

Information Distribution in Japanese Ideophones and Adjectives

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This study explores the relationship between surprisal and the phonological structure of Japanese ideophones and adjectives. In Information Theory [1], surprisal ($-\log_2 P(x)$) quantifies the information conveyed by an event in a given context, and phonemic bigram surprisal (hereafter surprisal) is a measure of the information in a word's phoneme-to-phoneme transitions. In American English, surprisal is elevated in words that are iconic, negative, humorous, or vivid, and these words exhibit increased processing difficulty and enhanced memorability [2]. These findings motivate the Attentional Optimization Hypothesis (AOH: [3]), which proposes that languages use phonological markedness not only for communicative efficiency but also to draw attention to meanings that warrant heightened cognitive engagement. We examine information distribution in Japanese, whose highly regular CV phonotactics pose challenges for surprisal-based analyses. Japanese has only five vowels (with length contrast), producing a rhythmic alternation in bigram predictability: consonant–vowel transitions are highly predictable (low surprisal), while vowel–consonant transitions are comparatively less predictable. Against this backdrop, ideophones stand out: they are disproportionately marked with rare phonological features such as initial /p/, voiced obstruents, and medial /r/ [4].

We computed bigram surprisal from the Corpus of Spontaneous Japanese [5]. All items were romanized, and mean bigram surprisal was calculated for each lexical type. Words were grouped into ideophones (112 words), nouns (106 words), verbs (131 words), adjectives (123 words), and function words (38 words) [6]. A linear mixed-effects model predicting surprisal across bigram position (Table 1) revealed that ideophones carry significantly more information than verbs overall ($\beta = 0.68$, $p < .001$), whereas adjectives ($\beta = 0.12$, $p = .468$), nouns ($\beta = 0.27$, $p = .145$), and function words ($\beta = 0.02$, $p = .944$) do not. The interaction terms showed that ideophones exhibit a significant drop in surprisal after the onset ($\beta = -0.09$, $p = .022$). Position-wise plots confirmed this pattern: ideophones concentrate surprisal at the beginning of words (Figure 1), while adjectives show elevated surprisal at the end (Figure 2). To probe these endpoints directly, we modelled first- and last-bigram surprisal. Only ideophones showed higher initial surprisal than verbs ($\beta = 0.64$, $p < .001$), while adjectives, nouns, and function words did not differ from the baseline. Conversely, only adjectives showed elevated final surprisal ($\beta = 0.96$, $p < .0001$), with all other categories statistically indistinguishable from verbs.

Taken together, these results show that ideophones and adjectives allocate information to opposite edges of the word: ideophones load information at the onset, adjectives at the offset. This complementary pattern suggests that Japanese uses different segments of the word to signal different types of semantic prominence. The concentration of surprisal at word onset in ideophones aligns closely with experimental findings on positional effects in sound-symbolic intuitions of Japanese speakers [7]. A plausible interpretation is that ideophones reflect expressive markedness consistent with the AOH, whereas adjectives reflect structural markedness tied to category-specific phonotactics rather than communicative highlighting. Crucially, these patterns support a functional view of phonological markedness under the Attentional Optimization Hypothesis. Within AOH, markedness is not a residual artifact of phonotactic constraint or diachronic accident; it is a resource language exploit to regulate attention. The elevated onset surprisal observed in ideophones constitutes a clear case of expressive markedness: front-loading information maximally captures listener attention, thereby signaling that the upcoming lexical item carries semantically salient, vivid, or affectively charged content.

Table 1. Linear mixed effects model results. Baseline category for word class is verb, baseline category for parity (even/odd bigram) is even.

<i>Predictor</i>	Estimate (β)	Std. Error	t value	p value
<i>Intercept</i>	3.81	0.11	33.94	< .001
<i>Adjective</i>	0.12	0.16	0.73	0.468
<i>Function word</i>	0.02	0.3	0.07	0.944
<i>Ideophone</i>	0.68	0.16	4.29	< .001
<i>Noun</i>	0.27	0.18	1.46	0.145
<i>Position</i>	−0.03	0.03	−1.02	0.31
<i>Parity = Odd</i>	−1.42	0.06	−25.47	< .001
<i>Adjective × Position</i>	0.06	0.04	1.54	0.124
<i>Function word × Position</i>	−0.04	0.12	−0.33	0.744
<i>Ideophone × Position</i>	−0.09	0.04	−2.29	0.022
<i>Noun × Position</i>	−0.05	0.06	−0.85	0.397

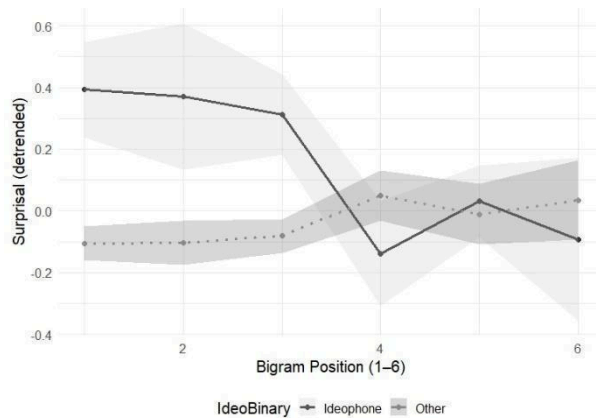


Fig. 1. Surprisal of ideophones against other word classes

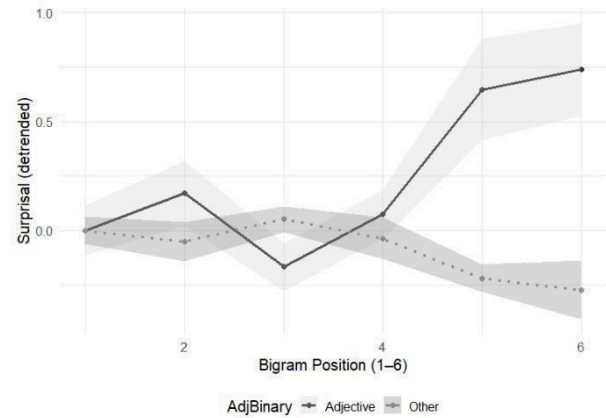


Fig. 2. Surprisal of adjectives against other word classes

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