



Prosody or syntax? The perception of focus by Mandarin speakers

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Abstract

Information structure describes the way in which information is organized in a discourse to serve the purpose of communication. A core part of information structure is focus, whose main function is to indicate new information or the information that updates the common ground. In a question (e.g., ‘What did the captain put on?’), the focus is the unknown information asked about by the *wh*-phrase. Prosody (prosodic prominence) and syntax (syntactic clefting) can be used to signal focus in Mandarin. However, the relative importance of these cues has not been established in speech perception. This study probes listeners’ judgements on the appropriateness of an answer to a question in Mandarin. Results show that prosodic prominence appears to be more effective than syntactic clefting as a cue for listeners to perceive where the focus is. Syntax plays an inhibitory rather than facilitatory role. This research provides the first evidence of the interaction of syntax and prosody in the perception of focus in Mandarin, and contributes to a growing body of research showing cross-linguistic differences in the weighting of prosodic and syntactic cues in the perception of focus.

Index Terms: prosody, syntax, focus, perception, Mandarin

1. Introduction

Successful communication is not simply about understanding the words that speakers say, but also the way they say them. For example, (2) would be suitable to answer the question as in (1), while (3) would sound pragmatically odd (bold shows main prosodic prominence, [...]F indicates focus).

- (1) Who put on the raincoat?
- (2) [The **captain**]F put on the raincoat.
- (3) The captain put on [the **raincoat**]F.

The key difference between (2) and (3) is the location of prosodic prominence, which signals the focus, i.e. the information the speaker is updating. In (2), prosodic prominence on *captain* indicates that the word conveys information that updates an explicit or implicit ‘question-under-discussion’ (QUD) like ‘Who put on the raincoat?’ [1]. In (3), however, prosodic prominence on *raincoat* indicates that the word conveys information that updates an explicit or implicit QUD like ‘What did the captain put on?’. Deaccenting of *captain* marks it as the given information. Therefore, it would be odd if the given information were focus-marked, i.e. if (3) were preceded by (1), and this would cause processing difficulties [2, 3, 4]. Similarly, syntactic prominence, i.e. syntactic clefting which can also signal focus, should indicate that the word that has syntactic prominence updates the QUD, but this is less studied compared to prosodic prominence [5].

Previous research has shown that a ‘mismatch’ between the intended focus of the QUD and the prosody of an answer results in lower naturalness ratings in judgements about whether a

sentence is prosodically (or syntactically) appropriate to an utterance [6, 7], but little research has been conducted in Mandarin. The aim of this paper is to look at the perception of prosodic and syntactic cues to focus in Mandarin. This helps us understand how listeners integrate different linguistic cues in speech comprehension.

Prosody, and in particular prosodic prominence, plays an essential role in signaling information structure in many languages around the world [8]. In Mandarin, prosodic focus is marked through prosodic prominence, i.e., larger F0 movement, longer duration, and higher mean intensity [9, 10, 11, 12, 13]. Unlike Germanic languages in which prosodic prominence is realized as pitch accenting, in Mandarin prosodic prominence is realized as pitch range expansion, because the local F0 contours of syllables are determined by their lexical tones. For example, as Figure 1 shows, the pitch range of the focused word *captain* in the top picture is expanded, compared to *captain* which is not focused in the bottom picture.

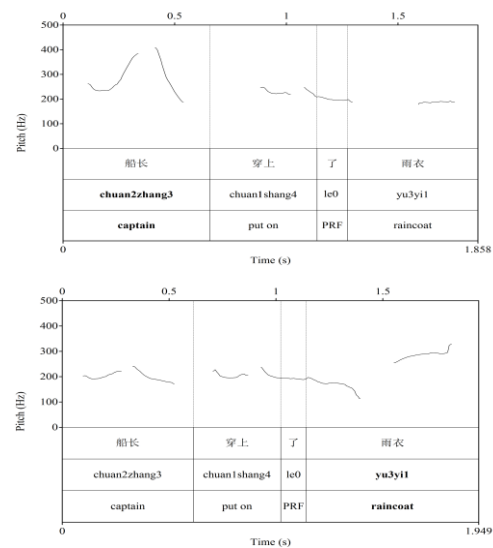


Figure 1: Prosodic prominence on the subject (top); Prosodic prominence on the object (bottom); Numbers in the second layer show tones.

