Phonetic and psycholinguistic prominences in pun formation: Experimental evidence for positional faithfulness

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1. Introduction

This paper addresses two issues. The first issue is the similarity effects in phonology. We commonly observe that speakers maximize the similarity between corresponding segments (e.g. input and output). In particular, several previous studies have noted that speakers can simplify their articulation so long as its consequence is perceptually non-conspicuous (Huang, 2001; Hura et al., 1992; Johnson, 2003; Kawahara, 2006; Kohler, 1990; Steriade, 2001). For example, Japanese speakers can devoice geminates when they occur with another voiced obstruent (Nishimura, 2003, 2006). Kawahara (2006) argues that devoicing of a geminate occurs because it is perceptually non-conspicuous i.e. voiced geminates and voiceless geminates are "perceptually similar enough". This example illustrates another point: various contextual factors contribute to the measure of similarity. In the Japanese example, geminates can devoice, but singletons do not (when they co-occur within another voiced obstruent). Based on acoustic and perception experiments, Kawahara (2006) argues that this asymmetry arises because a voicing contrast is less

perceptible in geminates than in singletons. In other words, the perceptibility of a voicing contrast depends on whether the contrast is hosted by a singleton consonant or a geminate consonant. In general, a position of a contrast matters for the perceptibility of its contrast (Steriade, 2001, and others). To summarize, this paper supports two themes about the similarity effects in phonology: speakers minimize the differences between corresponding elements, and the measure of similarity depends on contextual factors.

The second aim of this paper is to bear on the controversy between the positional faithfulness theory and positional markedness theory. Some phonological contrasts are maintained in some positions but neutralized elsewhere (the situation referred to as "positional neutralization") (Trubetzkoy, 1939/1969). For example, Tamil allows mid vowels and rounded vowels only in initial syllables (Beckman, 1997, p.6). In the current framework of Optimality Theory (Prince and Smolensky, 1993/2004), two major theories exist to account for positional neutralization patterns. One the one hand, the positional faithfulness theory posits that speakers prohibit changes in phonetically or psycholinguistically prominent positions (Beckman, 1997). On the other hand, positional markedness theory posits that speakers exert a strong pressure against having a particular contrast/structure in non-prominent positions (Zoll, 1998). Evidence for either position has been put forth in the recent OT literature (positional faithfulness: Casali 1997; Kawahara 2006; Kawahara and Hara 2009; Lombardi 1999; Steriade 2001, among others; positional markedness: de Lacy 2000; Itô and Mester 2003; Prince and Tesar 2004; Smith 2002; Zhang 2004, among others). To bear on this debate, this paper provides independent experimental support for the positional faithfulness theory.

To address these two questions—the issue of similarity effects in phonology and the controversy between the positional faithfulness theory and positional markedness theory—this paper analyzes Japanese puns (*dajare*). Punning is a common practice in Japanese, at least for some speakers. They create sentences using two identical or similar sounding words or phrases, as in *buta-ga butareta* 'A pig was hit', *aizusan-no aisu* 'Ice cream from Aizu' and *okosama-o okosanaide* 'Don't wake up a kid'. Paired words can contain identical sound sequences as in the first example, but they can also contain non-identical pairs of sounds ([z] vs. [s] in the second example, and [m] vs. [n] in the third example). Speakers nevertheless attempt to maximize the similarity between the corresponding words in Japanese imperfect puns (Cutler and Otake, 2002; Kawahara, 2009; Kawahara and Shinohara, 2009; Shinohara, 2004). Our experiments below show that the positions of mismatches affect the wellformedness of imperfect puns—speakers disprefer mismatches in certain phonological positions, in our case in initial syllables and long vowels. We argue that these positional effects are grounded in phonetic and psy-

cholinguistic prominences of these phonological positions, and that positional faithfulness, not positional markedness, can account for our observation.

Finally, before closing this introductory discussion, a remark on our theoretical context is in order. We would like to situate our work in a larger theoretical context, which is growing interests in using verbal art patterns to probe our linguistic knowledge especially by way of an experimental/corpus-based method (Fabb, 1997; Fleischhacker, 2000, 2005; Itô et al., 1996; Kawahara, 2007, 2009; Kawahara and Shinohara, 2009; Shinohara, 2004; Steriade, 2003; Yip, 1999; Zwicky, 1976; Zwicky and Zwicky, 1986, among others). To the extent that our arguments successfully address the above-mentioned phonological questions, this paper supports a general approach which addresses phonological questions through experimental studies of verbal art.

