Probing knowledge of similarity through puns*

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Abstract

This paper outlines the aims, results and future prospects of a general research program which investigates knowledge of similarity through the investigation of Japanese imperfect puns (*dajare*). I argue that speakers attempt to maximize the similarity between corresponding segments in composing puns, just as in phonology where speakers maximize the similarity between, for example, inputs and outputs. In this sense, we find non-trivial parallels between phonology and pun patterns. I further argue that we can take advantage of these parallels, and use puns to investigate our linguistic knowledge of similarity. To develop these arguments, I start with an overview of the results of some recent projects, and follow that with patterns that provide interesting lines of future research. I hope that this paper stimulates further research in this area, which is much understudied in the linguistic literature.

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1 Introduction

The notion of "*similarity*" plays an important role in recent phonological theories. For example, speakers seem to maximize the similarity between inputs and outputs, and this observation is expressed as a general notion of faithfulness constraints in Optimality Theory (Prince & Smolensky, 1993/2004). Speakers are also known to maximize the similarity between morphologically related words (Benua, 1997; Kenstowicz, 1996; Steriade, 2000). However, a question remains as to *what kind of similarity* speakers deploy to shape phonological patterns. Some recent proposals argue that speakers make use of *psychoacoustic* or *perceptual* similarity (Fleischhacker, 2005; Kawahara, 2006; Steriade, 2000, 2001; Zuraw, 2007, among others) while others argue for the importance of more abstract, phonological similarity (see Bailey & Hahn, 2005; Frisch, Pierrehumbert, & Broe, 2004; Kawahara, 2007; LaCharité & Paradis, 2005, for various models of similarity).

Against this background, this paper provides an overview of a general research project, which aims to investigate our linguistic knowledge of similarity through the study of Japanese imperfect puns. The first goal of this project is to describe and analyze the patterns of Japanese imperfect puns. The second goal of this project is to show that speakers minimize the differences between corresponding elements in puns, just as in phonology where speakers minimize the differences between corresponding segments. The third goal is, based on that premise, to investigate our knowledge of similarity through the analysis of imperfect puns. To achieve these goals, in this paper I summarize two major projects that have been completed. In section 2, I show that speakers attempt to maximize psychoacoustic similarity between corresponding segments in puns, and in section 3, I show that speakers avoid disparities in phonetically and psycholinguistically strong positions. It is my hope that this paper stimulates further research in this area, which has been understudied in the literature. To this end, in section 4 of this paper, I outline some patterns of imperfect puns that are yet to be investigated.

In the rest of this introductory section, I briefly introduce how Japanese speakers create puns. Japanese puns, or *dajare*, are very common. Speakers compose puns by creating sentences using identical/similar words or phrases, as in (1) and (2).[1]

[1]Speakers can also change an underlying form to achieve better resemblance with the corresponding word. For example, in *Hokkaidoo-wa dekkai do* 'Hokkaido is big.', speakers change the final conversational particle /zo/ to [do] to make /dekkai zo/ more similar to [hokkaido]. Speakers can also replace a part of proper names, clichés, or famous phrases with a similar sounding

(1) Arumikan-no ue-ni aru mikan.
Aluminum can-GEN top-LOC exist orange
'An orange on an aluminum can.'

(2) Aizu-san-no aisu.
Aizu-from-GEN ice cream
'Ice cream from Aizu.'

The first example in (1) involves an identical sequence of sounds, [arumikan].[2] The second example on the other hand involves a pair of two similar phrases, *aizu* and *aisu*. I will henceforth refer to the examples that involve non-identical matching sequences as "imperfect puns". Intuitively, we can already see that speakers attempt to maximize the similarity between two corresponding elements in puns. In the first example, the corresponding sound sequences are identical, and in the second example, the two words are almost identical except for the [z]-[s] pair, which involves nevertheless similar consonants (see Fleischhacker, 2005; Zwicky & Zwicky, 1986, for a similar observation about English imperfect puns). However, two questions still remain: (i) is the intuition supported by independent evidence beyond our intuition? (ii) if so, what kind of similarity is important in shaping pun patterns? Section 2 addresses these questions.