In Mandarin, focus can also be marked by clefts, e.g. using the 是...的 ‘SHI...DE’ construction, as shown in (4) and (5) [14, 15]. 是...的 ‘SHI...DE’ marks focus in Mandarin without changing the word order from canonical order (see (6)). Compared to subject clefts, object clefts have received very little attention. It is still under debate as to whether object focus can be marked by the 是...的 ‘SHI...DE’ [14, 15, 16]. The more recent literature argues that the object can be focus-marked with 的 ‘DE’ in the pre-verb position as in (5), though this might be largely restricted to Northern Mandarin (see e.g., [14, 15]).

In clefts, the nuclear prosodic prominence is usually on the clefted word, e.g. 船长 ‘captain’ in (4) and 雨衣 ‘raincoat’ in (5). However, it can also fall on a different constituent [15, 17, 18, 19, 20]. These ‘mismatch’ constructions potentially signal focus on both the clefted word and the prominent constituent.

- (4) **Subject focus**
 是 [船长]_F 穿上 的 雨衣
 SHI captain put.on DE raincoat
 ‘It was [the captain]_F who put on the raincoat.’
- (5) **Object focus**
 船长 是 穿上 的 [雨衣]_F
 captain SHI put.on DE raincoat
 ‘It was [the raincoat]_F that the captain put on.’
- (6) **Canonical word order**
 船长 穿上 了 [雨衣]_F
 captain put.on PRF raincoat
 ‘The captain put on the raincoat.’
 (PRF = perfective aspect)

It has been shown for many languages that prosodic prominence is an effective cue to the location of focus (e.g., [13, 21]). However, syntactic means of marking focus, e.g., clefts, have received far less attention in the psycholinguistic literature. Further, the relative importance of syntactic and prosodic cues in the perception of focus is not yet clear. When multiple focus cues fall on one word, it is very likely that the word will be perceived as focal. However, it becomes much more interesting if the syntactic and prosodic cues do not fall on the same word (e.g., It was [the captain]_F who put on [the raincoat]_F), a possibility which has received less attention (though see [5, 22, 23]). In [5] it was shown that the relative weightings of prosodic and syntactic cues matched expectations about how these cues are used in listeners’ native language, i.e. Samoan listeners privileged syntactic cues over prosodic cues (also see [22] for Korean). This seems to suggest different weightings of focus cues across languages. Though prosodic prominence is shown to be more effective than syntactic clefting in processing focus [23, 24] in Mandarin, no studies have looked at the relative roles of these two cues in focus perception.

2. The experiment

The current experiment aims to answer the question of the relative strength of different focus markers by investigating which cue(s) native Mandarin listeners use to perceive focus in an untimed question-answer appropriateness rating task. This task was designed adopting the procedures in [6] and [7]. That is, participants judge how appropriate an answer (e.g., ‘The captain put on the raincoat’) sounds to a preceding question (e.g., ‘Who put on the raincoat?’).

2.1. Participants

Thirty-six native Mandarin speakers (32 females and 4 males; mean age = 24.6, SD = 5.4, age range = 18–40) were recruited. They received supermarket vouchers in recognition of their participation. None of them reported any hearing or reading difficulties.

2.2. Stimuli

Forty-eight critical sentences were constructed. The sentences described a simple, plausible event in the past tense, using

commonly occurring nouns and verbs. Both subject and object nouns had two syllables. All sentences had seven syllables in the canonical order version. For each sentence, six versions were created, involving different types of focus marking on the subject and/or the object. The six versions, as shown in ‘Critical sentence’ in Table 1, were canonS (canonical word order with prosodic prominence on the subject), canonO (canonical word order with prosodic prominence on the object), ScleftS (subject cleft with prosodic prominence on the subject), ScleftO (subject cleft with prosodic prominence on the object), OcleftS (object cleft with prosodic prominence on the subject), and OcleftO (object cleft with prosodic prominence on the object).

Table 1: Examples of test materials

Context	天气渐渐变冷, 船长和水手穿上了他们的雨衣和夹克 The weather got colder. The captain and the sailor put on their raincoat and jacket.
Focus probe question	SQ: 谁穿上了雨衣? Who put on the raincoat? OQ: 船长穿上了什么? What did the captain put on?
Critical sentence (Answer)	canonS: [船长] _F 穿上了雨衣 ((S) _F V O) [The captain] _F put on the raincoat. canonO: 船长穿上了[雨衣] _F (SV[O] _F) The captain put on [the raincoat] _F . ScleftS: 是[船长] _F 穿上了雨衣 (SHI [S] _F V DE O) It was [the captain] _F who put on the raincoat. ScleftO: 是[船长] _F 穿上了[雨衣] _F (SHI [S] _F V DE [O] _F) It was [the captain] _F who put on [the raincoat] _F . OcleftS: [船长] _F 是穿上了[雨衣] _F ([S] _F SHI V DE [O] _F) It was [the raincoat] _F that [the captain] _F put on. OcleftO: 船长是穿上了[雨衣] _F (S SHI V DE [O] _F) It was [the raincoat] _F that the captain put on.
Rating question	答案听起来有多恰当? 按相应的数字输入您的答案。 How appropriate does the answer sound (to the question)?

