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**Prosody and processing of wh-in-situ questions in standard Persian**  
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# Chapter one

## Introduction

### 1.1 Preliminaries

All human languages allow their speakers to ask questions (Chisholm, Milic, & Greppin, 1984). The speech act of questioning is prevalent in human communication. The typical purpose of asking a question is to elicit a response from the hearer, whereas a statement is uttered to present facts or beliefs. Utterances require no sign to be recognized as statements. However, questions may be signaled lexically, for example by the insertion of *wh*-phrases and/or other syntactic devices, such as inversion of the subject and finite verb. Lexico-syntactic features are not the sole indicators of interrogativity (Haan, 2001). The literature on question intonation reveals that intonation plays an influential role in characterizing questions (e.g. Hermann, 1942; Haan, 2001).

### 1.2 Intonation of questions

Though there is cross-linguistic variation in the lexico-syntactic devices marking interrogativity, intonation is suggested to be the near-universal defining property of questions (Haan, 2001). Having conducted a survey of 177 languages, Hermann (1942) argued for the presence of a high pitch somewhere in the sentence as a cross-linguistic property of question intonation.<sup>1</sup> The results of previous studies on question intonation across languages lead to the conclusion that this high pitch can be observed both locally, that is in the initial, medial or final portion of the sentence (Benkirane, 1998; Cheng & Rooryck, 2000; Gryllia, Doetjes & Cheng, 2016 September; Haan, 2001; Haan, Van Heuven, Pacilly, & Van Bezooijen, 1997; Hadding-Koch, 1961; Hadding-Koch & Studdert-Kennedy, 1964; Ishihara, 2005; Iivonen, 1998; Kitagawa, 2005; Lee, 2005; Mahjani, 2003; Sadat Tehrani, 2011; Shen, 1990; Uldall, 1962; Yang, Gryllia, Doetjes & Cheng, 2016a September) and globally, namely in the form of raised register and/or the absence of an F0 downtrend (Bolinger, 1982; Geluykens, 1986; Haan, 2001; Haan et al., 1997; Inkelas & Leben, 1990; Lindsey, 1985; Sadat Tehrani, 2011; Thorsen, 1980; Vaissière, 1983). In addition to pitch features, durational properties, such as shorter duration, have been reported as the defining features of interrogatives (Cangemi &

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<sup>1</sup> According to Rialland (2004), polarity questions in 18 languages (in a database of 80 African languages) are not characterized by high tones and rising intonation. Thus, in this dissertation I do not consider the correlation between high pitch and questions as universal. Rather, we take it as language-specific.

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D’Imperio, 2013; Lindsey, 1985; Jorrisen, 2014; Van Heuven & Van Zanten, 2005; Yang et al., 2016a September).

### 1.3 Wh-questions

The syntactic literature offers different question types, one of which is the wh-question. They are called wh-questions because they are typically identified by phrases that start with the letters “wh” in English, e.g. *what, when, where* (Carnie, 2007). Wh-questions are considered a near universal question type (Sadock & Zwicky, 1985). They can be divided into two categories: (i) fronted wh-questions, and (ii) in-situ wh-questions. Fronted wh-questions are constructed by the obligatory movement of the wh-phrase. This obligatory movement is a syntactic process which results in the movement of the wh-phrase to sentence-initial position (Carnie, 2007; Chomsky, 1977; see example 1).

- (1) a. Mary bought a book.  
b. What did Mary buy?

English is an example of a fronted wh-question language. However, in some other languages the wh-phrase does not undergo movement, but it remains in the same site where the non-wh phrase is expected to occur in its declarative counterpart. This phenomenon is known as wh-in-situ: the wh-phrase does not move but stays in the original position where its declarative counterpart is expected to appear (see 2). One language characterized by in-situ wh-questions is Persian. 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; Mirsaedi, 2006; Toosarvandani, 2008).<sup>2</sup>

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<sup>2</sup> The wh-phrase can optionally move to 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; Mirsaedi, 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. As such, Persian cannot be categorized as a wh-movement language. Adli (2010), Kahnemuyipour (2001), Karimi (2005), Karimi and Taleghani (2007), Lotfi (2003) and Toosarvandani (2008) claim that the wh-phrase moves to earlier parts of the sentence to receive contrastive focus. Example (1) constitutes 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 counterpart of it is given in (2a) and (2b) within the text.

