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Prosody and processing of wh-in-situ questions in standard Persian
Shiamizadeh, Z.

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Chapter six

Discussion and conclusion

6.1. Introduction

Previous studies on the intonation system of Persian, such as Mahjani (2003) and Sadat Tehrani (2008), have largely concentrated on the phonological description of the accentual structure of different sentence types, including wh-questions and declaratives. The role of prosodic correlates in marking different parts of wh-in-situ questions (the complete utterance, including the pre-wh part and the post wh-part) as opposed to declaratives is, however, an understudied area in research in Persian prosody. Further understudied topics include the role of prosodic correlates in the identification of wh-in-situ questions before the occurrence of the wh-phrase in Persian.

This thesis investigated a) whether prosodic correlates characterize the pre-wh part, the post-wh part and the complete utterance of Persian wh-in-situ questions in the absence of the wh-phrase in sentence-initial position, b) whether the prosody of the pre-wh part of the sentence cues the identification of wh-in-situ questions in Persian, c) if the F0, the duration or their cooperation contributes more to the correct recognition of sentence type, and d) where in the pre-wh part Persian native speakers are able to identify wh-in-situ questions. To the best of our knowledge this is the first study to investigate the role of prosody in marking wh-in-situ questions as opposed to declaratives and in the identification of wh-in-situ questions before the wh-phrase is uttered by the speaker in Persian.

Chapter 1 comprised an introduction to the dissertation. Chapter 2 presented the production experiment conducted to tap into the first research question. A repeated-measures ANOVA (RM-ANOVA) revealed that the pre-wh part in wh-questions was marked by a shorter duration, a higher F0 onset, a raised pitch register level, a steeper upward F0 trend and a greater excursion size of the pitch accents associated with the pre-wh words. It was also shown that the complete sentence in wh-questions is made distinct from a declarative by the global acoustic correlates of raised pitch register level and shorter duration. Except for the F0 offset, which was higher in questions, other prosodic correlates in the post-wh part do not play a significant role in marking wh-questions.

Chapter 3 investigated whether the prosody of the pre-wh part can cue the identification of wh-in-situ questions in the absence of a wh-phrase at the beginning of the sentence. A perception experiment was conducted to investigate this question. The results showed that wh-questions were correctly distinguished from declaratives in 90.30% of cases. Accordingly, it was suggested that the prosodic characteristics of the pre-wh part of the sentence can cue identification of wh-in-situ questions as

opposed to declaratives in Persian. A RM-ANOVA showed that the reaction time (RT) to declaratives was shorter than the RT to questions.

The perception experiment in Chapter 3 is based on one-time stimulus presentation. This method cannot delineate how the decision whether a sentence is going to be a statement or a question develops over time and it cannot determine the amount of acoustic-phonetic information needed to identify a stimulus (Grosjean, 1996). Therefore, a gating paradigm perception experiment (cf. Grosjean, 1980) was designed (Chapter 4). The gating experiment tackled the question as to where in the pre-wh part Persian native speakers can identify the sentence type. In this experiment response accuracy, RT and confidence rating were recorded. The results showed that already upon hearing the first gate, where the F0 onset is introduced, listeners are able to recognize the sentence type above chance level (75.5%). Correct recognition of the sentence type and confidence rating reach the highest level of 91.5% and 4.4 (on a scale of 5) respectively at the last gate, where the pre-wh part was presented in its entirety. A RM-ANOVA indicated that identification improves, confidence rating increases and RT decreases as the amount of discriminating prosodic information increases.

Sentence type can be identified based on the prosody of the pre-wh part, that is before the occurrence of the lexical cue to sentence type (i.e., the wh phrase). This raises the question as to whether F0, durational cues in the pre-wh part or their cooperation contributes more to the correct recognition of the sentence type. A perception experiment with four conditions was conducted to examine the contribution of these variables and their cooperation, to the identification of wh-questions as opposed to declaratives (Chapter 5). The four conditions were: a) F0 manipulation condition, where only the F0 was manipulated (F0M), b) duration manipulation condition, where only the duration was manipulated (DM), c) F0 and duration manipulation condition, where both F0 and duration were manipulated (F0DM), and d) resynthesized condition, where a resynthesized version of the original sound was used (RSO). In the RSO condition, the F0 contour of the stimuli was stylized but none of the cues were manipulated. The F0M and DM conditions investigated the contribution of F0 and durational cues to sentence type identification respectively. The F0DM condition examined the contribution of both F0 and duration (their cooperation) to sentence type recognition. The RSO condition was used as the baseline for the experiment. The F0M and DM are called mismatching cue conditions, while the F0DM and RSO are called matching cue conditions. The results revealed a primary role for F0 and a secondary role for duration in the perception of the prosodic contrast. According to the results of the RM-ANOVA, identification increased and RT decreased in the matching cue conditions as compared with the mismatching cue conditions.

6.2 Theoretical implications

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 (Van Heuven & Haan, 2000). Prosody is the defining feature of questions in the absence of a syntactic interrogativity marker (e.g. Bolinger, 1978; Ohala, 1983, 1984). Generally, the results of the production experiment (Chapter 2) indicate that Lindblom's (1990) proposal is applicable to Persian *wh*-in-situ questions, as an interrogative sentence type where the lexico-syntactic interrogativity feature occurs later in the sentence.