For each critical sentence two questions were constructed: a subject question (SQ) that is intended to invoke subject focus and an object question (OQ) that is intended to invoke object focus (see Table 1). Six critical sentence (answer) types and two question types resulted in 12 experimental conditions. Each of the 48 critical sentences appeared in all 12 conditions, for a total of 576 experimental stimuli. Twelve lists of 48 experimental stimuli were constructed in a Latin square design so that each sentence was in a different condition in each list. Each participant saw only one list.

In addition, for each dialogue (i.e., question-answer pair), a short written context was constructed which introduced a scenario that made the event plausible (see Table 1). The context included the subject (*captain*) and object (*raincoat*), as well as an alternative to each of the subject (*sailor*) and object (*jacket*). The inclusion of the context and alternative sets for each of the subject and object made the cleft versions of the sentences pragmatically plausible. Finally, each trial ended with a visually-presented question that asked for participants’ judgements on a 1-7 Likert scale of the appropriateness of the question-answer pair. A further 24 filler trials were constructed, following the same structure as the critical trials.

The critical sentences were recorded in Praat [25] by a trained female native Mandarin speaker in a soundproof room. The focus probe questions were recorded by a male native Mandarin speaker. The critical sentences were checked by two native Mandarin speakers for the location of prosodic prominence. Mean F0, duration, mean intensity and F0 range (the difference between max F0 and min F0) for the critical

sentences were each fitted into a linear mixed effects model using lme4 [26] in R [27]. The fitted values are given in Table 2. Planned comparisons showed that focused words were more prominent than unfocused words for the same words in different sentence conditions (e.g., *captain* in canonS vs. canonO) and also for different words in the same prominence condition (e.g., *captain* vs. *raincoat* in canonS) (all p values < 0.05). The aforementioned differences confirm that the materials have the intended patterns of prominence location.

Table 2: Fitted mean values of duration (ms), mean F0 (Hz), mean intensity (dB) and F0 range (Hz) of the subjects and objects in different sentence conditions

Condition	Word	Duration	Mean F0	Intensity	F0 range
canonS	Subject	675	322	79	270
	Object	589	187	66	104
canonO	Subject	531	213	71	89
	Object	739	273	76	212
ScleftS	Subject	665	326	79	260
	Object	594	180	66	99
ScleftO	Subject	536	213	71	85
	Object	738	269	76	223
OcleftS	Subject	670	319	78	261
	Object	560	173	64	103
OcleftO	Subject	523	217	71	118
	Object	736	260	76	209

2.3. Procedure

The experiment was administered using OpenSesame v. 3.1 [28]. Participants received written instructions on the computer screen, which were also repeated orally by the experimenter. The instructions asked them not to judge appropriateness based on the context, i.e. whether the answer was appropriate in relation to the context. Rather, they were instructed to provide appropriateness ratings of the answer in relation to the question. The instructions were carefully created, following [5] and [6], so that participants would pay attention to ‘emphasis’ (which can refer to both syntactic and prosodic focus). These instructions were intended to reduce the risk that participants would be biased towards using one or other of the cues to focus.

Participants first saw a context, and they were instructed to press any key to proceed when they had read the context, with no time limit. They then heard a dialogue (over closed-ear headphones) including a question and an answer, with a 500 ms break between the two voices. The screen was blank with a black background while the audio was playing. After that they saw a screen asking how appropriate the answer sounded to the question, on a scale from 1 (not appropriate at all) to 7 (extremely appropriate). Participants had to press the key corresponding to their judgement within six seconds. After either a key press or six seconds the experiment moved automatically to the next trial. All 72 trials were randomized for each participant. Participants could have a break if they wanted when they were at the screen showing the context.

2.4. Results

As the dependent variable (ratings) was ordinal, cumulative link mixed models [29] were built to test how ratings were affected by a number of factors. The initial full model included stress position (subject, object), syntax (canonical, subject cleft, object cleft) and question type (subject question, object question), and their interactions. In addition to the fixed effects, the random effects included intercepts for participants and

items, and random slopes for syntax by participants. Effects were tested for significance by model comparison.