1. tʃi mæɾjæm diruz xæɾid?  
what Maryam yesterday buy.PAST.3SG.  
“What did Maryam buy yesterday?”



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Tehrani, 2008, 2009).<sup>3</sup> Location of stress in Persian words has been discussed in several works (e.g. Kahnemuyipour, 2003; Lazard, 1992; Mahootian, 1997; Rohany Rahbar, 2012; Sadat Tehrani, 2008, 2009).<sup>4</sup> Persian has been described as an intonation language (Esposito & Barjam, 2007; Mahjani, 2003; Mahootian, 1997; Sadat Tehrani, 2008; Towhidi, 1974). Towhidi (1974) studied the Persian intonation system within the theoretical framework of British tradition (Crystal, 1969). Esposito and Barjam (2007) used Tone and Break Indices (ToBI; Silverman, Beckman, Pitrelli, Ostendorf, Wightman, Price, Pierrehumbert, & Hirschberg, 1992) and Mahjani (2003) and Sadat Tehrani (2008) applied the autosegmental-metrical framework to study Persian prosody. The details of these studies are presented in Chapter 2.

Persian is described as an SOV language which allows changes in word order (Adli, 2010; Dabir-Moghaddam, 1982; Karimi, 1999, 2003, 2005; Lotfi, 2003; Mahjani, 2003; Rahmani et al., 2018; Sadat Tehrani, 2008). No study has been devoted to the reasons for changes in word order in Persian. Inspection of the data presented in Karimi (1999, 2005) shows that receiving contrastive focus is one of the reasons of changes in word order in Persian. However, to receive contrastive focus, a word does not necessarily move, it can remain in-situ and be interpreted as contrastive focus by changes in prosody (Karimi, 1999, 2005; Abolhasanizadeh et al., 2012; Mahjani, 2003; Rahmani et al., 2018; Sadat Tehrani, 2008, 2009; Taheri Ardali & Xu, 2012). Topic is mentioned as another reason for changes in word order by Karimi (1999, 2005).<sup>5</sup>

Similar to the reasons for changes in word order in Persian, as far as we know, no study has investigated how information structure is conveyed in Persian. Inspection of the data and the results of the studies by Abolhasanizadeh, et al. (2012), Mahjani (2003), Rahmani et al. (2018), Sadat Tehrani (2008, 2009) and Taheri Ardali and Xu (2012) suggest that contrastive focus in Persian can be conveyed by changes in prosody. Abolhasanizadeh et al. (2012), Rahmani et al. (2018), Tehrani (2008, 2009) and Taheri Ardali and Xu (2012) suggest that contrastive focus is conveyed by changes in the acoustic features of the pitch accent realized on the focused element. Inspection of the data presented in Karimi (1999, 2005) suggests that changes in word order and use of the morpheme “*fagat*” (only) can also convey information structure in Persian.<sup>6</sup>

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<sup>3</sup> Abolhasanizadeh, Bijankhan and Gussenhoven (2012) and Rahmani, Rietveld and Gussenhoven (2018) argued that the nature of prominence in Persian words is accent rather than stress. Since the focus of this dissertation is not on stress, we do not present the detail of the arguments.

<sup>4</sup> A summary of the position of stress in Persian words is as follows. In nouns, adjectives and most adverbs, the final syllable carries the stress. In prefixed verbs, the stress is on the prefix. Simple verbs are stressed on the final syllable of the main constituent, i.e., the present stem, the past stem, or the participle. Compound verbs comprise of a non-verbal element and a verb. In compound verbs, the non-verbal element carries the stress.

