Predictability of pitch accent in Kansai Japanese: A reaction time study

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People predict various information during comprehension [1,2], which likely facilitates comprehension [3]. For example, predicting meaning is likely helpful for quickly inferring the speaker's intended message. However, do people predict information that could make little contribution to semantic or syntactic information and thus rarely support comprehension? To explore this question, we tested prediction of pitch accent in Kansai Japanese (KJ)[1]. In addition to presence/position of the accent nucleus (*HL) seen in both KJ and Tokyo Japanese (TJ), KJ words are specified for register tone: low-rising (L-register) or high-level (H-register). The surface tonal realisations of an unaccented L-register words are conditioned by the register tone of the following word, making the register type of the word predictable.

We created 48 quadruplets of unaccented modifier + noun phrases as in Table 1. When the modifier had a L-register, the upcoming tone was predictable based on the modifier ending (Predictable condition). When the modifier had a H-register, the upcoming tone was unpredictable (Unpredictable condition). TJ does not distinguish H-/L- register tones, so the tone of the noun should be unpredictable in all conditions in TJ.

Forty native KJ speakers and 40 native TJ speakers (control) participated in Experiment 1 on ibex farm. We first conducted a picture familiarisation task, where participants saw the visual stimuli in black-and-white with their name and named them in their own accent. In the experiment, they saw objects that matched each phrase in Table 1 (Figure 1), heard one of the phrases, and selected a mentioned object as quickly and accurately as possible. If participants exploited the information about an upcoming tone, reaction time (RT) should be faster in the predictable vs. unpredictable condition in the KJ group, but not in the TJ group.

The results are shown in Figure 2 (left). A linear mixed-effects model for each group revealed a significant effect of predictability, and the predictability interacted with the noun accent ($|t|s>2$). A follow-up analysis revealed faster RT in the predictable vs. unpredictable condition only with H-register nouns in both groups, but this effect was larger in the KJ group than in the TJ group. We speculate that there are two separate processes going on. The predictability by group interaction suggests that KJ speakers were better at using the phonological rule in KJ to quickly identify the target. The larger predictability effect with H-register nouns is presumably because L-ending L-register modifiers deviate from the default H-ending. However, we did not expect to find the predictability effect in the TJ group. To test whether this effect was a false positive or it occurred because the TJ group had some knowledge of KJ, Experiment 2 repeated Experiment 1 with additional measurements.

Forty native TJ speakers participated in Experiment 2, where they additionally filled in a dialect background questionnaire and performed the picture familiarisation task both in TJ and KJ. Experiment 2 found a predictability effect only with H-register nouns (Figure 2, right), replicating Experiment 1. Thus, the effect is unlikely to be a false positive. The questionnaire data revealed that most of the participants had no or little regular exposure to KJ. None of the measures for the familiarity with KJ (exposure, self-rated listening/speaking proficiency) or the pronunciation performance in KJ predicted the predictability effect in the RT experiment. Thus, it is unlikely that the TJ group used the KJ-specific rule.

Our findings suggest that native KJ speakers referred to the dialect-specific phonological rule to quickly identify the upcoming tone. While we found no strong evidence for prediction (almost no response was made before the noun was mentioned), our data is compatible with the hypothesis that people can use purely phonological information to predict upcoming tone. At the same time, the TJ speakers were also sensitive to the KJ-specific rule where the all-L tone modifier must be followed by a H tone, even though they had no prior knowledge of lexical accent in KJ. We speculate that the effect in the TJ group may be related to the language-universal constraint against a sequence of L tones without a H tone within a word. To test the extent to which the predictability effect was driven by prediction, our future study will investigate predictability effects prior to the head noun using the visual world paradigm.

Table 1. Examples of the auditory stimuli for each condition. The tones in red + bold in the 'Tones associated with each mora' column indicates the position where the sandhi rule manipulation does or does not occur. Nouns in the H-register condition and L-register condition did not differ significantly in (log-transformed) word frequency (p = .8) or familiarity (p = .6).