The ANOVA table showing the significance of variables in the final model is given in Table 3. The final model showed a significant three-way interaction between question type, stress and syntax, three two-way interactions involving each pairing of these three factors, and simple effects for each factor. In order to see how the response was affected by the interaction between these three factors, comparisons were run using the *emmeans* function in the *emmeans* package [30]. The predicted ratings calculated from the model are shown in Figure 2.

Table 3: ANOVA table of the final model for ratings

Model: Syntax*Stress*QuestionType+(1|Item)+(1+Syntax|Participant)

	LR	Chisq	Df	P
Syntax	29.84		2	< 0.001
Stress	4.75		1	0.029
QuestionType	6.69		1	0.01
Syntax:Stress	20.48		2	< 0.001
Syntax:QuestionType	59.58		2	< 0.001
Stress:QuestionType	1128.01		1	< 0.001
Syntax:Stress:QuestionType	29.71		2	< 0.001

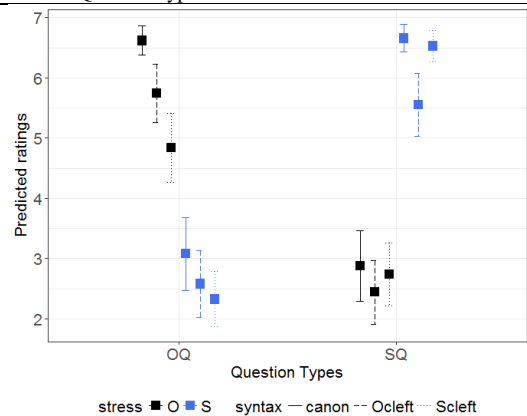


Figure 2: The predicted ratings for each condition (1-not appropriate and 7 extremely appropriate)

Planned comparisons were conducted between the three syntax types (canonical, subject and object clefts) for each of the two prosodic prominence conditions (prosodic prominence on the subject, prosodic prominence on the object) and for each of the two focus probe questions (SQ and OQ). The results showed that when the stress position matched the question (e.g., the question was about the subject and the prosodic prominence in the answer was on the subject), ratings varied significantly by sentence type. For questions that were about the subject (SQ), both canonical sentences and subject clefts were rated higher than object clefts (canonS vs. OcleftS: $z = 6.1$, $p < 0.001$; ScleftS vs. OcleftS: $z = 5.85$, $p < 0.001$), but they did not differ from each other (SQ: canonS vs. ScleftS: $z = 1.26$, $p = 0.22$). For questions that were about the object (OQ), the rating was the highest when the syntax was canonical, followed by object clefts and then by subject clefts (canonO vs. OcleftO: $z = 5.11$, $p < 0.001$; OcleftO vs. ScleftO: $z = 4.21$, $p < 0.001$; canonO vs. ScleftO: $z = 9.39$, $p < 0.001$).

When the stress position did not match the question, and when the question was about the subject (SQ), canonical sentences were rated marginally significantly higher than objects (canonO vs. OcleftO: $z = 1.75$, $p = 0.09$), but they did not differ significantly from subject clefts (canonO vs. ScleftO:

$z = 0.65, p = 0.51$; OcleftO vs. ScleftO: $z = -1.43, p = 0.17$). When the question was about the object (OQ), canonical sentences differed significantly from subject clefts (canonS vs. ScleftS: $z = 3.61, p < 0.001$) and marginally significantly from object clefts (canonS vs. OcleftS: $z = 1.915, p = 0.06$), but subject and object clefts did not differ from each other (ScleftS vs. OcleftS: $z = -1.254, p = 0.22$).

Further comparisons were conducted between the two types of focus probe questions for each of the sentence types (i.e., canonS, canonO, ScleftS, ScleftO, OcleftS, OcleftO). The results showed that under the same sentence condition, changing the question type resulted in a significant change of ratings for all sentence types (all p values < 0.001). For all sentence types, ratings were higher when the prosodic prominence in the sentence matched the intended focus invoked by the question. This shows the importance of prosodic prominence in focus perception.

3. Discussion and conclusion

This experiment aimed to investigate the relative effects of prosodic and syntactic cues in listeners' judgements of focus position using a question-answer appropriateness rating task. The experimental design manipulated focus probe question type (subject question, object question), stress position (subject, object) and syntax (canonical, subject cleft, object cleft). This study showed a significant three-way interaction between these three factors. Further analysis of the interaction showed that listeners use prosodic cues to identify the focus, which was reflected in their very high response ratings to the question-answer pairs where the stress location of the answer was consistent with the intended focus of the question. Further, syntactic cues do not seem to play as strong a role as prosodic cues. When prosodic and syntactic cues aligned, the word that had these cues were perceived as being in focus, but ratings were not higher than with prosodic cues alone. When these cues clashed, prosodic cues were clearly preferred by Mandarin listeners, although mismatching syntax lowered acceptability.

