

NON-FOCAL PROMINENCE^{*}

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1 Introduction — Nuclear Prominence in Japanese

In this paper, we report results of two experiments (phonetic production experiment and self-paced perception experiment) on what we call *nuclear prominence* in Japanese. The notion of nuclear prominence has been called diversely (nuclear stress/accent, sentential stress/accent, primary stress, etc.), and has been characterized differently by different researchers, often without a clear definition. In English, it is usually assumed that the final (i.e., rightmost) accented element within a sentence carries the nuclear prominence (Chomsky and Halle 1968). Phonologically, nuclear prominence is represented as the highest mark in a metrical grid representation (Lieberman 1975, Hayes 1995), and its location is often determined by phonological *rules* (often referred to as the Nuclear Stress Rule, Chomsky and Halle 1968, Halle and Vergnaud 1987), *constraints* (Truckenbrodt 1995, Féry and Samek-Lodovici 2006), or *syntactic structures* (Cinque 1993, Zubizarreta 1998, Kahnemuyipour 2009). Phonetically, there may be various correlates that mark nuclear prominence, such as pitch movements (including pitch accents), F₀-height, intensity, and duration. What is common to all these approach is the view that nuclear prominence is determined solely by some formal phonological procedure in the sentence grammar which applies automatically and cyclically to each (relevant) phrase as its domain, for the purpose of assigning an unmarked pattern of phrasal stress.

Some studies also discussed the presence of nuclear prominence in Japanese extending the research mentioned above (Ishihara 2001, Sato 2012). Ishihara (2001), for example, claimed that the nuclear prominence is assigned to the immediately preverbal phrase, regardless of the grammatical category of that phrase. In (1) below, therefore, the direct object *hon-o* 'book-ACC' bears the nuclear prominence (in an all-new context). On the other hand, in (2) below, where the

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direct object has been scrambled from the preverbal position, the nuclear prominence is claimed to fall on whichever phonetically overt element that comes to occupy the immediately preverbal position, i.e., the subject *Taro-ga* 'Taro-NOM' in (2a) and the adverb *kyoo* 'today' in (2b).

- | | | | | | |
|-----|-------------------------------|----------------|--------------------|--------------------|--------|
| (1) | Taro-ga | (kyoo) | hon-o | katta | |
| | Taro-NOM | today | book-ACC | bought | |
| | 'Taro bought a book (today).' | | | | |
| (2) | a. hon-o | Taro-ga | t _{hon-o} | katta | |
| | book-ACC | Taro-NOM | | bought | |
| | b. hon-o | Taro-ga | kyoo | t _{hon-o} | katta |
| | book-ACC | Taro-NOM | today | | bought |
- Ishihara (2001:145)

Ishihara attempts to capture those phenomena by adopting Cinque's (1993) approach, in which the most deeply embedded element in the syntactic representation receives the nuclear prominence, with an additional assumption that the verb is raised to tense in Japanese. To the best of our knowledge, however, discussion on the nuclear prominence in Japanese presented in the literature so far has not been accompanied by any quantitative confirmation.

The nuclear prominence has also been discussed in relation to the semantic/pragmatic notion of focus. In this context, it has often been claimed that the element bearing the nuclear prominence must be included in the focus of the sentence (Jackendoff 1972, Reinhart 1995, Truckenbrodt 1995). These claims share the view, in other words, that the interpretive component of sentential and/or discursal grammar just takes advantage of the phonetic prominence resulting from formal phonological procedures.

The goal of this study is two-fold. First, through a production experiment (Experiment 1), we attempt to provide quantitative confirmation of the presence of nuclear prominence in Japanese, which has only been sporadically and informally observed in the literature. Second, we examine in a perception experiment (Experiment 2) whether nuclear prominence has any effect on sentence comprehension.

The results of Experiment 1 confirm that the phrase immediately preceding the verb exhibits phonetic prominence. It will also be shown that this prominence is independent of phonetic effects of focus, contrary to what has often been claimed in the literature. The results of Experiment 2 then reveal a hitherto unnoticed aspect of nuclear prominence, that is, it also yields an interpretive effect which presumably is independent of focus. The combined results of our two experiments, in other words, point toward the view that the nature of nuclear prominence is not solely phonetico-phonological but is semantico-pragmatic at least in part. In what follows, Sections 2 and 3 present the design, the results and the discussion regarding Experiments 1 and 2, respectively, which are followed by concluding remarks in Section 4.

