of a sentence is indicative of the sentence type. In addition, the occurrence of the interrogativity marker at a later point in the sentence brings focus to the role of prosody in characterizing the pre-wh part (i.e., the part of the sentence before the wh-phrase) as compared with the post-wh part (i.e., the part of the sentence after the wh-phrase) of the sentence.

The organization of this paper is as follows. Section 2 provides an overview of the available literature on the prosody of interrogatives in different languages and on wh-questions in Persian.

Section 3 contains the details of the experiment. Section 4 elucidates the analysis of the data and Section 5 discusses the results and concludes the paper.

2 Prosody of interrogatives

This section first presents an overview of the literature on the prosody of interrogatives in different languages (Section 2.1) and after that on the prosody of Persian wh-in-situ questions (Section 2.2).

2.1 Interrogatives in different languages

Research on the acoustic features of questions in different languages has concentrated mainly on the prosodic features of yes-no questions and declarative questions. Some work has been done on the acoustic correlates of the prosody of fronted and wh-in-situ questions.

Hermann (1942) argued that interrogatives are universally marked by the presence of a high pitch somewhere in the sentence. Subsequent studies demonstrated that high pitch may manifest itself both locally, for example, in the initial, medial, or final portion of the sentence (Benkirane, 1998; Cheng & Rooryck, 2000; Haan, 2001; Haan, Van Heuven, Pacilly, & Van Bezooijen, 1997; Gryllia, Cheng & Doetjes, 2016; Hadding-Koch, 1961; Hadding-Koch & Studdert-Kennedy, 1964; Ishihara, 2005; Iivonen, 1998; Kitagawa, 2005; Sadat Tehrani, 2008, 2011; Uldall, 1962; Yang, Gryllia, Doetjes & Cheng, 2016 September) and globally, for example, in the form of a raised register and/or the absence of F0 downtrend (Bolinger, 1982; Geluykens, 1986; Haan, 2001; Haan et al., 1997; Inkelas & Leben, 1990; Lindsey, 1985; Sadat Tehrani, 2008, 2011; Thorsen, 1980; Vaissière, 1983).

According to Hadding-Koch (1961), Hadding-Koch and Studdert-Kennedy (1964), and Uldall (1962), interrogatives can be distinguished from declaratives by the presence of a terminal rise in Swedish and American English. The studies conducted by Bolinger (1982) and Geluykens (1986) revealed that a raised pitch register level differentiates interrogatives from declaratives in American English. Thorsen (1980) showed that the absence of F0 downtrend differentiates interrogatives from declaratives in Danish.

Different types of questions in Dutch are marked by several (different) prosodic features as opposed to statements: a) a higher level of pitch register marks yes–no, declarative, and wh-questions; b) a steeper F0 downtrend marks wh-questions and an F0 inclination marks yes–no and declarative questions; c) a higher F0 onset marks yes-no and wh-questions; d) a greater excursion size of pitch accents marks yes-no and declarative questions; e) a final rise marks yes–no and declarative questions and some instances of wh-questions (Haan, 2001; Haan et al., 1997); and f) a shorter duration marks declarative questions (Van Heuven & Van Zanten, 2005).

Sadat Tehrani (2008, 2011) reported that echo questions and tag questions have a high boundary tone. Based on qualitative analysis, Sadat Tehrani (2008, 2011) concluded that Persian leading yes–no questions have a higher pitch register as opposed to declaratives and yes–no questions are marked by a final rise, a greater excursion size of the pitch accents, less declination, a higher pitch register, and final lengthening.

In Finnish (Iivonen, 1998) and Western Arabic (Benkirane, 1998) questions are reported to have higher onsets than the corresponding statements. Questions in Hausa have a raised pitch register level (Inkelas and Leben, 1990) and shorter duration in comparison with declaratives (Lindsey, 1985). In Manado Malay and Orkney English yes–no questions have a decreased duration in comparison with declaratives (Van Heuven & Van Zanten, 2005). Cangemi and D'Imperio (2013) found in their study on a Neapolitan regional variety of Italian that durational differences between questions and statements are localized in specific portions of the sentence

(i.e., the first and the last segment) and that the global duration of questions does not differ from that of declaratives.

According to Lee (1990), wh-in-situ questions in Korean usually end with a fall, but a rise can also occur at the end. The wh-phrase in Korean wh-in-situ questions carries the last accentual phrase of the sentence and the post-wh part is de-accentuated (Jun & Oh, 1996).

Similar to Korean wh-in-situ questions, the wh-phrase in Tokyo Japanese wh-in-situ questions carries the emphatic accent (Ishihara, 2005; Kitagawa, 2005). This emphatic accent consists of a sharp rise in F0 followed by a fall on the wh-phrase. The post wh-phrase in Japanese wh-in-situ questions is characterized by a post-focus F0 reduction, which suppresses all lexical accents and continues until the end of the sentence. Ishihara (2005) calls this prosodic pattern focus intonation (FI), that is, the F0-peak of the wh-phrase is boosted (focus F0-boosting), while the F0-peaks of the post-wh-phrase are reduced significantly (post-focus F0-reduction). The end of wh-in-situ questions in Japanese is marked by a rise in F0 (Ishihara, 2005; Kitagawa, 2005).

According to Yang et al. (2016 September), several prosodic features differentiate Mandarin wh-in-situ questions containing the wh-phrase preceded by "dianr" from their matching declaratives, namely: a) the pre-wh part in wh-questions has a shorter duration than declaratives; and b) the post-wh part in wh-questions has a higher pitch but a smaller F0 range in comparison with declaratives. The authors suggested that the smaller F0 range in the post-wh part of wh-questions can be an indication of post-focal compression caused by the wh-phrase. Jorrisen's (2014) data on wh-in-situ questions in Mandarin Chinese demonstrated a shorter duration of the complete sentence compared with their declarative counterparts.

French wh-in-situ questions exhibit a rising intonation, similar to the intonation of yes–no questions in the same language (Cheng & Rooryck, 2000). However, several other researchers (e.g., Beyssade, Delais-Roussarie, & Marandin, 2007; Hamlaoui, 2008, 2011; Zubizarreta, 2003) have argued against the idea that French wh-in-situ questions are required to have a rising intonation contour. Similar to Mandarin Chinese wh-in-situ questions, the pre-wh part (i.e., the subject and the verb) in French wh-in-situ questions is marked by F0 and durational properties as opposed to the same part in declaratives (Gryllia et al., 2016). The first syllable of declaratives with mono-syllabic subjects has a longer duration in comparison with the matching wh-question. In addition, the low tone (L) realized on the verb is higher and its penultimate syllable is longer in declaratives. There is also a pitch rise on the final syllable of the verb in declaratives while pitch remains flat and low on the corresponding syllable in wh-questions. Finally, the wh-word carries an emphatic accent.