In relation to the role of prosodic cues in the perception of focus, the study shows that prosody is an effective cue. The appropriateness ratings of an answer to a question were very high when the prosodic focus of the answer matched what the question sought, for all syntax types (i.e., SQ-canonS; OQ-canonO; SQ-ScleftS; OQ-ScleftO; SQ-OcleftS; OQ-OcleftO, for all of which the fitted ratings were higher than 4.5, see Figure 2); the appropriateness ratings were very low when it was not (e.g., OQ-canonS, SQ-canonO; OQ-ScleftS vs. SQ-ScleftO; OQ-ScleftS vs. SQ-OcleftO, for all of which the fitted ratings were lower than 3.5, see Figure 2). This is consistent with the previous findings that listeners are sensitive to prosody in focus processing in Mandarin (e.g., [21, 23, 24, 31, 32]).

In relation to the role of syntactic cues, although syntactic cues played a role, unlike prosodic cues, this was in general inhibitory rather than facilitative. That is, consistent syntactic cues (i.e., when syntactic cues matched the focus probe question) did not enhance the cues to focus, but inconsistent syntactic cues (i.e., when syntactic cues did not match the focus probe question) lowered the appropriateness ratings.

For the question that was about the subject (SQ), having consistent syntactic cues did not improve the appropriateness ratings of the answer (canonS = ScleftS; canonO = ScleftO). For the question that was about the object (OQ), having consistent syntactic cues generally made the answer less appropriate (canonO $>$ OcleftO; canonS \geq OcleftS). This

shows that consistent syntactic cues did not have a facilitatory effect on the appropriateness ratings. Rather, it lowered ratings for object questions. This may be because the infrequency of using 是...的 'SHI...DE' to mark object focus makes OcleftO somewhat less acceptable, compared to canonO (see section 1). However, the ratings for OQ-OcleftO were still high, indicating object clefts were still broadly acceptable by the native Mandarin listeners, and they were more acceptable than the 'mismatch' sentences (e.g., OQ-ScleftO), as shown in Figure 2.

Inconsistent syntactic cues lowered the appropriateness ratings for both subject and object questions (SQ: canonS $>$ OcleftS, canonO \geq OcleftO; OQ: canonO $>$ ScleftO, canonS $>$ ScleftS). This is probably because inconsistent syntactic cues direct the listener's attention to irrelevant information to answer the question, which causes the answer to be less acceptable. However, for the comparison of canonS vs. OcleftS and canonO vs. ScleftO, it could also simply be that there are conflicting cues in 'mismatch' sentences (OcleftS and ScleftO) which the listener needs to resolve [e.g., 23, 24]. This adds uncertainty to their response, and therefore lowers appropriateness ratings.

With regard to the relative roles of prosodic and syntactic cues, although syntactic cues played a role, we also showed that prosodic cues were favoured over syntactic cues in the 'mismatch' conditions (OQ was preferred over SQ following ScleftO; SQ was preferred over OQ following OcleftS). It may be that in listening, prosodic cues are more salient than syntactic cues, which leads participants to attending to prosodic cues more and possibly ignore syntactic cues to some extent.

Together with previous literature (e.g., [5]), this study suggests that weighting of focus cues varies across languages: prosodic prominence is a stronger focus cue in Mandarin than syntax, while in English it is the other way around (there is also evidence in English that listeners' expectation of focus affects their perception of prosodic prominence). This study provides the first evidence of the relative weightings of prosodic and syntactic cues in focus perception in Mandarin, contributing to our (limited) knowledge of cross-linguistic differences in the weighting of prosodic and syntactic cues in the perception of focus. This is an important part of understanding speech comprehension processes in discourse contexts.

However, it is important to note that our findings need to be further validated in natural spontaneous conversations. In addition, the current study only looked at the SHI...DE cleft construction in Mandarin, we also need to compare other kinds of syntactic focus marking (e.g., word order) with prosodic focus marking to provide more evidence for the relative weighting of focus cues in Mandarin.

Further, considerable psycholinguistic evidence has been obtained for processing advantages that focus has, i.e. focused words are recognised faster and remembered better [22, 35]. Studies on Mandarin have shown that prosodic prominence is more effective than syntactic clefting in processing focal information [23, 24], suggesting a link between the relative importance of different cues in perceiving focus and their relative effectiveness in language processing. In future work it would be good to test more languages to confirm this.

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5. References

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