2 Experiment 1

We conducted a production experiment to test the hypothesis that Japanese exhibits nuclear prominence on the phrase immediately preceding a verb (henceforth simply *final phrase*). The experiment was designed to provide answers to the following concrete questions. First, can we quantitatively verify that the final phrase receives phonetic prominence as its default prosodic

pattern, regardless of its syntactic category or grammatical function? Second, if such prominence indeed exists, what phonetic properties does it have? Third, is nuclear prominence in Japanese interlocking with the notion focus or is it independent of focus?¹

2.1 Participants and Recordings

In our production experiment, stimulus sentences were uttered by 12 native speakers of Tokyo Japanese, 10 male and 2 female college students, ages 18~20, who were naïve about the purpose of the study. They were paid for participation. The recordings were done in June 2011 in a sound-attenuated booth in the Speech Laboratory of the Department of Language and Information Sciences, University of Tokyo, Japan. The participants attached a head-mounted microphone (Sony ECM-CR120), and their speech was digitally recorded using an IC recorder (Sony ICD-SX900). The sampling rate was 22.05 kHz and the quantization was at 16 bits in all the recordings. After the general instruction and a short practice session, the participants were presented experimental sentences on a computer screen one by one in a pseudo-randomized order, and asked to utter them. The instruction made clear that they must fully understand the meaning of the sentences before they recite them, and provide a natural utterance that represents the particular meaning they interpreted. They were asked to recite each sentence with a comfortably smooth flow rather than with careful and slow segmentation of each word or phrase.

2.2 Stimuli and Procedure

In order to address the questions above, we created three distinct sets of sentences, each consisting of the same lexical items, but with different word order and with different information packaging involved in a sentence. The experiment had two independent variables. One variable was *grammatical function (of the final phrase)*. Altering the order of three phrases before the verb, three different syntactic elements (*de*-(PP)-adjunct, *ni*-(dative) indirect object, and *o*-(accusative) direct object) were placed in the immediately preverbal position in a ditransitive construction, as schematically illustrated in (3a-c).

- (3) a. Noun-wa Noun-**de** Noun-**ni** Noun-**o** Verb
 -TOP -at -DAT -ACC
- b. Noun-wa Noun-**de** Noun-**o** Noun-**ni** Verb
 -TOP -at -ACC -DAT
- c. Noun-wa Noun-**ni** Noun-**o** Noun-**de** Verb
 -TOP -DAT -ACC -at

The other variable was *information packaging*. Three distinct ways of information packaging were applied to a sentence, as exemplified in (4).

¹ Until we present and discuss the results of our second experiment below, we will use the label "nuclear prominence" to refer only to a prosodic phenomenon.

(4) a. All-new Declarative:

Nori'yuki-wa Yona'guni-de Nao'miti-ni awa'mori-o azu'keta.
 Noriyuki-TOP Yonaguni-at Naomichi-DAT rice.brandy-ACC entrusted
 'Noriyuki entrusted *awamori* (rice brandy) to Naomichi at Yonaguni.'

b. Verum Focus on Verb:

Nori'yuki-wa Yona'guni-de Nao'miti-ni awa'mori-o azu'keta?
 Noriyuki-TOP Yonaguni-at Naomichi-DAT *awamori*-ACC entrusted
soretomo azuke'-**nakat**-ta?
 or entrust-not-PAST
 'Did Naoyuki entrust or did he not entrust *awamori* to Naomichi at Yonaguni?'

c. Constituent Focus (answer to a *wh*-question):

Q: pro₁ pro₂ pro₃ **na'ni-o** azu'keta?
 what-ACC entrusted

'What did he₁ entrust to him₃ there₂?'

A: Nori'yuki-wa Yona'guni-de Nao'miti-ni **awa'mori-o** azu'keta.
 Noriyuki-TOP Yonaguni-at Naomichi-DAT rice.brandy-ACC entrusted
 'Naoyuki entrusted *awamori* to Naomichi at Yonaguni.'

In one condition, the target sentence was a declarative sentence as in (4a), which was presented *without any context*, and hence involving all new information for the participants including the topic-marked phrase. In another condition, the whole target sentence was presented without any context, but as a question involving a verum focus, which is realized on the verb, as in (4b). In this condition, preverbal elements are placed right before focused elements (*i.e.*, verbs). In the third condition, the target sentence was a declarative sentence in which the preverbal element was to be interpreted as a constituent focus as the answer to a *wh*-question as in (4c-A). As far as we can tell, there does not exist any factor which gives rise to a constituent focus interpretation of the preverbal elements in (4a) and (4b), in contrast to (4c).