2. Experiment 1

2.1. Introduction and background

The first experiment tested whether speakers avoid mismatches in initial positions. If speakers attempt to maximize the similarity between corresponding words in puns, we expect that they do avoid mismatches in initial positions, because initial syllables play an important role in word recognition and hence mismatches in these positions would be perceptually salient. Here we briefly review the evidence for the psycholinguistic prominence of initial syllables (see Beckman 1997; Hawkins and Cutler 1988; Smith 2002 for more comprehensive reviews). First, hearing initial portions of words helps listeners to retrieve the whole words in short-term memory recall tasks (Horowitz et al., 1968, 1969; Nooteboom, 1981). Second, in "tip-of-the-tongue" phenomena, speakers can only vaguely remember the word they are trying to pronounce, but cannot remember its exact phonological shape, and in such cases speakers can guess the first sounds more accurately than non-initial sounds (Brown, 1991; Brown and MacNeill, 1966). Third, in tip-of-the-tongue situations, initial sounds help retrieve the whole word (Freedman and Landauer, 1966). Fourth, listeners are faster when detecting mispronunciations in non-initial positions (Cole, 1973; Cole and Jakimik, 1980)—once they hear initial syllables, that input activates words starting with those syllables, and hence the listeners can anticipate what is coming next. Finally, sound symbolism—particular images associated with particular sounds—is stronger word-initially than non-word-initially, at least in Japanese (Bruch, 1986; Kawahara et al., 2008a).

Because of their psycholinguistic prominence, initial syllables exhibit a privileged status in phonology as well (Beckman, 1997). For example, in Sino-Japanese, while initial syllables can contain a variety of consonants, second syllables only allow [t] and [k] (Kawahara et al., 2002; Tateishi,

1990). Cast in the framework of Optimality Theory (Prince and Smolensky, 1993/2004), if there were an underlying form like /sasu/ (*as per* Richness of the Base), then speakers avoid changing the initial [s] but not the second [s] (perhaps to [satu]).[1] In other words, speakers avoid making changes particularly in initial syllables.

To the extent that phonological patterns and pun patterns are governed by the same principles, we would expect that speakers avoid mismatches in initial syllables in puns as well. Correspondence Theory (McCarthy and Prince, 1995) helps us to illustrate this prediction.[2] As in Table 1(a), in Sino-Japanese phonology speakers allow changes in word-internal positions ($/s_k/ \rightarrow [t_k]$), but do not allow changes in word-initial positions ($/s_i/ \rightarrow [s_i]$). If a parallel exists between phonological patterns and pun patterns, then speakers should disprefer mismatches in word-initial positions in puns, as in (b). In both cases, the identity restriction should be stronger word-initially than word-internally—the following experiment supports this prediction.

2.2. Method

In order to control for factors other than positional effects, we performed wellformedness judgment experiments. The first experiment tested whether speakers avoid mismatches in initial positions. The stimuli were minimal pairs that contain a pair of sounds that minimally differ in voicing ([t-d], [d-t], [k-g], [g-k], [s-z], [z-s]).[3] To control for the phonological distance between the punning constituents, the stimuli all had the same structure, [X-particle Y]. The punning constituents X and Y were all three syllables long. In one condition the mismatch occurred in the initial syllables (e.g. **s***asetsu-ni* **z***asetsu* 'I gave up making a left turn'), and in another condition, the mismatch occurred in the second syllables (*hi***s***ashi-ni hi***z***ashi* 'Sunlight on the

[1] Kawahara et al. (2002) develop an analysis of these patterns using positional faithfulness constraints. Initial syllables are protected by special faithfulness constraints, which dominate markedness constraints that collectively rule out all consonants but [t,k]. These markedness constraints dominate general faithfulness constraints for Sino-Japanese, which results in neutralization of all consonants to [t,k] in non-initial syllables. A positional-markedness based analysis is also possible, which would use constraints that prohibit consonants other than [t,k] in non-initial syllables.

[2] Our formalization based on Correspondence Theory is not new. Several authors have proposed a correspondence theory of rhymes and other language games (Hayes and MacEachern, 1998; Holtman, 1996; Itô et al., 1996; Steriade, 2003; Steriade and Zhang, 2001; Yip, 1999).

[3] We could not control for matches in accents for two reasons. First, we could not find enough minimal pairs if we controlled accents. Second, lexical accents are subject to high interspeaker variability due to dialectal and generational differences, and therefore it was impossible to find minimal pairs that match in accents for all speakers.

We chose a [voice] mismatch because we found it easiest to create the stimuli this way. Replicating our result with other featural mismatches would strengthen our claim about position sensitivity, but we will leave it for future research.