2 Consonant correspondence

This section[3] reviews a previous analysis of consonant correspondence in imperfect puns by Kawahara & Shinohara (2009). The aim of this general project was to answer the following question: what kind of similarity do speakers use to make

word. For instance, one finds a pun like *Maccho-ga uri-no shoojo* 'A girl who's proud to be a macho', which is based on *Macchi uri-no shoojo* 'The Little Match Girl'—*macchi* is replaced with *maccho-ga*. We have not analyzed these patterns yet, but they are certainly worth further investigations.

[2] Accents differ, however. The first [arumikan] is unaccented, whereas the second [arumikan] has accents on the first [a] and [i]. It would be interesting to investigate how accentual mismatches affect the formation of puns.

[3] Due to space limitation, the following discussion is brief. For further methodological details, discussions and references, see Kawahara & Shinohara (2009) (Kawahara, Shigeto & Kazuko Shinohara "The role of psychoacoustic similarity in Japanese imperfect puns", *Journal of Linguistics*, 45(1), ©Cambridge University Press, forthcoming (March 2009)). I am grateful to Cambridge University Press for allowing me to reproduce the data and Figure 1 from the paper.

puns? Before moving on, a remark on our methodology is in order. A traditional, 'introspection-based' approach to generative phonology seems inappropriate to address this question, because the distinction between, say, featural similarity and psychoacoustic similarity can be subtle, and one can hardly be unbiased about this sort of judgments (see Schütze, 1996, for critical discussions on a purely introspection-based approach to linguistics). Instead we took on a corpus-based approach to find general, statistical patterns in pun pairing.

2.1 Method

To investigate how similarity influences the formation of Japanese imperfect puns, Kawahara & Shinohara (2009) collected 2371 examples of imperfect puns from online websites and consultations with native Japanese speakers. We defined corresponding domains in imperfect puns as sequences of moras in which corresponding vowels are identical.[4] For example, in *Aizu-san no aisu*, the corresponding domains include the first three moras (*aizu* and *aisu*). In the domains defined as such, we compiled pairs of corresponding consonants between the two words. We ignored identical pairs of consonants, because we were interested in similarity, not identity. Therefore, from the example *Aizu-san no aisu*, for instance, we extracted the [z-s] pair. We coded the consonant pairs based on surface forms, instead of phonemic forms. For instance, [ʃi] is arguably derived from /si/, but we considered its onset consonant as [ʃ] (in this regard, we followed Kawahara, Ono & Sudo (2006) and Walter (2007) who suggest that similarity is based on surface forms rather than phonemic forms). We counted only onset consonants, because Japanese coda consonants place-assimilate to the following consonants (Itô, 1986). We ignored singleton/geminate differences, because we were focusing on segmental similarity.

The aim of this project was to investigate what kinds of consonant pairs speakers like to use in imperfect puns. For this purpose, one needs a measure of combinability between two segments. Absolute frequencies are of little use (Trubetzkoy, 1969). Consider the following analogy. The probability of 'coming to school' and 'having breakfast' is perhaps higher than the probability of 'going to a supermarket' and 'being hit by lightning'. However, just because the former combination

[4] There are examples like *Haideggaa-no zense-wa hae dekka?* 'Was Heidegger a fly in his previous life?' in which the corresponding words have one internal vowel mismatch. At the time of data collection, we did not find many examples of this kind, so we took the definition as defined above—however, see section 4.1 for the analysis of examples with vowel mismatches.

has a higher probability, it does not mean that 'coming to school' and 'having breakfast' are better combined than 'going to a supermarket' and 'being hit by lightning': the probability of 'being hit by lightning' is low in the first place. Instead of absolute frequencies, therefore, we need a measure of the frequencies of two combined events relativized with respect to their individual frequency.

For this reason, we used O/E ratios as a measure of how well two consonants combine. O/E ratios are ratios between how often a pair is observed (O-values) and how often it is expected to occur if two elements are combined at random (E-values) (e.g. Frisch et al., 2004). Mathematically, the O-value of a sound [A] is how many times [A] occurs in the corpus, and the E-value of a pair [A-B] is $P(A) \times P(B) \times N$ (where $P(X)$ = the probability of the sound [X] to occur in the corpus; N = the total number of consonants). The higher the O/E ratios, the more likely the two consonants are combined. In performing an O/E analysis, we excluded consonants whose O-values are less than 20 because including them yielded exceedingly high O/E ratios: combining two rare consonants yields a very low E-value, and any observed pair of that type would result an artificially high O/E ratio (e.g. the O/E ratio of the [p^j-b^j] pair is 1121.7). Therefore, we excluded [ts], [dʒ], [j], [n^j], [r^j], and all non-coronal palatalized consonants. As a result, 535 pairs of consonants were left for the subsequent analysis.