We prepared three lexical sets for each word order and sentence type, yielding 27 sentences in total. All the phrases contained five moras (including the phrase-final monomoraic particle) and had a HL pitch accent on the second mora, so that they had LHLLL tonal pattern. The participants recited each of the sentences seven times in a semi-randomized order (the first repetition was excluded from the analysis). For the constituent focus sentences, the experimenter read the preceding *wh*-questions, and the participants read the target sentences.

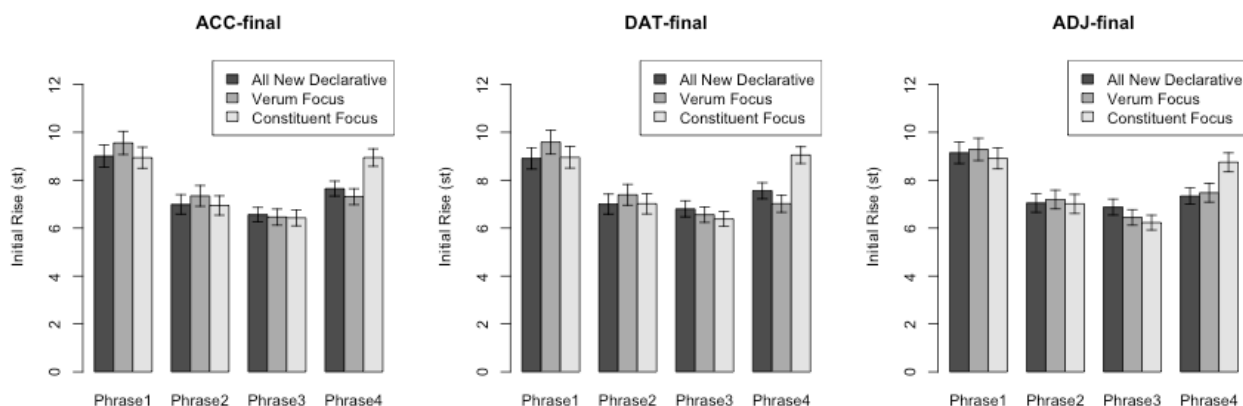
F₀ values of intonational landmarks were calculated using Praat (Boersma and Weenink 2017), and statistical analyses were run in R (R Core Team 2017).

2.3 Results

Figure 1 below shows the size of the F₀ rises (which we will refer to simply as *rises* below) from the phrase-initial lowest pitch to the highest pitch in each phrase. In most of the cases (1679 out of 1944 tokens, 86.3 %), the highest pitch appeared on the second mora (*i.e.*, the 'H' part of the LHLLL tonal pattern), which means that the measured values represent the size of the *initial rise* (also known as *initial lowering*). In other cases (265 tokens), the highest pitch was detected on an

additional rise on the final mora (i.e., the final ‘L’ of the LLLLL tonal pattern changed to an H), which typically appeared only on the immediately preverbal phrase in our data. In this paper, we do not discuss this variation any further due to space limitation, and analyze only the initial rise in the nominal portion.²

Figure 1: Comparison of F_0 rise in four noun phrases before the verb



In all three types of information packaging (all-new declarative, verum focus, and constituent focus) and with all three grammatical functions (accusative object, dative object and locative adjunct), the preverbal elements (phrase 4) showed a larger rise than the elements immediately preceding them (phrase 3). While the amount of rise decreased progressively from phrase 1 through phrase 3, phrase 4 showed a larger rise than phrase 3, which suggests that preverbal elements received some phonetic prominence.

To verify the observation statistically, we assessed whether rises are larger in phrase 4 than in phrase 3, by building linear mixed models with speaker, item, and repetition as random factors. The dependent variable was the size of rise in semitones throughout. First, since we are interested in whether the prominence of phrase 4 is statistically robust (in comparison to phrase 3), and how the prominence of phrase 4 interacts with the information packaging and the grammatical function of the preverbal element, the model contained the amount of rises on phrase 3 and phrase 4 (RISE), information packaging (PACKAGING), and grammatical function of preverbal elements (FUNCTION) and their interactions as fixed factors. Highly significant effects were found for RISE ($F(1,3857)=492.98$, $p<.001$) and PACKAGING ($F(2,3857)=51.02$, $p<.001$). The interaction between PACKAGING and RISE was also highly significant ($F(2,3857)=93.67$, $p<.001$). This means that the prominence of phrase 4 depends on the information packaging to a large degree.