Summarizing the results of studies on interrogatives in different languages, we can state that there appears to be considerable cross-linguistic evidence that interrogativity is associated with local and global prosodic characteristics that set this sentence type apart from declaratives. As such, this study intends to investigate whether the prosodic encoding of interrogatives can be generalized to Persian wh-in-situ questions.

2.2 Wh-questions in Persian

A few studies have been conducted on the intonation system of Persian, all of which revolve around the phonological description of the accentual structure of different sentence types, including wh-questions and declaratives. This section presents a summary of these phonological studies.

Towhidi (1974) studied the Persian intonation system within the theoretical framework of British tradition (Crystal, 1969). He defined Persian intonation based on prosodic and paralinguistic features, dividing speech into tone units which consist of at least one syllable. Each tone unit is

divided into prehead, head, nucleus, and tail. The presence of prehead, head, and tail are optional whereas one nucleus must be present in each tone unit. He identified three major categories of tones for Persian, that is, simple, compound, and complex.

Mahootian (1997) identified five types of intonation patterns for Persian: rising–falling, mid-rising, low-rising, mid-falling, and high-falling. High-falling intonation is typical of wh-questions. It starts at a high level and falls at the end of the question. According to Mahootian, the intonation peak in wh-questions is on the wh-phrase. A possible reason for the occurrence of the intonation peak on the wh-phrase might be the focus nature of the wh-phrase in wh-questions.

Mahjani (2003) applied the autosegmental-metrical (AM) framework to study the prosody of different types of Persian sentences. He stipulated an accentual phrase (AP), an intermediate phrase (iP), and an intonation phrase (IP) as the levels of the Persian intonation system. The AP is the smallest unit of the Persian prosodic system, consisting generally of one content word. The AP is represented by either a L+H* or a H* pitch accent. Mahjani proposed that a L+H* pitch accent is assigned to polysyllabic words which are not initially stressed. Initially stressed content words and monosyllabic content words are assigned the H* pitch accent. He posited that the starred tone of the AP is assigned to the accented (stressed) syllable of the word and the L tone is associated with the syllables preceding the accented syllable. Stress is usually realized on the last syllable of words in Persian (Kahnemuyipour, 2003; Sadat Tehrani, 2008). AP and its boundary tone account for the F0 movement within a content word. Based on Mahjani, one or more APs form the iP. The end of an iP is demarcated by low (L-) or high (H-) tones, which are called phrase accents. The phrase accent characterizes the pitch from the last pitch accent to the end of the iP (for a definition see Sadat Tehrani, 2008).[2] The IP as the highest level of the Persian intonation system is composed of at least one iP. It can have either a low (L%) or a high (H%) boundary tone (Mahjani, 2003). IP boundary tones define the F0 contour from the end of the iP boundary tone to the end of the IP (Sadat Tehrani, 2008).

Esposito and Barjam (2007) used tone and break indices (Silverman, Beckman, Pitrelli, Ostendorf, Wightman, Price, Pierrehumbert, & Hirschberg, 1992) labeling conventions to investigate prosody of different types of questions including wh-questions in Persian. They proposed a two-level intonational structure for questions: an AP and an IP. The domain of an AP is a single content word. Each AP contains a pitch accent and ends with either a low or a high tone. The pitch accent is realized as L+H*, L+^H* (^H* denoting an extra high rise), H*, or ^H *. The starred tone is associated with the stressed syllable of the word and the unstarred tone is associated with the syllables preceding the stressed syllable. One or more APs form an IP, the end of which is marked by a L-L%, L-H%, H-^H%, or an H-L% boundary tone. An AP accounts for the F0 movement within a content word and the IP and its boundary tone define the F0 contour from the end of the last AP to the end of the IP.

Sadat Tehrani (2008) examined the intonation of Persian sentences within the AM framework. He argued for a two-level hierarchy for the Persian intonation system. This two-level hierarchy is composed of an AP and an IP. Tehrani considered the AP as the smallest unit of Persian prosody. The AP can consist of a content word or a compound noun. He proposed that the regular AP of Persian has the pitch accent L+H* or H* and every content word in Persian is associated with a pitch accent. The L+H* pitch accent is associated with polysyllabic words with the stress on the final syllable. The H* pitch accent is assigned to monosyllabic content words and initially stressed words. The right edge of the AP is marked by either a low (l) or a high (h) boundary; if the AP contains the nuclear pitch accent (NPA; the last pitch accent in an IP), it carries a low (l) boundary tone, otherwise it carries a high (h) boundary tone. The pitch accent of an AP accounts for the F0 changes within a content word and the boundary tone of an AP handles the F0 changes between the
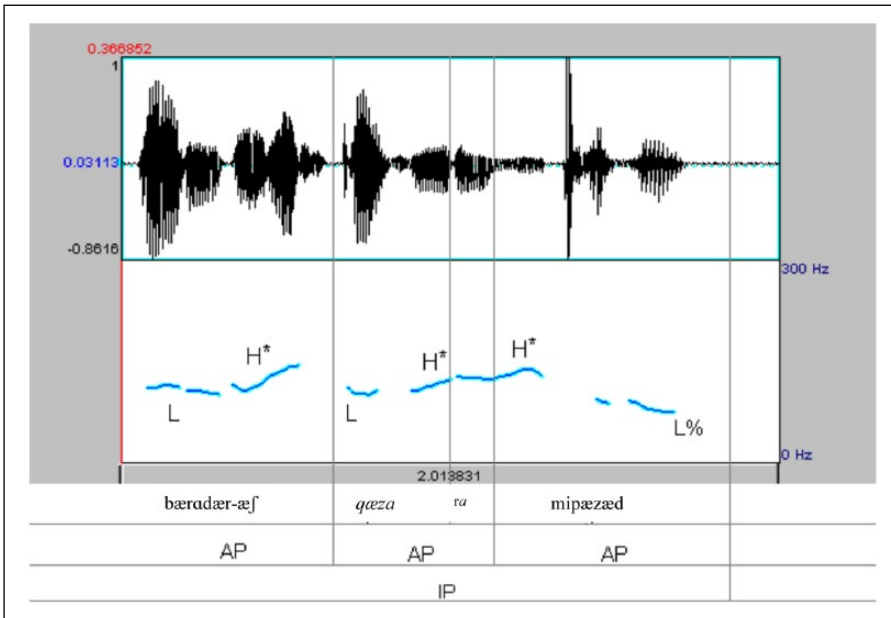
Figure 1. Prosodic structure of a simple sentence in Persian (from Mahjani, 2003, p. 38). Three accentual phrases (AP) comprise an intermediate phrase (iP) and the iP comprises an intonation phrase (IP). Mahjani (2003) does not mark the iP in this figure as there is only one iP in the prosodic structure of this sentence which is dominated by an IP. The English equivalent of the sentence is "His brother cooks the food."

last tone of the pitch accent and the end of the AP. The next level of Persian prosody is the IP. It is composed of one or more APs, one of which contains the NPA. The right edge of an IP is marked by a low (L%) or high (H%) boundary tone. The prosodic structure proposed by Sadat Tehrani (2008) does not include the level iP and its tone, the phrase accent. He suggested that the AP boundary tone can account for the part of the F0 contour that Mahjani (2003) referred to as iP and its tone: the F0 contour from the last pitch accent to the end of the IP. Figure 1 presents an example of the prosodic structure of a simple Persian sentence.