<sup>5</sup> Karimi (1999, 2005) argued that the moved element can be a topic or contrastive focus. She suggested that the stress that the moved element receives determines if the word is a focus or a topic, i.e. the focused element receives a stronger stress than the topic. However, she does not explain what she means by stress. She did not present empirical or quantitative data on the role of stress in the interpretation of the moved element as the focus or topic.

<sup>6</sup> Recently, there has been some dispute about the conditions in which the morpheme “*fagat*” can convey information structure (in this case focus) in Persian (c.f. Rahmani et al., 2018).

## 1.5 Theoretical background

Fronted *wh*-questions, such as (1b), are syntactically marked by the presence of the *wh*-phrase in sentence-initial position. In contrast, *wh*-in-situ questions such as (2b) are not marked syntactically sentence-initially: the syntactic structure does not designate the clause type at the beginning of the sentence. The absence of lexico-syntactic markers (i.e. a *wh*-phrase) at the beginning of *wh*-in-situ questions raises questions regarding the role of prosody in the production and perception of *wh*-in-situ questions. Zubizarreta (1998) proposed that the difference between fronted and in-situ *wh*-questions lies in the way they are marked: while fronted *wh*-questions are syntactically marked by the overt movement of the *wh*-phrase to the specifier of the CP, in-situ *wh*-questions are prosodically marked.

Prosody is the defining feature of questions in the absence of a syntactic interrogativity marker (e.g. Bolinger, 1978; Ohala, 1983, 1984). The hyper- and hypo-theory of speech production (Lindblom, 1990) predicts that in interrogatives with lexico-syntactic features of interrogativity the prosodic cues will be weaker, whereas prosodic interrogativity marking will be stronger when lexico-syntactic features of interrogativity are absent or are fewer in the sentence. Gunlogson's (2008) and Lindblom's (1990) proposals can be extended to interrogatives where the lexico-syntactic interrogativity feature occurs later in the sentence, as in *wh*-in-situ questions: prosody marks the production of *wh*-in-situ questions in the absence of the *wh*-phrase in sentence-initial position.

Bolinger (1989) argued that the contrast between statements and questions is universally characterized by a dichotomy between relaxation (low, falling pitch), which marks statements, and tension (high, rising pitch), which characterizes questions. Hermann (1942) claimed that cross-linguistically questions tend to have raised pitch levels in comparison to statements. Similarly, Ohala's (1983, 1984) frequency code (FC) considers high pitch as a universal characteristic of questions in human languages. Ohala's FC suggests that the questioner is asking a question to prompt the respondent to provide some piece of information, so he/she needs to show his/her dependence on the addressee's knowledge and cooperation. Therefore, the questioner raises his/her pitch to signal his/her submissiveness or politeness to the respondent. Bolinger (1964, 1978, 1989), Bartels (1997) and lately Gunlogson (2008) have argued for a possible association of high F<sub>0</sub> values and questions. Similar to Ohala (1983, 1984), Bartels (1997) and Gunlogson (2008) proposed that rising intonation shows the questioner's dependency on the respondent. While the questioners use high F<sub>0</sub> to show their dependence on the respondent, the respondents use low F<sub>0</sub> to assert their authority.

According to Van Heuven and Van Zanten (2005), a faster speech rate (i.e. a shorter utterance duration) can convey the same message to the hearer as that expressed by a high F<sub>0</sub>. They suggested that high pitch can be tied with fast speech rate in signaling questions. The association between acoustic correlates (high vs. low pitch and fast vs. slow speech rate) and sentence modality contrast (statements vs. questions) can be more prominent in sentences where the syntactic or lexical markers to sentence type are absent or appear later in the sentence (Lindblom, 1990). The implication is that prosody may play an important role in characterizing the

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production of wh-in-situ questions in the absence of the lexico-syntactic interrogativity marker in sentence-initial position.