Therefore, as a next step, linear mixed models were run separately for each information packaging type, with RISE and FUNCTION and their interaction as fixed factors. For *all-new declarative sentences*, rises were larger in phrase 4 than phrase 3 ($F(2,1277)=53.921$, $p<.001$), and this effect marginally interact with grammatical function ($F(2,1277)=2.970$, $p=.05165$). As can be seen in Figure 1, in the all-new declarative sentences, the differences of rises between phrases 3 and 4 were equally clear in both accusative-final and dative-final sentences. The difference between the two conditions was not significant ($t=1.169$, n.s.). On the other hand, the difference between phrases 3 and 4 was significantly smaller in the adjunct-final condition when

² See related discussions in Kawahara and Shinya (2008) and Ishihara (2011) on this variation.

compared to the accusative-final sentences ($t=2.437$, $p<.05$).

For *verum-focus sentences*, again rises were larger in phrase 4 than phrase 3 ($F(2,1277)=57.429$, $p<.001$). This effect also marginally interacts with FUNCTION ($F(2,1277)=2.700$, $p=.06756$). The differences of rises between phrases 3 and 4 were equally clear in accusative-final and adjunct-final sentences. The difference between the two conditions was not significant ($t=-0.711$, n.s.). On the other hand, the difference between phrases 3 and 4 was significantly less pronounced in dative-final sentences than in accusative-final sentences ($t=-2.272$, $p<.05$).

Finally in *constituent focus sentences*, phrase 4 was more prominent than phrase 3 ($F(2,1277)=539.62$, $p<.001$), and there was no significant interaction between RISE and FUNCTION ($F=0.20$, $p=.8183$).

Next, to assess whether three different information packaging types affected the prominence of phrase 4, linear mixed models were built for each pair of information packaging types (i.e., all-new vs. verum focus, verum focus vs. constituent focus, and constituent focus vs. all-new) in which PACKAGING, RISE, and their interaction were the fixed factors. The interaction terms were significant for the model comparing all-new declarative and constituent focus ($F(1,2575)=138.77$, $p<.001$) and the one comparing verum focus and constituent focus ($F(1,2575)=138.00$, $p<.001$), reflecting the observation that prominence of phrase 4 is more pronounced in the constituent focus sentences than the other two sentences. The interaction was not significant in the model comparing all-new declarative and verum focus ($F(1,2575)=0.006$, $p=.9372$). These results are summarized in (5).

(5) Experiment 1: Summary of the results

- a. Phrase 4 showed a larger initial rise than Phrase 3 in all of the stimulus sentences. The phonetic prominence of the final phrase, i.e., the immediately preverbal element, in Japanese holds across all three information packaging types, even along with verum focus.
- b. The size of phonetic prominence in Phrase 4 is larger when it received constituent focus, as in (4c), than the other two conditions. Constituent focus has an additional boosting effect that is independent of the prominence assigned to the final phrase.
- c. All types of phrases (*o*-accusative, *ni*-dative, *de*-adjunct) received phonetic prominence in Phrase 4. There were a few cases of interactions with the grammatical function of the final phrases (for the reason unknown to us).

2.4 Discussion

As reported in (5a), phrase 4 consistently exhibited a larger rise in all three information packaging types. If the increase of rise on the final phrase found in our experiment is taken to be a phonetic correlate of nuclear prominence, our results confirm that nuclear prominence is assigned to the immediately preverbal element in Japanese. The result summarized in (5c) above also suggests that it is generally assigned regardless of grammatical functions or syntactic categories (i.e., whether the final phrase is an argument NP carrying some grammatical case or an adjunct PP), which confirms the observation made by Ishihara (2001) quantitatively.

Probably a more intriguing implication, which is made by the results in (5a) and (5b), is that nuclear prominence is independent of focus. While the effect of constituent focus was detected, as summarized in (5b), a rise on phrase 4 was consistently found regardless of the information

packaging types, even in the verum focus sentences, where the focus of the sentence is presumably located on the verb. This implication is in contrast with some influential claims previously made in the literature.