According to Mahjani (2003), Esposito and Barjam (2007), and Sadat Tehrani (2008), the intonational structure of wh-questions is similar to that of declaratives in that the IPs of both sentence types contain a series of APs and end with a L% boundary tone. The place of the NPA in a declarative sentence depends on the syntactic structure of the sentence and the verb type (for details of the place of the NPA in declaratives the reader is referred to Sadat Tehrani, 2008). However, the wh-word in wh-questions attracts the NPA as it is the most prominent word regarding the information structure of the sentence. The part of the sentence following the NPA in both declaratives and wh-questions is de-accented. According to Sadat Tehrani (2008), in wh-questions and declaratives with a contrastive focus item, the NPA is assigned to the contrastive focus item. Therefore, the wh-phrase in a wh-question with a contrastive focus item will not carry the NPA unless it is the contrastive focus of the sentence.

Previous studies on Persian prosody did not provide a comparative account of the acoustic features of wh-in-situ questions and declaratives. The current study is an attempt to systematically explore and compare global and local acoustic features of Persian statements and wh-questions with a focus on the pre- and post-wh parts of the sentence. Studying the differences in the acoustic correlates of the pre- and post-wh parts in declaratives and interrogatives is novel and important.

The prosody of wh-in-situ questions is an understudied area of research in general, and there is no study on their prosodic correlates in Persian. The present study can reveal whether prosodic properties of wh-in-situ questions tend to localize in the pre-wh part only, as prosodic information is most needed where the syntactic ambiguity is maintained, or whether they are distributed throughout the sentence.

3 Research questions, hypotheses, and approach

3.1 Research questions and approach

The present study is concerned with the intonational properties of interrogativity in Persian wh-in-situ questions, with the main aim of investigating whether the prosodic correlates of interrogativity characterize the pre-wh part in wh-questions.

The interrogative marker in Persian wh-in-situ questions (i.e. the wh-phrase), which is the lexical cue to sentence type, occurs in the same position as the non-interrogative phrase in a declarative sentence (see example (2)). The pre-wh parts in wh-in-situ questions and matching declaratives are lexically and syntactically identical. The pre-wh part precedes the lexical cue to the sentence type. This means that sentence type ambiguity resides in the pre-wh part. The main focus of the experiment is on the role of prosody in characterizing the pre-wh part in the production of wh-in-situ questions as opposed to declaratives. On the basis of the dominant focus of the experiment, the first research question (RQ1) is formulated as: do global and local F0 properties and the duration of the pre-wh part mark wh-in-situ questions as compared with declaratives? The global F0 properties refer to pitch register and the overall F0 trend and the local F0 properties refer to F0 onset and the size of the pitch accents of the pre-wh words. The answer to RQ1 not only sheds light on the role of prosody in encoding sentence type, but also lays the ground for further investigation into the role of prosody in decoding sentence type before the appearance of the wh-phrase.

Similar to the pre-wh parts, the post-wh parts in wh-in-situ questions and matching declaratives are lexically and syntactically the same. However, the post-wh part follows the lexical cue to sentence type. This means that sentence type ambiguity is not maintained in the post-wh part, rather that ambiguity is resolved as soon as the wh-phrase occurs. RQ1 taps into the role of prosody in disambiguating the syntactically ambiguous part of the sentence. However, it cannot illustrate whether prosodic characteristics of wh-in-situ questions are distributed throughout the sentence or tend to localize in the pre-wh part. Therefore, a second research question (RQ2) was added: do F0 properties and the duration of the post-wh part characterize wh-in-situ questions?[3] The F0 properties in this question refer to pitch register, overall trend of F0, and F0 offset. The presence of the wh-phrase causes de-accentuation in the post-wh part in wh-questions, but there can be pitch accent(s) in the post-wh part in declaratives depending on the non-interrogative phrase (Sadat Tehrani, 2008). Therefore, the excursion sizes of the pitch accents in the post-wh part are not compared. RQ1 and RQ2 enable us to compare the role of prosody in characterizing wh-in-situ questions before and after the occurrence of the lexical cue to the sentence type.

Investigating the prosodic correlates of the pre- and post-wh parts (RQ1 and RQ2) gives information on the role of prosody in characterizing questions at a more local level. However, if and how prosodic correlates characterize questions at a more global level is also unclear. Therefore, the final research question (RQ3) was formulated: do global F0 properties and the duration of the complete sentence distinguish in-situ wh-questions from declaratives? The global F0 properties in RQ3 refer to pitch register and overall trend of F0.

RQ2 and RQ3, along with RQ1, provide a complete picture of the prosodic informativity of the entire sentence. This picture contributes to the investigation of the applicability of the hyper- and

hypo-theory of speech (Lindblom, 1990) to interrogatives where lexico-syntactic features of interrogativity appear later in the sentence.

Though the pre- and post-wh parts in declaratives and matching wh-questions are lexically and syntactically the same, the wh-phrase and the non-interrogative phrase necessarily consist of different words. As such, the acoustic features of the wh-phrase in wh-questions and the non-interrogative counterpart in declaratives are not compared.

To answer the three research questions, a question–response task was designed in which 40 declaratives and 40 wh-questions were elicited from 18 Persian native speakers.

3.2. Hypotheses

On the basis of the findings of previous studies on the prosody of interrogatives in different languages, we expect wh-questions to be prosodically marked by global prosodic features of (i) less declination (Haan, 2001; Haan et al., 1997; Sadat Tehrani, 2011; Thorsen, 1980; Vaissière, 1983), (ii) a raised level of pitch register (Bolinger, 1982; Gluykens, 1985; Haan, 2001; Haan et al., 1997; Hermann, 1942; Inkelas & Leben, 1990; Lindsey, 1985; Sadat Tehrani, 2011), and (iii) a shorter duration (Jorrisen, 2014; Lindsey, 1985; Van Heuven & Van Zanten, 2005), and local prosodic features of (i) a higher F0 onset (Benkirane, 1998; Haan, 2001; Hermann, 1942; Iivonen, 1998), and (ii) a higher F0 offset (Haan, 2001), in the absence of the interrogativity marker in sentence-initial position. A greater excursion size of the pitch accents is expected to be associated with the pre-wh words in wh-questions according to Haan's (2001) and Haan et al.'s (1997) study on Dutch declarative questions and Sadat Tehrani's (2008, 2011) qualitative report on Persian yes-no questions.