TABLE 1 A correspondence theoretic illustration of the parallel between phonology and pun formation. The top figure (a)=phonological input-output correspondence. The bottom figure (b)=surface-to-surface correspondence in pun.

a. Phonological input-output correspondence

Input	/	$\mathbf{s}_i$	a_j	$\mathbf{s}_k$	u_l	/
		|	|	|	|	
Output	[	$\mathbf{s}_i$	a_j	$\mathbf{t}_k$	u_l	]

b. Pun formation (surface-to-surface correspondence)

Word 1	[	$\mathbf{s}_i$	a_j	$\mathbf{s}_k$	u_l	]
		|	|	|	|	
Word 2	[	$\mathbf{s}_i$	a_j	$\mathbf{t}_k$	u_l	]

sun roof').[4] (Due to space limitation, we cannot provide a full list of the stimuli—please contact the authors to obtain the list.) Additional filler items were interwoven with the target questions. The participants rated both the funniness and the acceptability of each pun sentence on a 1-to-4 scale for both questions. We were interested in the second question, but we included the first question, so that the participants would tease apart these questions. We put the funniness rating before the wellformedness rating to make it clear that the wellformedness rating should not be based on funniness. The questionnaire started with two sample questions, with one example which is clearly an example of a Japanese pun (*arumikan-no ue-ni aru mikan* 'An orange on a can') and one example which clearly is not (*hana-yori dango* 'Foods are more important than cherry blossom'). The latter example does not involve a pair of similar words/phrases, and hence it is not a good example of a pun. A total of 37 speakers participated in this study, but we excluded eight of them because they did not consider the first example *arumikan-no ue-ni aru mikan*

[4] We also included pairs which contained mismatches in final syllables in our experiment (reported in Kawahara et al. 2008b). These syllables behaved just like initial syllables. This result is a bit unexpected because it is known that initial syllables are psycholinguistically more prominent than final syllables, at least in a lexical retrieval task (Nooteboom, 1981). It may be that recency effects (Gupta, 2005; Gupta et al., 2005) are playing a role here—speakers remember the final syllables of the first word most vividly when they find the second punning word, and therefore they avoid mismatches in final syllables because of the vivid memory. See also Brown & McNell (1966) for evidence that speakers remember word-final segments as much as word-initial segments in tip-of-the-tongue phenomena. See also Walter (2002) for some evidence that final syllables are positionally strong in phonology.

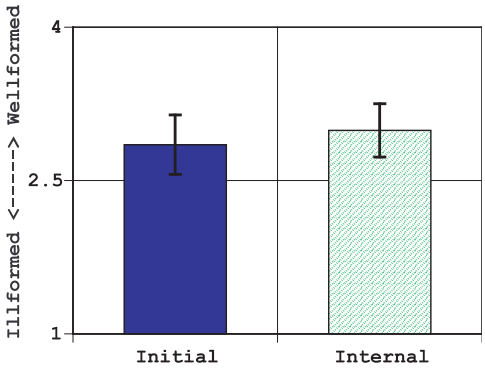

FIGURE 1 Wellformedness of puns with initial mismatches and those with internal mismatches. The error bars = 95% CIs calculated across 29 speakers.

as a good pun or considered *hana-yori dango* as a perfect pun.

2.3. Results and discussion

Figure 1 illustrates the wellformedness ratings of puns with initial mismatches and those with internal mismatches. As observed, speakers judged mismatches in initial syllables less acceptable than those in non-initial syllables (average ratings: initial 2.85 vs. internal 2.99). One may argue that this difference is too small to be conclusive. Indeed speakers have different standards about pun-wellformedness, and so the effect of the positional difference may look small with respect to relatively large variability. However, the difference is robust within each speaker, and hence statistically significant according to a non-parametric Wilcoxon signed ranks test ($z = 2.59, p = .01$) (we used this within-subject non-parametric test because we could not assume normality).

3. Experiment 2

3.1. Introduction and background

Experiment 1 supports the principle of positional faithfulness in that speakers avoid mismatches in initial positions, but a question arises whether we observe other kinds of positional effects. The second experiment thus tested whether speakers avoid mismatches in long vowels. Long vowels are, by definition, phonetically long. Different long vowels are more different from each other than different short vowels (Steriade, 2003)—an [aa]-[ii] pair is more different than an [a]-[i] pair. A change in long vowels would be more perceptible also because speakers hyperarticulate long vowels more than short vowels in Japanese, and as a result, long vowels are more (psycho-)acoustically

TABLE 2 A correspondence theoretic illustration of the parallel between phonology and pun formation.

a. Phonological input-output correspondence

Input	/	t_i	$\tilde{a}\tilde{a}_j$	t_k	$\tilde{a}_l$	/
		|	|	|	|	
Output	[	t_i	$\tilde{a}\tilde{a}_j$	t_k	a_l	]

b. Pun formation (surface-to-surface correspondence)

Word 1	[	t_i	$\tilde{a}\tilde{a}_j$	t_k	$\tilde{a}_l$	]
		|	|	|	|	
Word 2	[	t_i	$\tilde{a}\tilde{a}_j$	t_k	a_l	]

dispersed than short vowels (Hirata and Tsukada, 2003; Hisagi et al., 2008).