First, it has been claimed by many that nuclear prominence must be contained in a focused constituent (Jackendoff 1972, Cinque 1993, Reinhart 1995, and Truckenbrodt 1995). In our results in (5a), however, the increase of rise on the final phrase was observed in all three information packaging types in (4). Note then that nuclear prominence is *not* contained in the verum focus realized on the verb in (4b), contrary to such a view.

Second, some researchers consider that the most important or new part of a declarative utterance always constitutes focus (a.k.a. "presentational/informational focus") of different sizes (Büring 2006: 335, Krifka 2008: 251) and induces alternatives as an answer to an implicit *wh*-question suggested by the context (Klein and von Stutterheim 1987, van Kuppevelt 1994, Roberts 1996, Büring 2003). Therefore, English sentences comparable to (4a), for example, are considered to be capable of answering any of the questions like "What happened?," "What did Noriyuki do?" and "What did Noriyuki entrust to Naomichi at Yonaguni?". If one adopts this assumption, s/he is led to consider that virtually all sentences involve focus and induce alternatives, as assumed by Krifka (2008: 251). In our results in (5c), however, an extra boosting effect on the rise was observed only on the constituent focus in the preverbal position of (4cA). It therefore is necessary to distinguish the prominence assigned to the preverbal element in (4a-b) from that assigned to the constituent focus in (4c). If we assumed that a sentence like (4a) can be an answer to the implicit *Wh*-question "**What** did Noriyuki entrust to Naomichi at Yonaguni?" (similar in meaning to (4cQ)), we would not be able to capture this contrast. We therefore consider that the nuclear prominence in all-new declarative sentences should *not* be identified with the prominence induced by constituent focus.

3 Experiment 2

Now that we confirmed the presence of phonetic realization of nuclear prominence in Japanese, the next question we raise is whether the phonetic prominence we have observed on the preverbal phrase also has any interpretive effect that is independent of focus. In order to examine such "interpretive" nuclear prominence effects in sentence comprehension, we conducted a self-paced reading experiment.

Suppose that phonetic prominence of an immediately preverbal element in Japanese has a functional *raison d'être* of signifying that this item has some interpretive prominence. We have already confirmed that, prosodically, nuclear prominence must be distinguished from focus prominence. It then must be the case that this item is not regarded by the interlocutors as inducing alternatives but as carrying somewhat greater informational weight than other (preceding) elements in a sentence, and hence has a potential to alter the conversational common ground. Such a string of thoughts led us to hypothesize that an element bearing nuclear prominence (i.e., an immediately preverbal element) becomes informationally salient and more prominently accessible than the other elements without nuclear prominence when an item in the following sentence anaphorically refers back to it.

With this hypothesis in mind, Experiment 2 tests the following prediction: an anaphoric topic NP is read faster if its antecedent receives the nuclear prominence in the previous sentence. If an immediately preverbal phrase of a sentence (Sentence 1, S1), for example, is referred back to by

the topic phrase of the following sentence (Sentence 2, S2), as in (6) below, it is more quickly read than when any other phrase of Sentence 1 is referred to. If this prediction is borne out, it supports the hypothesis that nuclear prominence influences the comprehension of sentences.

(6) a. Context sentence (S1)

Wakatekasyu-wa hatubutai-de daizyoyuu-ni **kodoogu-o** nagetuketa.
 young.singer-TOP stage.debut-in great.actress-DAT **stage.prop-ACC** threw.at
 'The young singer threw a stage prop to the great actress in her stage debut.'

b. Target sentence (S2)

sono kodoogu-wa ensyutuka-ga kan'ippatu-de uketomete ...
that stage.prop-TOP director-NOM by.a.whisker caught ...
 'Speaking of that stage prop, the director caught it by a whisker, and ...'

3.1 Participants and Experimental Settings

Forty-one students of Tsuda university, all female, native speakers of Japanese, and naïve about the purpose of the study, participated in our sentence comprehension experiment. They were paid for participation. The task was a self-paced reading in a moving-window fashion. It took approximately 30 minutes to complete the experiment. The experiment was conducted individually in a quiet place in the university, using a laptop PC. In order to make sure that the participants pay enough attention to the propositional content of the sentences, each trial was followed by a comprehension question that can be answered by either yes or no. As can be seen in a sample set of stimuli in the next section, 36 sets of items (a pair of sentences) were prepared and distributed into 9 lists. 45 fillers were added to each list, then a participant read 81 pairs of sentences in total.