We further expect both the pre- and post-wh parts to be characterized by (i) a shorter duration (Jorrisen, 2014; Lindsey, 1985; Van Heuven & Van Zanten, 2005; Yang et al., 2016 September) and (ii) a raised level of pitch register. Based on the general trend of F0 in questions reported in Haan (2001), Haan et al. (1997), Thorsen (1980) and Vaissière (1983), less declination is predicted for the pre-wh part. However, based on the de-accentuation that is reported for the post-wh part in different languages, including Persian (Mahjani, 2003; Sadat Tehrani, 2008, 2011), a steeper declination is expected for the post-wh part.

4 Experiment

4.1 Method

4.1.1 Participants. Eighteen native speakers of standard Persian (9 males and 9 females) between the ages of 24 and 42 years participated in the production experiment. All of them were university students or university lecturers at different universities in Tehran.

4.1.2 Materials. The materials of this experiment represent two main conditions: (i) wh-in-situ questions and (ii) declaratives. We composed a corpus of 40 sentences for each condition, which means that each participant produced 80 sentences. The structure of the wh-questions and declaratives used in this experiment is presented in (3) and (4), respectively:

(3) Subj	Adv	Wh-phrase	Verb
(4) Subj	Adv	ADO/IDO/AdjT/AdjM/AdjP	Verb

Subject is abbreviated as Subj, adverb as Adv, animate direct object as ADO, inanimate direct object as IDO, adjunct of time as AdjT, adjunct of manner as AdjM and adjunct of place as AdjP. ADO, IDO, AdjT, AdjM, and AdjP will be referred to as declarative wh-phrase counterparts

(DWCs). Different categories of DWCs in example (4) are separated by slashes to illustrate that each declarative includes only one of the categories of DWCs. An example of a declarative and a matching wh-question is given in (5a) and (5b). Stressed syllables are underlined in the phonetic transcription.[4]

(5) a. mohæmædʔæ<u>min</u>   pæri<u>ruz</u>   ʔæs<u>r</u>   ʃenɑ-<u>kæ</u>rd.
    Mohamadamin   two days ago   afternoon   swim- do.PAST.3SG
    'Mohamadamin swam in the afternoon two days ago.'

   b. mohæmædʔæ<u>min</u>   pæri<u>ruz</u>   <u>kej</u>   ʃenɑ-<u>kæ</u>rd?
    Mohamadamin   two days ago   when   swim- do.PAST.3SG
    'When did Mohamadamin swim two days ago?'

The sentences in both conditions were structured so as to be minimally different to provide the best comparison across conditions. Moreover, sentences were composed of the same number of words and syllables in both conditions. To avoid the effect of pitch perturbation caused by obstruents (Ladd, 2008), we tried to use words consisting of sonorants as much as possible. However, in some cases it was not possible to avoid certain stops, e.g. /k/ in the word *kodʒa* "where."

As illustrated in examples (3) and (4), the questions and declaratives are both constructed of four constituents, three of which are the same (the subject, the adverb, and the final verb), and only the third constituent differs: it is either a wh-phrase or a DWC. Appendix 1 presents the structure and the list of the words used in both sentence types. There are two variations for each category of the DWC in declaratives (2 Subj * 2 Adv * 2 DWCs * 5 verbs), hence there are 40 statements. The DWCs were varied so the result will not be limited to only one variation of argument or adjunct. In wh-in-situ questions, we have the same two subjects, two adverbs, five wh-phrases, and matching verbs, and all sentences are presented twice (2 Subj * 2 Adv * 5 wh-phrases * 2 repetitions) resulting in 40 wh-question stimuli. The total number of stimuli elicited from all participants is 1440 (40 stimuli per sentence type * 2 sentence types * 18 speakers).

4.1.3 Procedure. Participants were recorded using a high-quality microphone (Sennheiser PC 141 Headset) and a digital recorder (M-Audio MicroTrack II) in a quiet room. The target sentences were elicited from participants in a question–answer task. Declaratives and wh-questions were put into two separate blocks. These blocks were presented in a counter-balanced order, whereby half of the participants received the questions first while the other half were presented with the declaratives first. The sequence in which the sentences within each block were elicited was randomized per participant. Prior to conducting the main experiment, participants took part in a practice session. They were instructed that they would see a question and the target sentence on the computer screen. Simultaneously, they heard the question (also shown on the computer screen) read to them by a trained speaker, namely the first author of this article. The participants were asked to read the sentence (either a declarative or a wh-question) in response to the question they heard. The basic form of the questions asked by the experimenter to elicit wh-question stimuli from participants is given in (6).

(6)   You know that Mohamadamin swam two days ago. In order to know when he swam, what would you ask?

The wh-question produced by the participants in response to (6) is (5b). All of the declaratives were produced in response to the question "what happened?"[5] Each stimulus accompanied by a spoken question was presented one at a time. Participants were asked to act as naturally as possible when producing the sentences. They were also told that if they made a mistake, such as an unusual pause when producing the sentence or incorrect pronunciation of the words, they should produce

the sentence again. The entire session took about 25 minutes for each participant and they were given a five-minute break in the middle of their session.

4.2 Data analysis

4.2.1 Segmentation. The sentences were analyzed and segmented in Praat Version 6.0.04 (Boersma & Weenink, 2014). The beginning and the end of the sentences were determined and the boundaries of the pre- and post-wh parts were indicated manually. The subject plus the adverb construct the pre-wh part of the sentence in both declaratives and wh-questions. Next, the pre-wh part was segmented into the subject and the adverb. The post wh-part was not segmented.

4.2.2 Acoustic correlates

4.2.2.1 Definition of the acoustic correlates. This section presents the definition of the acoustic features that are the target of the current study. F0 onset and offset are the F0 of the first and the last voiced frame of a segment (phoneme, word, sentence) (Haan, 2001). Pitch register is defined as the pitch mean of the sentence following Rietveld and Vermillion (2003). Declination is the gradual time-dependent lowering of F0 in the course of an utterance or a text (e.g., Cohen & 't Hart, 1967; Liberman & Pierrehumbert, 1984). The slope of the regression line is taken as a measure of declination (Lieberman, Katz, Jongman, Zimmerman, & Miller, 1985; Swerts, Strangert, & Heldnert, 1996). A pitch accent is "a local feature of a pitch contour — usually but not invariably a pitch range, and often involving a local maximum and minimum — which signals that the syllable with which it is associated is prominent in the utterance" (Ladd, 2008, p. 42). The pitch accents in Persian are described as H* or L+H* (see Section 2.2), in which the starred tone is associated with the stressed syllable. Pitch excursion can be defined as "the size of a local pitch movement" (Ladd, 2008, p. 69). The following section explains how these phonetic correlates were measured.