Processing conversational speech is an integral part of language processing. Listeners utilize any source of information that can facilitate the processing of conversation (Grosjean, 1983, 1996). Prosody is one of the multiple sources of information available in the processing of conversational speech. Grosjean's (1983, 1996) studies suggest that the role of prosody in processing becomes prominent in the absence of other sources of information, such as syntactic information regarding the clause type. In a normal conversation, the questioner raises a question with the purpose of eliciting a response from the addressee. The interlocutors who are engaged in a conversation rarely leave gaps between exchanges (Brazil, 1981; Sacks, 2004; Sacks, Schegloff, & Jefferson, 1974; Schegloff, 2006; Stivers, Enfield, Brown, Englert, Hayashi, Heinemann, Hoymann, Rossano, De Ruiter, Yoon, & Levinson, 2009). The implication here is that listeners draw on past and present information to process the sentence up to the point uttered by the speaker, as well as to predict upcoming events. In the absence of the syntactic interrogativity device in sentence initial position, prosody can aid the listener in predicting the sentence type and start the process of preparing a response. This suggests that prosody can cue the perception of wh-in-situ questions before the occurrence of the wh-phrase. Furthermore, several studies have indicated that language users may have implicit knowledge about the relationship between prosody and syntax, and are capable of using this knowledge to guide linguistic choices (e.g. Carlson, Clifton, & Frazier, 2001; Snedeker & Trueswell, 2003).

Several prosodic correlates, namely F0, intensity and duration, closely cooperate in the production of prosodic contrasts (Lehiste, 1970; Peng, Chatterjee, & Lu, 2012). Cooperation of the same cues is assumed to contribute to the perception of prosodic contrasts (Hazan & Rosen, 1991; Lehiste, 1970, 1976; Peng et al., 2012). Prosodic correlates do not contribute equally to the production and perception of prosodic contrasts, which are mainly conveyed through variations in F0, but this variation is often accompanied by variation in intensity and duration patterns (Cooper & Sorensen, 1981; Ladd, 1996; Lehiste, 1970, 1976; Peng et al., 2012; Van Heuven & Van Zanten, 2005). Similarly, the recognition of prosodic contrasts is mainly achieved by relying on F0 variation as the primary cue while other cues, such as duration and/or intensity, are considered secondary (Cangemi & D'Imperio, 2013; Lehiste, 1976; Peng et al., 2012). Perception studies (e.g. Fry, 1955; Hazan and Rosen, 1991) reported improved perception of prosodic contrasts in matching cue conditions in comparison to mismatching cue conditions. These studies suggest that prosodic correlates may not contribute equally to the perception of sentence modality contrast in Persian.

### 1.6 Research questions and approach

Four research questions are addressed in this dissertation:

- 1) Does the prosody of the pre-wh part, the post-wh part and the complete sentence distinguish Persian wh-in-situ questions from declaratives?

- 2) Does the prosody of the pre-wh part cue the correct perception of Persian wh-in-situ questions?
- 3) At which point in the pre-wh part can Persian wh-in-situ questions be identified?
- 4) Does the F0 or the durational cues or their cooperation contribute more to the identification of wh-in-situ questions in Persian?

Four separate experiments were conducted to investigate these research questions. The first experiment was a production experiment in which declaratives and wh-questions were elicited from Persian native speakers. In this experiment, the prosodic correlates of the pre-wh part, the post-wh part and the complete sentence in questions and declaratives were measured and compared.

Following the production experiment, three perception experiments were run. A forced choice sentence identification task was designed for each experiment. Part of the sentences elicited in the production experiment formed the base of the material of the perception experiments. The same material was used in all the perception experiments. However, since each perception experiment had different objectives, different procedures were adopted to prepare the stimuli for each perception experiment.

The first perception experiment was run to tackle the second research question. This experiment will be referred to as the sentence identification experiment. The purpose of this experiment was to investigate whether the prosodic differences between sentence types are perceivable by listeners. In this experiment the pre-wh part of declaratives and wh-in-situ questions was played to Persian native speakers in a forced choice sentence identification task. They were required to decide whether what they heard was going to be a wh-question or a declarative as quickly as they could.