3.2 Stimuli and Procedure

The experiment was designed with two factors (3 x 3) which yields 9 crucial conditions. The first factor was the word order of the context sentence (S1). S1 was presented in 3 different word orders, as illustrated in (7a–c) below. The second factor was sentence-initial (topic) NPs in the target sentence (S2). S2-initial NPs were chosen, for example, as in (8a–c) from NPs in (6a) as S1.

(7) Factor 1: S1 word order

a. Accusative-final (*de-ni-o*)

Noun-wa Noun-de Noun-ni **Noun-o** Verb
 -TOP -at -DAT **-ACC**

b. Dative-final (*o-de-ni*)

Noun-wa Noun-o Noun-de **Noun-ni** Verb
 -TOP -ACC -at **-DAT**

c. Adjunct-final (*ni-o-de*)

Noun-wa	Noun-ni	Noun-o	Noun-de	Verb
-TOP	-DAT	-ACC	-at	

(8) Factor 2: Sentence-initial NP in S2

a. Topic NP (*wa*) = Accusative NP (*o*) in S1

sono kodoogu-wa ensyutuka-ga kan'ippatu-de uketomete ...
 that stage.prop-TOP director-NOM by.a.whisker caught ...

'Speaking of that stage property, the director caught it by a whisker, and ...'

b. Topic NP (*wa*) = Dative (*ni*)

sono daizyoyuu-wa ensyutuka-ga meezita toori-ni...
 that great.actress-TOP director-nom ordered exactly.as

'Speaking of that great actress, she did ... exactly as the director had instructed.'

c. Topic NP (*wa*) = Adjunct (*de*)

sono hatubutai-wa ensyutuka-ga koosyoo-site ...
 that stage.debut-TOP director-NOM negotiated ...

'Speaking of that stage debut, it was arranged by the director's negotiation ...'

We tested the hypothesis that informational salience induced by the nuclear prominence in S1 facilitates the processing of the topic NP in S2. Out of the 9 conditions, there are 3 conditions in which the S2-initial topic NP matches the phrase in S1 with nuclear prominence, as exemplified above by (6a-b). We classified these three conditions as *Match* conditions, and the other 6 conditions as *Mismatch* conditions. (9) below lists three Match conditions, i.e., (6a-b) and their two other variants.

(9) Match conditions:

<i>S1 word order</i>	<i>S2-initial NP</i>	<i>in S1</i>
ACC-final <i>de-ni-o</i>	stage prop-TOP	accusative
DAT-final <i>o-de-ni</i>	actress-TOP	dative
AJCT-final <i>ni-o-de</i>	stage debut-TOP	adjunct

It was predicted that the mean reading time of the S2-initial NPs in Match conditions becomes faster than that in Mismatch conditions.

We calculated the mean reading times for the S2-initial NPs. The data points that are outside of ± 3 SD were trimmed. Trials that were incorrectly answered in the comprehension question were also excluded from the analysis. The linear mixed effects models were constructed in R in order to examine effects of Match/Mismatch conditions on the reading time of the S2-initial NP.

3.3 Results

Figure 2 below shows the mean reaction time of the topic-marked NP in S2 in Match and Mismatch conditions for each of the three types of phrases (*de*-adjunct, *ni*-dative, and *o*-

accusative). A main effect of MATCH was found ($t=2.45$, $p<.02$).³ The S2-initial topic NPs in the Matched conditions were in general read faster than those in the Mismatched conditions.

Figure 2: Mean reaction time (in ms) of the topic-marked NP in S2 in **Match and Mismatch conditions**