4.2.2.2 Measurement of the acoustic correlates. According to the findings of the literature on interrogatives in several languages and based on our predictions, separate scripts were run in Praat to extract the slope of the regression line, the pitch mean and the duration of the pre-wh part (see Figures 2 and 3), the post-wh part and the complete sentence.[6] The excursion size of the pitch accents associated with the pre-wh words (see Figures 2 and 3) and the F0 onset and the F0 offset were also measured. The term "pre-wh word" refers to the subject and the adverb in both declaratives and wh-questions. All F0 values are expressed in equivalent rectangular bandwidth (ERB), which is held to be the psychophysically most relevant F0-scale in intonation languages (Hermes & Van Gestel, 1991).

Regression techniques were adopted to inspect the global trend of the F0 of the sentence as these techniques are reproducible and can be objectively verified (Lieberman et al., 1985; Swerts et al., 1996; Van Heuven & Haan, 2000). A regression line was automatically calculated using all F0 points of the pitch contour of the pre-wh part, the post wh-part and the complete sentence as a function of time. The slope of the regression line was computed as a measure of the global trend of the F0 of the pre-wh part, post-wh part, and the complete sentence. The boundaries of the pre-wh part, the post-wh part, and the complete sentence correspond with the beginning and end of the regression line computed for them.

With respect to the F0 onset and offset, taking the first and the last measurable F0 point of the sentence respectively can be subject to estimation errors. Therefore, regression techniques were applied to also calculate the F0 onset and F0 offset of the sentence. The F0 level at the beginning and the end of the regression line was considered as the F0 onset and F0 offset of the sentence, respectively. Relying on the regression line of the pre-wh part to measure the F0 onset can cause
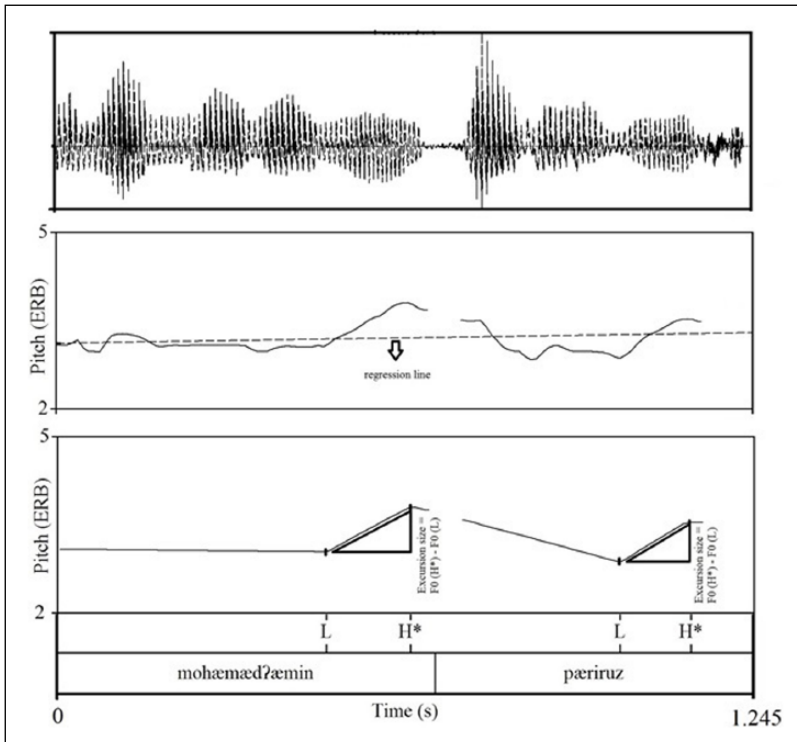
Figure 2. The acoustic correlates measured in the pre-wh part of a declarative sentence. In the second panel, the solid line is the pitch contour and the dotted line is the regression line. "L" and "H*" represent the valleys and the peaks of the realized pitch accents. The second tier represents the word boundaries. In the pitch stylized panel, only the points designating L and H* are kept and the irrelevant points are deleted. The vertical side of the triangle shows the excursion size of the pitch accents that is computed by subtracting the F0 value of H* (the peak of the accent) from the F0 value of L (the valley of the accent). The non-stylized pitch contour is presented along with the regression line.

the F0 onset measurement to be more heavily affected by the excursion size of the pitch accents of the pre-wh words. Similarly, relying on the regression line of the post-wh part to measure the F0 offset can cause the F0 offset measurement to be more heavily affected by the de-accentuation in the post-wh part of the sentence.

The pitch means of the pre-wh part, post-wh part, and the complete sentence were calculated as a measure of pitch register of the relevant part, following Rietveld and Vermillion (2003).

To accurately determine the location and F0 value of the valleys and peaks of the pitch accents, two steps were taken. First, the pitch contour was stylized using a 1 semitone frequency resolution. Every subject and every adverb carried a L+H* pitch accent, as predicted by the phonological account of Persian intonation (cf. Mahjani, 2003; Sadat Tehrani, 2008). The L and H* points were indicated by hand in the stylized pitch contour. Then the points designated as the valley (L) and the peak (H*) were automatically moved to the maximum F0 and the minimum F0 in the original F0 contour using Praat functions (this method was adopted from Sadat Tehrani, 2009). The F0 value of the peak was subtracted from the F0 value of the valley of each pitch accent by running a script in Praat. The subtraction provided us with the excursion size of the pitch accents realized on the pre-wh words.
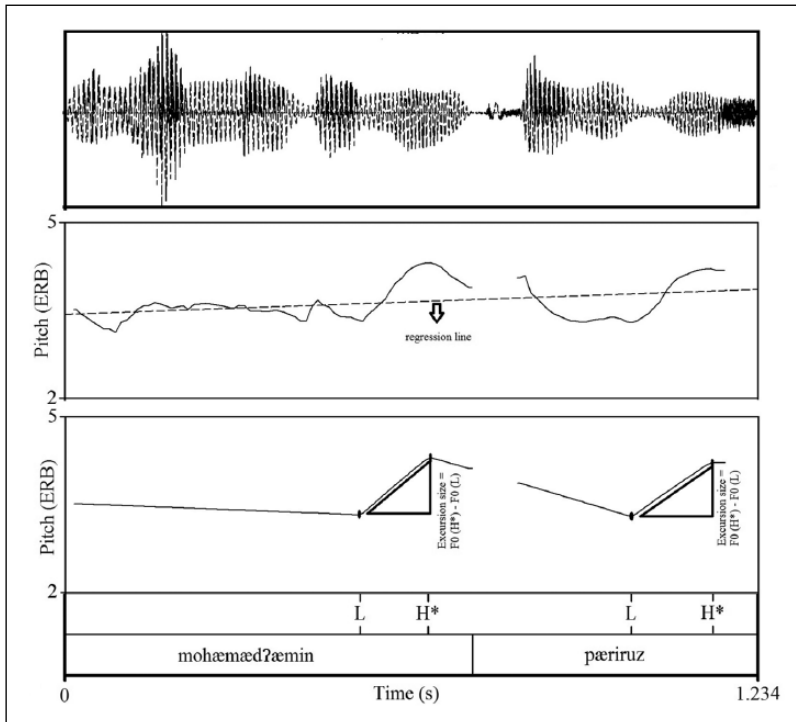
Figure 3. The acoustic correlates measured in the pre-wh part of a question. In the second panel, the solid line is the pitch contour and the dotted line is the regression line. "L" and "H*" represent the valleys and the peaks of the realized pitch accents. The second tier represents the word boundaries. In the pitch stylized panel, only the points designating L and H* are kept and the irrelevant points are deleted. The vertical side of the triangle shows the excursion size of the pitch accents that is computed by subtracting the F0 value of H* (the peak of the accent) from the F0 value of L (the valley of the accent). The non-stylized pitch contour is presented along with the regression line.