To answer the third research question, a gating paradigm perception experiment was run (cf. Grosjean, 1980). This question was posed to investigate at which point in the pre-wh part Persian native speakers are able to identify the sentence type. To prepare the stimuli of this experiment, the pre-wh part of the sentences was divided into several gates. The gated stimuli were played to Persian native speakers in a forced choice sentence identification task. After hearing each gate, they were instructed to a) opt for either a declarative or a wh-question as the sentence type as quickly as possible, and b) report how confident they were about their decision by choosing a number between 1 and 5, where 1 is not sure at all and 5 is completely sure. This experiment will be referred to as the gating experiment in this dissertation.

Another perception experiment was designed to explore the final research question. This experiment will be called the manipulation experiment in the remainder of the dissertation. The F0 and durational features of the pre-wh part of the utterances were manipulated. The goal of this experiment was to weigh the relative contribution of the F0 features, the durational features and their cooperation to the identification of sentence modality contrast. Similar to the sentence identification experiment, Persian native speakers listened to the pre-wh part of declaratives and wh-in-situ questions. Upon hearing each stimulus, they were asked to decide whether what they heard was going to be a wh-question or a declarative as quickly as possible.

## 1.7 Hypotheses

On the basis of the theoretical framework (Bartels, 1997; Bolinger, 1964, 1978; Bolinger's dichotomy theory of relaxation and tension, 1989; Gunlogson, 2008; Hermann, 1942; Lindblom's hyper- and hypo-theory of speech production, 1990; Ohala's FC, 1983, 1984; Zubizarreta, 1998) and the findings of previous investigations on the prosody of interrogatives in different languages (Benkirane, 1998; Cangemi & D'Imperio, 2013; Cheng & Rooryck, 2000; Gryllia et al., 2016 September; Geluykens, 1986; Haan, 2001; Haan et al., 1997; Hermann, 1942; Inkelas & Leben, 1990; Iivonen, 1998; Jorrisen, 2014; Lindsey, 1985; Sadat Tehrani, 2011; Vaissière, 1983; Van Heuven & Van Zanten, 2005; Yang et al., 2016a September) we expect prosody to characterize the pre-wh part, post-wh part and the complete sentence in wh-questions as opposed to declaratives.

Drawing on the work of Grosjean (1983, 1996), Brazil (1981), and Snedeker and Trueswell (2003) and the results of previous studies on the role of prosody in the identification of interrogatives in different languages (e.g., Gryllia, Yang, Pablos, Doetjes & Cheng, 2016 September; Petrone & D'Imperio, 2011; Yang, Gryllia, Pablos, Doetjes & Cheng, 2016b September), I hypothesize that Persian native speakers can differentiate wh-in-situ questions from declaratives on the basis of prosodic correlates of the pre-wh part of the sentence.

Finally, we expect F0 variation to be the dominant contributor to the identification of wh-questions in comparison to statements (Cangemi & D'Imperio, 2013; Lehiste, 1976; Peng et al., 2012). An augmented effect of matching cue condition on sentence type categorization in comparison to the mismatching cue condition is also expected (e.g. Fry 1955; Hazan & Rosen, 1991).

## 1.8 Outline of the dissertation

This dissertation focuses on a series of experiments on the production and perception of a sentence modality contrast in Persian, namely statements as opposed to wh-in-situ questions. Chapters two to five are written as independent articles and have their own introduction and conclusion. Thus, there may be a certain amount of overlap between the introduction and the conclusion or other sections of these chapters and the general introduction and the conclusion of the dissertation. Chapter two deals with the production experiment on the prosodic correlates of declaratives and wh-in-situ questions. Chapter three focuses on the sentence identification experiment that investigates the role of prosody in the identification of wh-in-situ questions. The gating experiment investigating the point in the pre-wh part of the sentence where categorization is feasible is explained in chapter four. Chapter five presents the manipulation experiment on the relative contribution of the F0 and the duration to sentence modality contrast identification. The sixth and final chapter provides the general summary of the dissertation, the discussion of the overall results, the limitations of the study and suggestions for further research.