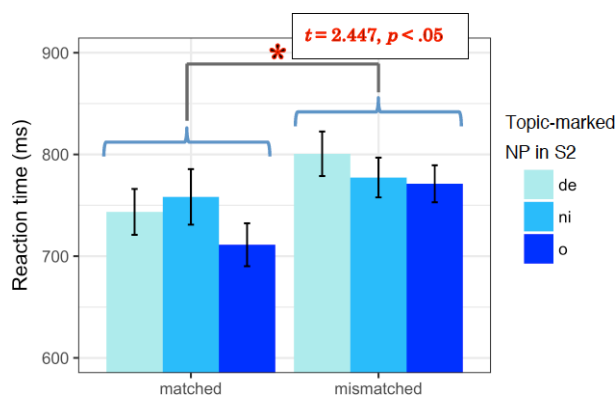
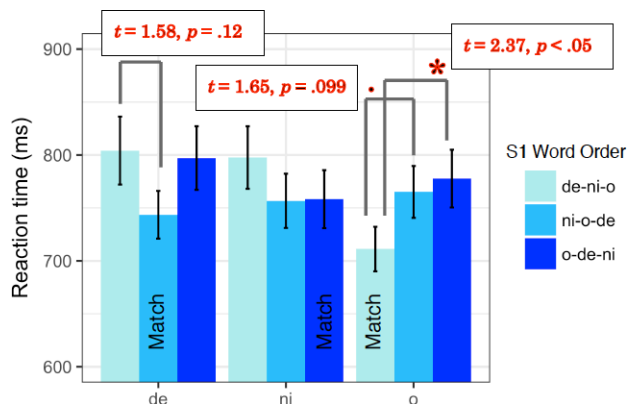


Figure 3 below shows the mean reaction time on the topic-marked NP in S2 in Match and Mismatch conditions for each of the three types of phrases (*de*-adjunct, *ni*-dative, and *o*-accusative). It turns out that, though marginally, the *o*-accusative NP in the *de-ni-o* condition (Match) was significantly faster than the other (mismatch) *o*-conditions. (against *ni-o-de*: $t=1.65$, $p=.099$, against *o-de-ni*: $t=2.37$, $p<.05$).⁴ The other two types of NPs, (*de*-adjunct and *ni*-dative), however, did not exhibit significant effects.

Figure 3: Mean reaction time (in ms) of the topic-marked NP in S2 for the **three grammatical functions** (*de*-adjunct, *ni*-dative, *o*-accusative)



3.4 Discussion

The S1 word order factor, or more specifically Match factor, seems to be at work in general;

³ The linear mixed effects model for the analysis includes MATCH (Match/Mismatch conditions), S1 word order, S2 word order, and the trial order as fixed factors and items and participants as random factors.

⁴ The models were applied to each data of the three grammatical functions (*de*-adjunct, *ni*-dative, and *o*-accusative) with the S1 word order and the trial order as fixed factors, and items and participants included as random factors.

There is a general trend that the reading time of the S2-initial Topic marked NP was faster when such an element has appeared as the immediately preverbal element in S1. The strongest effect was observed when the accusative NP in S1 was used as the S2-initial Topic-marked NP. This reading time pattern matches the prediction made by the hypothesis that nuclear prominence induces some semantico-pragmatic effect. It suggests that the element with the nuclear prominence is informationally salient, and an informationally salient element is more readily accessible to a topic-marked NP referring back to it.⁵

Despite the above-mentioned results, however, we did not obtain the expected significant effects when NP-*de* and NP-*ni* were involved. There may be more than one cause of this asymmetry. First, as Satoshi Tomioka pointed out to us, the absence of a case particle from the S2-initial topic may have caused it. When a direct object is topicalized with *wa*-marking, its accusative marker is known to have to be eliminated but similar topicalization of dative and adjunct phrases need not eliminate their particles. Therefore, when the S1-final direct object is repeated as the S2-initial topic without its accusative particle indicated as in (6a-b), the form is exactly as expected and its anaphoric interpretation does not require any extra process. On the contrary, when the S1-final dative or adjunct phrase is repeated as the S2-initial topic with their particles eliminated as in (8b-c), motivation for their elimination may be sought, giving rise to a momentary mental search for a distinct grammatical function associated with the phrase. Rise of such an extra interpretive option might have slowed down the reading time of the S2-initial topic slightly when a dative or adjunct phrase is involved. Second, a processing cost of scrambling in S1 may have influenced the reading time of the S2-initial topic when a marked word order is involved in S1 as in (7b-c). We must leave further investigation of this asymmetry for future research.

4 Conclusion

In this article, we have reported the results of a phonetic production experiment and a self-paced perception experiment on nuclear prominence in Japanese. Their results quantitatively confirmed, first, that, with or without a focus present, phonetic prominence is assigned to the immediately preverbal element in a sentence, and second, that such phonetic prominence is closely associated with informational prominence, which presumably is independent of focus.