The production experiment (Chapter 2) provides evidence for the association of high pitch (Bolinger, 1964, 1978, 1989; Ohala, 1983, 1984; Bartels, 1997; Gunlogson, 2008) and faster speech rate⁴⁸ (Bolinger, 1989; Van Heuven & Van Zanten, 2005) with questions. Ohala posited that the questioner needs to be polite or subservient to the respondent. Hence, the speaker raises his/her pitch as a sign of submission or politeness to the hearer. Bartels (1997) claimed that rising intonation shows a dependency of the speaker on the addressee. Ohala (1983, 1984) and lately Gunlogson (2008) suggested that rising intonation implies that the speaker is dependent on the addressee's information and that the addressee is the sole source of information. Therefore, the addressee is the authority and has superiority over the speaker as a source. The purpose of asking a question is to elicit a verbal response from the respondent and to fill in the knowledge gap that the questioner has. This purpose implies that the questioner is uncertain and is dependent on the respondent's cooperation to provide him or her with an answer. Therefore, we can propose that questioners use high F0 to show their dependence on the respondent. On the other hand, the respondents use low F0 to show their authority. Van Heuven & Van Zanten (2005) proposed that a faster speech rate may express the same message conveyed by a high F0 to the hearer. Therefore, it can be suggested that high pitch is tied to a fast speech rate in signaling questions. Bolinger's (1989) theory on the dichotomous association between relaxation and declarativity on the one hand, and tension and interrogativity on the other, can be the reason for the association of high pitch and fast rate with questions. Indeed he claimed that statements and questions are characterized by a dichotomy between relaxation (low, falling pitch) and tension (high, rising pitch), respectively (Bolinger, 1989). It would seem a natural extension of this principle to argue that slow speech rate or deceleration would be another correlate of relaxation, and that high speech rate and acceleration are associated with tension (Van Heuven & Van Zanten, 2005).

Lindblom's (1990) hyper- and hypo-theory of speech could also possibly explain the characteristic role of prosody in the pre-*wh* part in contrast with its insignificant role in marking the post-*wh* part in *wh*-questions (Chapter 2). The prosodic interrogativity cues will be stronger in the pre-*wh* part since the syntactic cue (the *wh*-phrase) to the sentence type is absent. On the other hand, the role of prosodic interrogativity marking becomes weaker in the post-*wh* part since the syntactic cue to the sentence type is uttered before the post-*wh* part. Indeed, the appearance of the syntactic cue to the sentence type obviates or diminishes reliance on the role of prosody in cueing the sentence type in the post-*wh* part.

⁴⁸ This equates with a shorter duration of utterances.

Based on earlier studies on the cuing of syntactic structure by prosody (e.g. Cooper & Paccia-Cooper, 1980),⁴⁹ 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 Persian wh-in-situ questions (Chapter 2) and identification of sentence type before the occurrence of the syntactic cue to sentence type (Chapters 3, 4, 5) is in line with Snedeker and Trueswell's (2003) proposal. Speakers in these studies were capable of using prosody to encode (Chapter 2) and decode (Chapters 3, 4, 5) the sentence type before the cue to the sentence type was uttered. Listeners use their language-specific implicit knowledge that high pitch and fast speech rate represent an interrogative while low pitch and slow speech rate denote a declarative in order to identify the sentence type (Chapter 3, 4).

Listeners' use of prosody to predict the sentence type (Chapters 3, 4) before the occurrence of the syntactic cue can be discussed from the point of view of processing. Prediction can facilitate the processing and decoding of the sentence type and response preparation on the part of the listener (Grosjean, 1983, 1996). Therefore, prediction and how prosody guides prediction must be integrated into language processing models (Grosjean, 1983, 1996). Processing models also need to account for the fact that the listener's prediction can be reset as more prosodic information becomes available (Grosjean, 1983 & 1996).

Wh-in-situ questions can be considered to be sentences with temporary syntactic ambiguity. Chapters 3 and 4 demonstrated that prosody can guide the resolution of this temporary syntactic ambiguity before the occurrence of the syntactic cue to sentence type. In line with Beach (1991), this result suggests that models of spoken sentence processing need to account for the online use of prosody in temporary syntactic ambiguity resolution.

From the view of efficient communication, it is logical that sentence mode is recognized by the listener as early as possible in an utterance (Chapter 4; Brazil, 1981; Petrone & Niebuhr, 2014). Identifying the sentence type in the absence of syntactic or lexical cues and based on prosody serves this communicative need.

6.3 Suggestions for further research

This dissertation has found that prosody has an influential role not only in the characterization but also in the identification of wh-in-situ questions as opposed to declaratives in Persian. However, more studies are required to tap into the cognitive and neural mechanisms of prosody-driven processing of wh-in-situ questions as sentences with temporary syntactic ambiguity. Neurolinguistic research techniques, such as electroencephalography (EEG), are needed to examine how prosody guides identification and processing of wh-in-situ questions. Due to its fine-grained time resolution, EEG can give additional insights into the time course of prosody processing.

⁴⁹ There are even earlier studies that show the cuing of syntax by prosody, e.g. Blesser (1969) and Lindblom and Svensson (1973).

While Persian wh-in-situ questions have temporary syntactic ambiguity, Persian yes-no questions without the question word “aya” have global syntactic ambiguity. Following Lindblom (1990), and based on the results of the current dissertation, it can be proposed that prosody also contributes to the characterization and the identification of yes-no questions. Investigating the role of prosody in the marking and processing of Persian yes-no questions is therefore another suggestion for further research.