2.2 Featural similarity

To statistically verify the correlation between combinability in puns and similarity, as a first approximation, Kawahara & Shinohara (2009) estimated the similarity of consonant pairs in terms of how many feature specifications they share in common (e.g. Bailey & Hahn, 2005). (I later discuss the importance of psychoacoustic similarity in section 2.3 and argue that featural similarity fails to account for some detailed aspects of the pun patterns. I nevertheless start with this simple version of featural similarity in order to first statistically establish the correlation between similarity and combinability.)

To estimate the numbers of shared feature specifications among the set of distinctive consonants in Japanese, Kawahara & Shinohara (2009) deployed eight features: [sonorant], [consonantal], [continuant], [nasal], [strident], [voice], [palatalized], and [place]. According to this system, for example, [s] and [ʃ] are considered to be highly similar because they share seven distinctive features, whereas a pair like [ʃ]-[m] agrees only in [cons], and is considered as a highly non-similar pair.

Figure 1 shows the correlation between featural similarity and combinability in

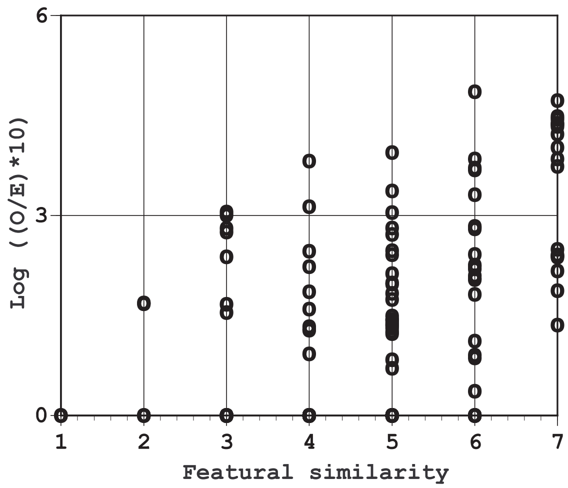

Figure 1: The correlation between featural similarity (the number of shared feature specifications) and combinability ($\log_e((O/E) * 10)$).

puns. For each consonant pair, it plots the number of shared feature specifications on the x-axis and plots the natural log-transformed O/E ratios multiplied by 10 ($\log_e((O/E)*10)$) on the y-axis. We applied log-transformation so as to fit all the data points in a small graph. Since log(0) is undefined, we replaced $\log_e(0)$ with 0. However, the log of O/E ratios smaller than 1 are negative, and hence would be incorrectly treated as values smaller than zero (e.g. $.5 > 0$, but $\log_e(.5) < 0$). Therefore, we multiplied O/E ratios by 10 before log-transformation. The plot excludes pairs in which one member is null (e.g. [ϕa]-[ta]) since it is difficult to define ϕ in terms of distinctive features; I discuss these pairs in section 2.3.

Figure 1 shows the positive correlation between combinability and featural similarity: the more feature specifications a pair shares, the higher the corresponding O/E ratio is ($\rho = .497, t(134) = 6.63, p < .001$). This statistically significant correlation shows that speakers tend pair similar consonants when they compose puns.

2.3 Psychoacoustic similarity

The analysis in section 2.2 used distinctive features to estimate similarity. Kawahara & Shinohara (2009) argue however that featural similarity ultimately fails to

Table 1: The O/E ratios of minimal pairs differing in place.

m-n:	8.85	b-d:	1.09	p-t:	1.11
		b-g:	.65	p-k:	1.08
		d-g:	.39	t-k:	.87

capture some of the detailed aspects of pun pairings. Rather Japanese speakers use psychoacoustic similarity or *perceived similarity between sounds, which refers to acoustic details*. One example that supports the role of psychoacoustic similarity is the [r-d] pair, whose O/E ratio is 3.99. According to the featural similarity measure, the pair agrees in six features (all but [son] and [cont]), but the average O/E ratio of other consonant pairs agreeing in six distinctive feature is 1.49. The 95% confidence interval of the O/E ratios of such pairs is .39–2.59, and 3.99 is outside of the interval. Thus the high O/E ratio of the [r-d] pair is unexpected in terms of featural similarity, but makes sense from a psychoacoustic perspective. Japanese [r] is a flap which involves a ballistic constriction (Nakamura, 2002). [r] and [d] auditorily resemble each other in that they are both voiced consonants with short constrictions (Price, 1981).