That is to say, our experimental results point toward the view that the nature of nuclear prominence is not solely phonetico-phonological but is semantico-pragmatic and it is independent of focus. It is not the case, however, that we are denying the possibility that there is a phonological mechanism in the grammar which achieves the phonetic effects of nuclear prominence. On the contrary, we do consider that such a mechanism exists. What we would like to and hope to have demonstrated in this article is that it probably is a mistake or at least insufficient to attempt to elucidate the nature of nuclear prominence paying attention solely to its sounds.

⁵ One may consider that the observed interpretive effect may simply show a recency effect. That is, the topic-marked NP in S2 in the Match conditions may have been read fast because it was the most recent NP appeared in the trial. This account predicts that there should be a linear increase of the reading time as the element is placed further away from the sentence-final position. Figure 3, however, does not show such a pattern, at least in an obvious way. Thus, we suggest that the interpretive advantage observed in this experiment is driven by a special mechanism only available to the immediately preverbal position of the sentence rather than its recency.

References

- Boersma, Paul, and David Weenink. 2017. Praat: doing phonetics by computers [Computer program]. URL <http://www.praat.org>.
- Büring, Daniel. 2003. "On D-trees, beans, and B-accents," *Linguistics and Philosophy* 26, 511–545.
- Büring, Daniel. 2006 "Focus Projection and Default Prominence," in Molnár, Valéria and Susanne Winkler eds., *The Architecture of Focus*, Mouton De Gruyter, Berlin/New York, 321-346.
- Chomsky, Noam and Morris Halle. 1968. *The Sound Pattern of English*, Harper & Row, New York.
- Cinque, Guelielmo. 1993. "A Null Theory of Phrase and Compound Stress," *Linguistic Inquiry*, 24, 239–298.
- Féry, Caroline and Vieri Samek-Lodovici (2006) Focus projection and prosodic prominence in nested foci. *Language* 82:131–150.
- Halle, Morris and Jean-Roger Vergnaud. 1987. *An essay on stress*. MIT Press, Cambridge, MA.
- Hayes, Bruce. 1995. *Metrical stress theory: Principles and case theory*. University of Chicago Press, Chicago.
- Ishihara, Shinichiro. 2001. "Stress, focus, and scrambling in Japanese," *MIT Working Papers in Linguistics* 39, MITWPL, Cambridge, MA, 151–185.
- Ishihara, Shinichiro. 2011. Japanese focus prosody revisited: Freeing focus from prosodic phrasing. *Lingua* 121, 1870–1889.
- Jackendoff, Ray. 1972. *Semantic Interpretation in Generative Grammar*, MIT Press, Cambridge, MA.
- Kahnemuyipour, Arsalan. 2009. *The syntax of sentential stress*. Oxford: Oxford University Press.
- Kawahara, Shigeto and Takahito Shinya. 2008. The intonation of gapping and coordination in Japanese: evidence for intonational phrase and utterance. *Phonetica* 65 (1–2), 62–105.
- Klein, Wolfgang and Christiane von Stutterheim. 1987. "Quaestio und referentielle Bewegung in Erzählungen," *Linguistische Berichte* 109, 163–183.
- Krifka, Manfred. 2008. "Basic Notions of Information Structure," *Acta Linguistica Hungarica* 55, 243–276.
- Lieberman, Mark. 1975. The intonational system of English. Ph.D. dissertation, MIT.
- R Core Team. 2017. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <http://www.R-project.org>.
- Reinhart, Tanya. 1995. *Interface strategies*. OTS Working Papers in Theoretical Linguistics, OTS, Utrecht University, Utrecht.
- Roberts, Craige. 1996. "Information structure in discourse: Towards an integrated formal theory of pragmatics," In Jae Hak Yoon and Andreas Kathol (eds.) *OSU Working Papers in Linguistics* 49: *Papers in Semantics*, 91–136. The Ohio State University, Columbus.
- Sato, Yosuke. 2012. "Phonological interpretation by phase: Sentential stress, domain encapsulation, and edge sensitivity," in Ángel J. Gallego ed., *Phases: Developing the framework*, Mouton de Gruyter, Berlin, 283–307.
- Truckenbrodt, Hubert. 1995. *Phonological phrases: Their relation to syntax, focus, and prominence*. Ph.D. dissertation, MIT.
- van Kuppevelt, Jan. 1994. "Topic and comment," In Ronald E. Asher (ed.) *The encyclopedia of language and linguistics*, 4629–4633. Pergamon Press, Oxford.
- Zubizarreta, Maria. 1998. *Prosody, Focus, and Word Order*, The MIT Press, Cambridge, MA.