4.2.3 Statistical analysis. Before running any kind of statistical analysis, all dependent variables were checked for normality of distribution. To answer the research questions, a multivariate repeated measures analyses of variance (RM-MANOVA) was conducted, with sentence type as the independent variable and the slope of the regression line, the F0 mean and the duration of the complete sentence, the excursion size of the pre-wh words, the slope of the regression line, the pitch mean and the duration of the post-wh part, and the F0 mean and the slope of the regression line of the pre-wh part as the dependent variables. The assumptions of repeated measures analysis of variance were met.

One of the conditions of the RM-MANOVA is that the correlation between dependent variables must not be higher than 0.80 (Field, 2009). As the duration of the pre-wh part and that of the complete sentence ($r = 0.849$, $p < 0.001$), the pitch mean of the complete sentence and the F0 onset ($r = 0.918$, $p < 0.001$), and the pitch mean of the complete sentence and the F0 offset ($r = 0.831$, $p < 0.001$) were highly correlated, the duration of the pre-wh part, and the F0 onset and the F0 offset were not included in the RM-MANOVA. Relying on the correlation between the pre-wh part and the sentence duration, the result of the univariate analysis for the sentence duration holds true for the univariate analysis of the pre-wh part duration. Based on the same logic, the result of the univariate analysis for the F0 mean of the complete sentence is applicable to the univariate analysis for the F0 onset and the F0 offset (Field, 2009).

Table 1. Results of the univariate tests and descriptive statistics for the acoustic correlates of the pre-wh part, the post-wh part and the complete sentence for the two sentence types.

Variable	F	df	p	η_p^2	M SD (Decl)	M SD (Wh-q)	N
Subject pitch excursion (ERB)	28.536	(1, 17)[a]	.000**	.627	0.991 0.327	1.478 0.517	1440
Adverb pitch excursion (ERB)	60.471	(1, 17)	.000**	.781	0.710 0.210	1.325 0.339	1440
Slope of regression line of the pre-wh part (ERB/sec)	48.535	(1, 17)	.000**	.741	0.068 0.139	0.585 0.354	1440
Slope of regression line of the post-wh part (ERB/sec)	0.281	(1, 17)	.603	.016	−1.155 0.633	−2.573 1.985	1440
Slope of regression line of the Sentence (ERB/sec)	4.363	(1, 17)	.052	.204	−0.179 0.157	−0.318 0.304	1440
F0 mean of the pre-wh part (ERB)	88.966	(1, 17)	.000**	.840	4.830 1.402	5.720 1.587	1440
F0 mean of the post-wh part (ERB)	0.000	(1, 17)	.999	.000	4.440 1.198	5.183 1.395	1440
F0 mean of the complete sentence (ERB)	80.883	(1, 17)	.000**	.826	4.731 1.332	5.582 1.505	1440
Duration of the post-wh part (in sec)	0.635	(1, 17)	.437	.036	0.831 0.085	0.816 0.087	1440
Duration of the sentence (in sec)	143.486	(1, 17)	.000**	.894	2.637 0.201	2.213 0.190	1440
Duration of the pre-wh part (in sec)[b]	–	–	–	–	1.362 0.100	1.107 0.112	1440
F0 onset (ERB)[b]	–	–	–	–	4.955 1.462	5.923 1.697	1440
F0 offset (ERB)[b]	–	–	–	-	4.458 1.141	5.187 1.364	1440

Note. Decl = declaratives; Wh-q = wh-in-situ questions.
[a]The values in brackets give the degrees of freedom for condition and participants.
[b]Since the duration of the pre-wh part, the F0 onset and the F0 offset were not included in the RM-ANOVA (see Section 2.4.2.3), only the descriptive statistics of these variables are reported.
**$p < .01$.

4.3 Results

The multivariate test revealed a significant effect of the sentence type on the acoustic features of the pre-wh part, the post-wh part and the complete sentence, $F (10, 8) = 22.325$, $p < 0.001$, Wilks' Lambda = 0.035, $\eta_p^2 = 0.965$. As Table 1 illustrates, univariate tests for the individual variables indicated a significant effect of sentence type on the F0 excursion size of the pre-wh words, the slope of the regression line and the F0 mean of the pre-wh part, and the duration and the F0 mean of the complete sentence. The effect sizes (η_p^2) suggest that there is a substantial effect of the independent variable on all dependent variables (effect sizes larger than 0.13 count as significant) (Pallant, 2013).

According to Table 1, a larger pitch excursion size can be attributed to the subject and the adverb in wh-questions. The upward trend of the F0 (the slope of the regression line) of the pre-wh part is steeper in questions than in declaratives. The larger pitch excursion size of the subject and the adverb in wh-questions can explain this steeper upward trend of F0 of the pre-wh part in questions

in comparison with the same part in declaratives. A higher F0 mean is another characteristic of the pre-wh part in wh-questions. The complete sentence in wh-questions is characterized by a higher F0 mean and a shorter duration in comparison to declaratives (Table 1). The positive high correlation between the duration of the complete sentence and the pre-wh part and between the F0 onset and the F0 mean of the complete sentence (see Section 4.2.3) suggests that a decreased duration of the pre-wh part and a higher F0 onset characterize wh-questions in comparison to declaratives.

Based on the positive high correlation between the F0 offset and the F0 mean of the complete sentence (see Section 4.2.3), a higher F0 offset can be claimed to be the prosodic characteristic of wh-questions in comparison with declaratives.