Just as in initial syllables, we observe that in phonology speakers avoid long vowel mismatches. Hindi for example allows a surface nasality contrast in long vowels, but not in short vowels (Steriade 1994 and references cited therein). A hypothetical underlying /tããtã/ would map to [tããta]. As illustrated in Table 2(a), in phonology speakers avoid making changes—or neutralizing contrasts—more in long vowels (/$\tilde{a}\tilde{a}_j$/ → [$\tilde{a}\tilde{a}_j$]) than in short vowels (/$\tilde{a}_l$ → [a_l]). Similarly, we expect that speakers avoid mismatches in long vowels more than in short vowels in imperfect puns, as in (b).

3.2. Method

The method is almost identical to Experiment 1, except that we had four practice questions. In addition to the two examples used in the previous experiment, we had *manjuu-o mittsu moratta Akechi Mitsuhide-ga "A, kechi, mittsu hidee"* 'Akechi Mitsuhide was given three pieces of manjuu, and said "that's mean, only three?"'—an example of a good pun—and *dakara, kore-wa zura dewa arimasen* 'I am telling you that this is not a wig'—an example of a non-pun sentence. The design had three fully crossed factors: 10 vowel combinations ([a-i], [a-u], [a-e], [a-o], [i-u], [i-e], [i-o], [u-e], [u-o], [e-o]) × 2 orders (e.g. [a-i] vs. [i-a]) × 2 lengths (short vs. long). An example of a crucial pair was: *jook***uu**-*no jook***aa** 'A joker in the sky' vs. *ripp***u**-*ga ripp***a** 'The lips are fine'. Additional fillers were added and interwoven with the target items. 26 speakers participated in the study. All the participants judged the sample good puns as good puns and sample non-puns as non-puns, and hence the data from all the participants were included in the analysis.

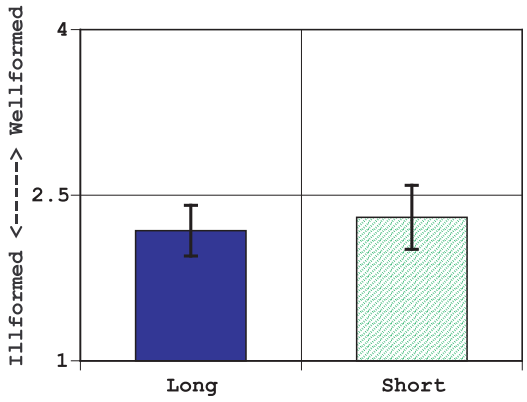

FIGURE 2 Wellformedness of puns with long vowel mismatches and short vowel mismatches. The error bars represent 95% CIs across 26 speakers.

3.3. Results and discussion

Figure 2 illustrates the results. Speakers rated those with long mismatches as worse than short mismatches (average ratings: long 2.09 vs. short 2.30) and the difference is statistically significant according to a within-subject ranked-signs Wilcoxon test ($z = 2.93, p < .01$). Mismatches in long vowels are perceptually salient because of their long duration and their hyperarticulated nature, and hence avoided by the participants.

4. Conclusion

4.1. Summary

In summary, speakers avoid mismatches in initial syllables and long vowels in Japanese imperfect puns, just as in phonology. We thus find the same principle both in phonology and pun formation. In this regard we find non-trivial parallels between phonology and verbal art patterns.

4.2. Bearing on the positional faithfulness vs. markedness debate

The principle of positional faithfulness can explain our results, because we observe that speakers avoid mismatches in strong positions in puns, and the avoidance of mismatches in strong positions is what positional faithfulness demands (Beckman, 1997). Positional markedness on the other hand has nothing to say about the results because it evaluates the wellformedness of one form only, but it does not demand anything about the relation between

two forms (Zoll, 1998).[5] Overall, therefore, our experiments provide independent support for the principle of positional faithfulness that speakers avoid mismatches in phonetically and psycholinguistically strong positions.

4.3. Concluding discussion

Before closing this paper, we would like to address one final issue. One may argue that our argument is based on "para-linguistic patterns". However, we find non-trivial parallels between pun patterns and phonology (Kawahara, 2009; Kawahara and Shinohara, 2009), and we would miss the parallels if we treated them separately. In other words, to the extent that we find parallels between pun patterns and phonology, which we hope to have shown that we do in this paper, it is effective to use verbal art patterns to investigate our knowledge of similarity. To conclude, our paper supports the general strategy to probe our linguistic knowledge through the analysis of verbal art patterns.

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[5] We do not wish to imply that positional markedness constraints are not necessary—they do not explain our results.

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