Prosodic cues to rhetorical questions in Mandarin Chinese: f0, duration, voice quality

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In contrast to information-seeking questions (ISQs), rhetorical questions (RQs) do not require an answer ([1, 2], among many others). Syntactically, however, RQs and ISQs may share the same surface structure. Previous research has systematically investigated the prosodic differences between string-identical ISQs and RQs in intonation languages ([3] for German, [4] for English, [5] for Icelandic). These studies show that RQs differ prosodically from ISQs in regard to intonation (nuclear and prenuclear pitch accent types, edge tones), constituent duration (longer for RQs), and voice quality (higher proportion of breathy voice for RQs) [3-5]. The present paper extends this line of research to Mandarin Chinese – a tone language in which every syllable carries one of four lexical tones (or a neutral tone) [6]. F0 is hence considerably constrained by tone even though it is used for intonation contrasts and focus [7], or the distinction of utterance types (polar questions vs. declaratives) [8]. Like in the previously studied intonation languages, the same surface structure can be used as an ISQ or RQ in Mandarin polar and wh-questions, cf. (1). Against this background, we investigate the specific role of f0 for the distinction between RQ and ISQ in Mandarin along with other prosodic cues.

In a production experiment, twelve female native speakers of Mandarin Chinese (recorded in Beijing and Shanghai) read context descriptions on a screen (ISQ vs. RQ reading) and subsequently produced target interrogatives. To this end, the 22 context-question quadruplets from Braun, et al. [3] were translated from German into Mandarin and culturally adapted where necessary. In the quadruplets, question type (polar vs. wh-question) and illocution type (ISQ vs. RQ) were manipulated, such that every participant produced an interrogative in both illocution types, but either as a polar or as a wh-question, see Fig. 1 for an example wh-pair.

In total, we analysed 507 interrogatives (128 polar-ISQs, 131 polar-RQs, 123 wh-ISQs, 125 wh-RQs) in regard to f0 characteristics, duration, and voice quality, using linear mixed effects regression models [9]. Globally, RQs were produced with significantly lower mean f0 irrespective of question type (ISQ: 260.1Hz, RQ: 235.7Hz, p<0.05). RQs further showed a higher number of instances with the main sentence prominence on the first constituent (“yòurén” ‘anyone’ in polar questions, “shéì” ‘who’ in wh-questions), while the sentence accent in ISQs typically occurred towards the end of the interrogative (particle “me” in polar questions, sentence-final object (sfo) in wh-questions). Acoustically, this was mirrored in a higher f0 range in the first constituent in RQs (1.3st larger than in ISQs, p<0.05) and a later alignment of the low target in the rising tone 2 in the first constituent (for second syllable in “yòurén”: 7.5% later in polar-RQs than in polar-ISQs, for “shéì”: 2.5% later in wh-RQs than in wh-ISQs; stronger effect in polar questions, p<0.05), see Fig. 2 for time-normalized f0 contours of the first constituent. Additionally, irrespective of question type, there was an effect of illocution type on duration, with RQs being longer than ISQs (10.5% overall, p<0.05; all constituents were longer except for “me” in polar questions). Finally, RQs showed a higher proportion of glottal voice in the final constituent (particle “me” in polar, sfo in wh-questions) than ISQs (28.9% in RQs vs. 13.5% in ISQs, p<0.05). This phenomenon, however, might be caused by the lowered f0 in RQs and therefore be a byproduct of f0 modifications (cf. [10, 11]).

Taken together, Mandarin makes use of the f0 contour as well as duration and voice quality to signal rhetoric illocution. In order to shed more light on f0 modifications based on specific tones, we are currently analysing the overall f0 contours, using General Additive Modelling [12, 13]. In the paper, we will discuss the universality of cues to rhetorical questions across typologically different languages, along with ideas to test the perceptual relevance of cues to RQs for Mandarin listeners.
(1a) polar question
有人(yǒurén)吃(chī)柠檬(níngméng)吗(me)?
Anyone eat lemon PRT
“Does anyone eat lemon?”

(1b) wh-question
谁(shéi)吃(chī)柠檬(níngméng)?
Who eat lemon
“Who eats lemon?”

Figure 1. Example pair of a Mandarin wh-question, ISQ (left) and RQ (right).

Figure 2. Normalized raw f0 values for the first constituent (yǒurén in polar questions (left), shéi in wh-questions (right)), split by illocution type. Dashed lines indicate +/- 1 standard error of the mean.