The statistics indicated that all of the pre-wh part acoustic features measured in this study mark the pre-wh part in wh-questions as opposed to declaratives. However, among the post-wh part acoustic features measured in this study only F0 offset characterizes the post-wh part in wh-questions. These results imply that a) in comparison with the post-wh part, the pre-wh part in a wh-question is prosodically more distinct from the pre-wh part in the corresponding declarative, and b) the acoustic correlates of the pre-wh part are mainly responsible for the prosodic characteristics of the complete sentence in wh-questions as opposed to declaratives.

5 Discussion and conclusion

The present study is concerned with the intonational properties of interrogativity in Persian wh-in-situ, questions with the aim of investigating whether a) the prosodic correlates of interrogativity characterize the—syntactically ambiguous—pre-wh part, b) the presence of the interrogativity marker (wh-phrase) affects the distribution of intonational properties of interrogativity in the pre- and post-wh part, and c) the prosodic correlates of interrogativity set Persian wh-in-situ questions apart from their matching declaratives at a more global (complete sentence) level.

The results of the current study confirm the prediction that a) the prosodic correlates in the pre-wh part of the sentence, namely a higher F0 onset, a raised pitch register level, a steeper F0 upward trend, and a greater excursion size of the pre-wh words differentiate wh-questions from declaratives, and b) wh-questions are made distinct from declaratives by a raised register level and a shorter duration at a more global level. In contrast with our prediction, except for F0 offset, the prosodic correlates in the post-wh part do not play a significant role in marking wh-questions. As opposed to the dominant role of prosody in the pre-wh part, where sentence type ambiguity is maintained, the role of prosody is diminished in the post-wh part. This limited role of prosody in the post-wh part can be attributed to the occurrence of the lexical cue (the wh-phrase) to the sentence type. As soon as the wh-phrase is uttered, the sentence type is revealed, so the role of prosody in indicating the sentence type is diminished. This is in line with the suggestion that the presence of an interrogative marker (lexical or syntactic) in Persian questions makes the role of prosody in marking questions less crucial (Mahjani, 2003; Sadat Tehrani, 2008, 2011). The difference in the role of prosody in characterizing the pre- and post-wh parts suggests that prosodic correlates of interrogativity are not equally distributed throughout wh-in-situ questions. Rather, they tend to localize in the pre-wh part, where prosodic information is most needed to resolve sentence type ambiguity.

The reported differences in the pitch height between wh-in-situ questions and declaratives agree with what has been reported earlier for yes–no questions without the question word "aya" in Persian as well as for interrogatives in different languages: (i) a higher F0 onset (Benkirane, 1998; Hermann, 1942; Haan, 2001; Iivonen, 1998); (ii) a higher F0 offset (Haan, 2001); (iii) a raised level of pitch register (Bolinger, 1982; Geluykens, 1986; Hermann, 1942; Haan, 2001; Haan et al., 1997; Inkelas & Leben, 1990; Lindsey, 1985; Sadat Tehrani, 2008, 2011); (iv) less declination (Haan, 2001; Haan et al., 1997; Thorsen, 1980; Vaissière, 1983); and (v) a greater excursion size of

the pitch accents associated with the pre-wh words (Haan, 2001; Haan et al., 1997; Sadat Tehrani, 2008, 2011). These findings also support the general claim that a greater pitch height in questions can be regarded as a universal feature of languages (Hermann, 1942).

Another acoustic feature that distinguishes Persian wh-in-situ questions from statements is the shorter duration of the pre-wh part and the complete sentence in wh-questions. The decreased duration of questions in comparison with declaratives has already been demonstrated for Mandarin Chinese wh-in-situ questions (Jorissen, 2014; Yang et al., 2016 September), for yes–no and declarative questions in Dutch, yes–no questions in Manado Malay and Orkney English (Van Heuven & Van Zanten, 2005), and in Hausa (Lindsey, 1985).

Ohala (1984) explained the use of high pitch in questions in ethological terms as a phonologized remnant of animal behavior. The questioner needs to be polite or subservient to his/her respondent when posing a question. In comparison with large (dangerous) creatures, small (harmless) creatures have higher pitches, and make faster movements. Hence, the speaker raises his/her pitch to pretend to be smaller than he/she is physically. Pitch raising by the speaker is interpreted as a sign of submission or politeness to the respondent. Van Heuven and Van Zanten (2005) interpreted faster movements made by small creatures as fast speech rate. They suggested that fast speech rate may express the same message conveyed by high F0 to the respondent. This proposal ties high pitch with fast rate in signaling questions. Previous studies provided evidence for the positive correlation between speech rate and pitch (Rietveld & Gussenhoven, 1987) and the association of high pitch (Bolinger, 1964, 1978) and fast rate with questions (Bolinger, 1989). In a speech perception study, Rietveld and Gussenhoven (1987) asked listeners to make judgements about the speech rate of original and pitch manipulated versions of utterances. They found that listeners judged higher-pitched versions of temporally unaltered sentences as being faster. Bolinger (1989), in his dichotomy theory of relaxation and tension, argued that statements and questions are universally characterized by a dichotomy between relaxation (low, falling pitch) and tension (high, rising pitch), respectively. According to Van Heuven and Van Zanten (2005), Bolinger's dichotomy theory might be naturally extended to argue that slow rate or deceleration would be a correlate of relaxation, and that high rate or acceleration is associated with tension.

Further support for the possible association (we are not considering this association as universal, it can be language-specific) of high F0 values and questions is suggested by Bartels (1997) and lately by Gunlogson (2008). The purpose of asking a question is tantamount to eliciting a verbal response from the respondent and filling in the questioner's knowledge gap. This purpose implies that the questioner is dependent on the respondent's cooperation to provide him or her with an answer. Bartels (1997) claimed that rising intonation in questions shows dependency whereas falling intonation shows assertiveness of the speaker. Simiar to Ohala (1983, 1984) and Bolinger (1978), Gunlogson (2008, p.29) argued that "rising intonation is the defining property essential for imparting a questioning flavor to a declarative." He suggested that rising intonation implies that the speaker is dependent on the addressee's information and the addressee is the sole source of information. In other words, rising intonation declares that the addressee is the authority and has superiority over the speaker as a source. Therefore, we can propose that questioners use high F0 (possibly in combination with shorter duration) to show their dependence on the respondent. Likewise, respondents use low F0 (possibly in combination with longer duration) to show their authority. This association between acoustic correlates and sentence type may be more prominent in interrogatives where the syntactic or lexical markers of interrogativity are absent or appear later in the sentence. It can possibly explain the dominant role of prosody in the pre-wh part, in contrast with its diminished role in marking the post-wh part in wh-questions. Indeed, appearance of the lexical cue to the sentence type (wh-word) obviates or diminishes reliance on the role of prosody in cueing the sentence type.