Note: H = high tone, L = low tone

Predictability	Register tone of the modifier	Register tone of the noun (initial mora)	Japanese pronunciation	English translation	Tones associated with each mora
Predictable	Low	Low	Chairo no suka:to	brown skirt	LLL **H** **L**HLL
Predictable	Low	High	Chairo no su:tu	brown suit	LLL **L** **H**LL
Unpredictable	High	Low	Kiiro no suka:to	yellow skirt	HHH **H** **L**HLL
Unpredictable	High	High	Kiiro no su:tu	yellow suit	HHH **H** **H**LL

Figure 1. An example of the visual stimuli.

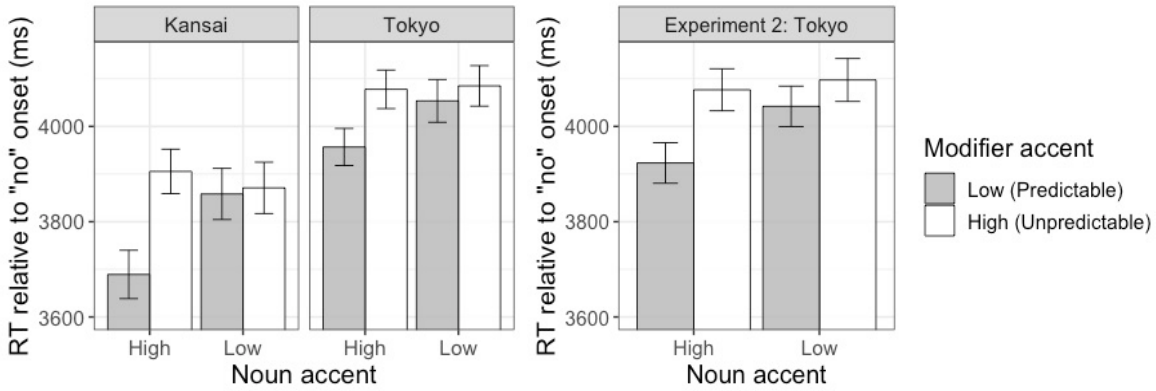

Figure 2. Reaction time from the particle "no" onset for each condition and group in Experiment 1 (left) and Experiment 2 (right). The error bars represent 95% confidence intervals. The noun onset relative to the "no" onset was 1464 ms in all items.

References

[1] Pickering & Gambi (2018). *Psychol. Bull*. [2] Kuperberg & Jaeger (2016). *Lang. Cogn. Neurosci.* [3] Staub (2015). *Lang. Linguist. Compass.*

Additional information about the sandhi rule in Kansai Japanese

[1] Kansai dialects are spoken in a Kansai area in Japan including Osaka, Hyogo, Kyoto, Nara and Wakayama. Kansai dialects distinguish **high-level register (H-register)** and **low-rising register (L-register)**, whereas Tokyo dialects do not (Uwano, 2012, *Lingua*). A H-register word starts with a high (H) tone, and the tone falls after an accent kernel or remains high if there is no accent kernel (e.g., kiiro, 'yellow' – HHH). L-register word starts with a low (L) tone, and the tone rises to H at an accent kernel or at the final mora if there is no accent kernel (e.g., chairo, 'brown' – LLH). Thus, KJ has a larger number of possible tonal patterns resulting from combinations of accent type and register type. Among unaccented words, there are two patterns of tonal sequence depending on the register type in Kansai dialects, whereas there is only one pattern of tonal sequence for unaccented words in Tokyo dialects.

In this study, we made use of a sandhi rule for unaccented, L-register tone in Kansai dialects. As shown in Table 1, when an unaccented L-register phrase (e.g., chairo no 'brown') precedes a H-register word, it ends with a L tone. When it precedes a L-register word, it ends with a H tone. In contrast, an unaccented H-register phrase (e.g., kiiro no 'yellow') does not undergo a tone change depending on the tone of the next word. Thus, the tone of the noun's initial mora is predictable when the modifier has an unaccented L-register and unpredictable when the modifier has an unaccented H-register.