

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

Katharina Zahner¹, Manluolan Xu, Nicole Dehé¹, Bettina Braun¹

¹ University of Konstanz

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 (“yǒurén” ‘anyone’ in polar questions, “shéi” ‘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 “yǒurén”: 7.5% later in polar-RQs than in polar-ISQs, for “shéi”: 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)么(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?”

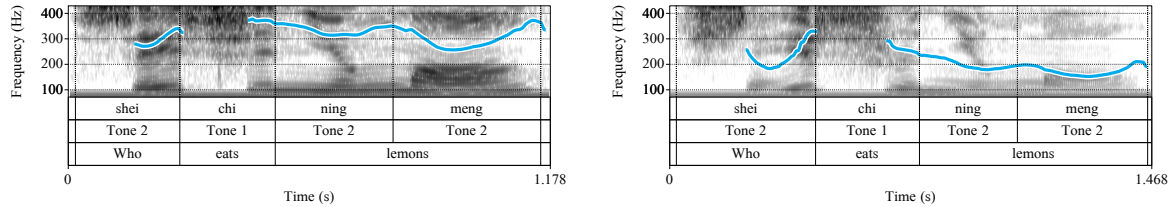


Figure 1. Example pair of a Mandarin *wh*-question, ISQ (left) and RQ (right).

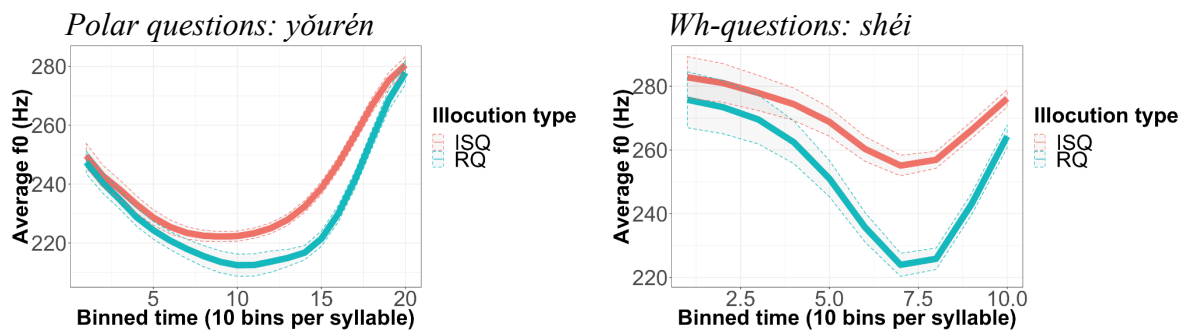


Figure 2. Normalized raw f_0 values for the first constituent (*yǒurén* in polar questions (left), *shéi* in *wh*-questions (right)), split by illocution type. Dashed lines indicate ± 1 standard error of the mean.

- [1] Biezma, M. and Rawlins, K., "Rhetorical questions: Severing asking from questioning," in *Proceedings of SALT 27*, 2017, pp. 302–322.
- [2] Han, C.-H., "Interpreting interrogatives as rhetorical questions," *Lingua*, vol. 112, pp. 201–229, 2002.
- [3] Braun, B., Dehé, N., Neitsch, J., Wochner, D., and Zahner, K., "The prosody of rhetorical and information-seeking questions in German," *Language and Speech (online first Dec 2018)*. 2018.
- [4] Dehé, N. and Braun, B., "The prosody of rhetorical questions in English," *English Language and Linguistics*. (accepted for publication 12 Apr 2019).
- [5] Dehé, N. and Braun, B., "The intonation of information seeking and rhetorical questions in Icelandic," *Journal of Germanic Linguistics* (accepted for publication 18 Feb 2019).
- [6] Chao, Y. R., "Tone, intonation, singsong, chanting, recitative, tonal composition and atonal composition in Chinese," in *For Roman Jakobson: Essays on the Occasion of His Sixtieth Birthday*, Halle, M. et al. Eds., The Hague, The Netherlands: Mouton Publishers, 1956, pp. 52–59.
- [7] Xu, Y., "Effects of tone and focus on the formation and alignment of f_0 contours," *Journal of Phonetics*, vol. 27, pp. 55–105, 1999.
- [8] Lee, O. J., "The prosody of questions in Beijing Mandarin," Ph.D. thesis, Ohio State University, 2005.
- [9] Baayen, R. H., Davidson, D. J., and Bates, D. M., "Mixed-effects modeling with crossed random effects for subjects and items," *Journal of Memory and Language*, vol. 59, pp. 390–412, 2008.
- [10] Kuang, J. J., "Covariation between voice quality and pitch: Revisiting the case of Mandarin creaky voice," *Journal of the Acoustical Society of America*, vol. 142, pp. 1693–1706, 2017.
- [11] Kuang, J. J., "The influence of tonal categories and prosodic boundaries on the creakiness in Mandarin," *Journal of the Acoustical Society of America*, vol. 143, pp. EL509–EL515, 2018.
- [12] Wieling, M., "Analyzing dynamic phonetic data using generalized additive mixed modeling: A tutorial focusing on articulatory differences between L1 and L2 speakers of English," *Journal of Phonetics*, vol. 70, pp. 86–116, 2018.
- [13] Baayen, R. H., Vasishth, S., Kliegl, R., and Bates, D., "The cave of shadows: Addressing the human factor with generalized additive mixed models," *Journal of Memory and Language*, vol. 94, pp. 206–234, 2017.