Snedeker and Trueswell (2003) proposed that language users possess some implicit knowledge about the relationship between prosody and syntax, and are capable of using this knowledge to guide linguistic choices. Prosodic marking of the pre-wh part in wh-in-situ questions is in line with Snedeker and Trueswell's (2003) proposal. Speakers were capable of using prosody to encode sentence type (wh-questions vs. statements) before the cue (wh-phrase) to the sentence type was uttered. Language users' awareness of the association between prosody and syntax and their capability to use it has also been demonstrated in other studies (e.g., Cooper & Paccia-Cooper, 1980).

According to Rialland (2004), polarity questions in 18 languages (in a database of 80 African languages) are not characterized by high tones and a rising intonation. This suggests that the association between high pitch and questions is not universal. Our study indicates that the linking of high pitch and fast rate (Rietveld & Gussenhoven, 1987; Van Heuven & Van Zanten, 2005) is applicable to Persian wh-in-situ questions. This result is in line with the suggestion that linking high pitch with interrogativity is the preferred, but not universal, association in the languages of the world (Gussenhoven, 2004).

The present study accounts for the role of prosody in characterizing a cross-linguistically understudied type of interrogative (wh-in-situ questions) in a prosodically understudied language (Persian). The results suggest that the presence of a lexical or syntactic cue to sentence type may affect the role of prosody in encoding different parts of the same sentence. The role of prosody in encoding the part of the sentence which is marked by a lexical or syntactic cue to the sentence type is decreased in comparison with the role of prosody in marking another part of the same sentence that is not marked by a lexical or syntactic cue to the sentence type. This study also provides evidence for the applicability of the hyper- and hypo-theory of speech (Lindblom, 1990) to interrogatives where lexico-syntactic features of interrogativity appear later in the sentence.

Speakers' use of prosody to encode sentence type can help listeners to predict the sentence type before the actual production of the syntactic cue to the sentence type. Prediction of the sentence type can facilitate processing and decoding of sentence type and response preparation on the part of the listener (Grosjean, 1983, 1996). Perception studies are required, therefore, to investigate whether listeners rely on prosody to decode the sentence type before hearing the wh-phrase.

Notes

1. The wh-phrase can optionally move to the earlier parts, including the beginning of the sentence (Abedi et al., 2012; Adli, 2010; Gorjian et al., 2012; Kahnemuyipour, 2009; Karimi, 2005; Karimi & Taleghani, 2007; Lotfi, 2003; Megerdoomian & Ganjavi, 2000; Mirsaeedi, 2006; Toosarvandani, 2008) for non-syntactic reasons. These authors claim that the movement of the wh-phrase to earlier parts of the sentence is not triggered by the syntactic (+wh) feature. Therefore, Persian cannot be categorized as a wh-movement language. Adli (2010), Kahnemuyipour (2001), Karimi (2005), Karimi & Taleghani (2007), Lotfi (2003), and Toosarvandani (2008) claim that the wh-phrase moves to earlier parts of the sentence to receive

contrastive focus. (1) is an example of a sentence in which the wh-phrase "chi" (what) moves to the beginning of the sentence to receive contrastive focus. The declarative and wh-in-situ question counterparts of it are given in (2a) and (2b) within the text.

    1.   tʃi   mærjæm   diruz   xærid?
            what   Maryam   yesterday   buy.PAST.3SG.
            "What did Maryam buy yesterday?"

2. Sadat Tehrani's (2008) model for Persian intonation does not include the level iP, but he does provide a clear definition of iP.

3. This study originally investigated only RQ1. RQ2 and RQ3 were added as additional RQs to investigate local (i.e., F0 offset) and global prosodic correlates of the post-wh part and the complete sentence, following the comments of two anonymous reviewers.

4. For more information on the position of stress in Persian words, see, for example, Kahnemuyipour (2003), Lazard (1992), Mahootian (1997), Rohany Rahbar (2012), and Sadat Tehrani (2008).

5. As a result of the elicitation method, the declarative stimuli are all-new information focus sentences. In wh-questions the wh-phrase, as the information focus of the sentence, attracts the NPA and this causes deaccentuation in the post-wh part, that is, the verb. However, in the declaratives, the NPA can be on the non-interrogative phrase or on the verb (Sadat Tehrani, 2008). In Persian every content word is produced with a pitch accent (see Section 2.2). An inspection of Taheri Ardali and Xu (2012) and Sadat Tehrani's (2009) results suggests that information structure does not affect the presence of pitch accents on the words preceding the NPA. Rahmani, Rietveld, and Gussenhoven (2018) show that every content word preceding the NPA of the sentence retains its pitch accent, even if it contains given information. Therefore, the words in the pre-wh part of both declaratives and wh-in-situ questions have pitch accents and can, thus, be compared (see Section 3.1).

6. An anonymous reviewer commented that since the post-wh parts do not tonally match in the two sentence types, their prosodic correlates cannot be compared in detail. They suggested using narrow information focus declaratives (with the NPA on the non-interrogative phrase) instead of all-new information focus declaratives. This would indeed solve the problem that in some cases a pitch accent is realized after the non-interrogative phrase in the declaratives. However, the post-wh parts of the two sentence types would still not be completely comparable prosodically. The reason is that in a small number of cases the phonological shape of the post-wh part in wh-questions is different from its matching declarative, that is, declaratives all end in L% whereas some wh-questions have a H% boundary tone. Therefore, even if the declarative stimuli were produced with narrow focus, we still could only make global comparisons for the post-wh part (and the complete sentence).

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Appendix 1. Structure and words used as the constituents of sentence stimuli in declaratives and wh-questions.

Subject	Adverb	3rd constituent of the sentence		Verb
		Wh-phrase	DWC	
1) mohæmædʔæmin (Mohamadamin) 2) mohæmædʔæli (Mohamadali)	1) seʃænbe (Tuesday) 2) pæriruz (two days ago)	1) tʃi (what)	Inanimate DO[a] 1) kæfʃ (shoe) 2) kif (bag)	tæʔmir-kærd (repaired)
		2) ki (who)	Animate DO 1) jɑs (Yas) 2) nɑz (Naz)	dæʔvæt-kærd (invited)
		3) kodʒɑ (where)	Adjunct of Place[b] 1) dʒængæl (jungle) 2) kutʃe (street)	bɑzi-kærd (played)
		4) kej (when)	Adjunct of Time 1) zohr (noon) 2) ʔæsr (afternoon)	ʃenɑ-kærd (swam)
		5) tʃetori (how)	Adjunct of Manner 1) bɑʔænduh (sadly) 2) bɑdeqæt (carefully)	sohbæt-kærd (talked)

a. DO refers to direct object. The object marker "ra" occurs after the direct object in declaratives and wh-in-situ questions. The stressed syllable in each word is underlined.

b. The preposition "tu" which means "at" precedes the adjunct of place in declaratives but not in wh-in-situ questions.