Below I present four more kinds of arguments for pun composers exploiting psychoacoustic—rather than featural—similarity. First, speakers treat [place] in oral consonants and [place] in nasal consonants differently (2.3.1). Second, speakers consider a [voice] mismatch less serious than a mismatch in other features (2.3.2). Third, speakers are sensitive to similarity contributed by voicing in sonorants, a phonologically inert feature (2.3.3). Finally, pun-makers pair ϕ with consonants that sound similar to ϕ (2.3.4).

2.3.1 Sensitivity to context-dependent salience of [place]

The first piece of evidence for the importance of psychoacoustic similarity is the fact that speakers treat [place] in oral consonants and [place] in nasal consonants differently. Table 1 lists the O/E ratios of minimal pairs of consonants differing in place.

In Table 1, the [m-n] pair has a higher O/E ratio than any other minimal pair (by a binomial-test, p = .5^6 =.034). This pattern shows that Japanese speakers treat the [m-n] pair as more similar than any minimal pairs of oral consonants:

they treat the place distinction in nasal consonants as less salient than in oral consonants.

We find support for the lower perceptibility of [place] in nasals in some previous phonetic and psycholinguistic studies. First, a similarity judgment experiment shows that nasal minimal pairs are considered perceptually more similar to each other than oral consonant minimal pairs (Mohr & Wang, 1968). Second, it has been shown that Dutch speakers perceive [place] in nasals less accurately than [place] in oral consonants (Pols, 1983). Place cues are less salient in nasal consonants than in oral consonants for two reasons: (i) formant transitions into and out of the neighboring vowels are obscured by coarticulatory nasalization and (ii) burst spectra play an important role in distinguishing different places of articulation (Stevens & Blumstein, 1978), but nasals have weak or no bursts (see Jun, 1995, 2004, for relevant discussion).

In short, speakers take into account the lower perceptibility of [place] in nasals, and the lower perceptibility of [place] in nasals has a psychoacoustic root: the blurring of formant transitions and weak bursts. The data in Table 1 therefore shows that speakers use psychoacoustic similarity in composing puns.

2.3.2 Sensitivity to different saliency of different features

The second argument that speakers deploy psychoacoustic rather than featural similarity comes from the fact that they treat a mismatch in [voice] as less disruptive than a mismatch in other manner features. This patterning accords well with previous claims about the perceptibility of [voice] and its phonological behavior. The weaker perceptibility of [voice] is supported by previous psycholinguistic findings, such as Multi-Dimensional Scaling (Peters, 1963; Walden & Montgomery, 1975), a similarity judgment task (Broecke, 1976; Greenberg & Jenkins, 1964), and an identification experiment under noise (Wang & Bilger, 1973). Steriade (2001), building on this psycholinguistic work, argues that [voice] is phonologically more likely to neutralize than other manner features because the change in [voice] is less perceptible. Kenstowicz (2003) further observes that in loanword adaptation, when the recipient language has only a voiceless stop and a nasal, the original voiced stops always map to the stop—i.e. [d] is always borrowed as [t] but not as [n]. Again, this observation follows if the change in [voice] is less perceptible than the change in other features, assuming that speakers attempt to minimize the perceptual changes caused by their phonology.

Given the relatively low perceptibility of [voice], if speakers are sensitive to

Table 2: The O/E ratios of minimal pairs differing in three manner features.

cont		nasal		voice	
p-ɸ:	5.58	b-m:	4.68	p-b:	8.51
t-s:	.90	d-n:	1.12	t-d:	7.64
d-z:	1.68			k-g:	8.03
				s-z:	11.3
				ʃ-ʒ:	6.81

psychoacoustic similarity, we expect that pairs of consonants that are minimally different in [voice] should combine more frequently than minimal pairs that disagree in other manner features. Table 2 compares the O/E ratios for the minimal pairs defined by [cont], [nasal], and [voice].

The O/E ratios of the minimal pairs that differ in [voice] are significantly larger than those of the minimal pairs that differ in [cont] or [nasal] ($Wilcoxon$ $W = 15, z = 2.61, p < .01$). Speakers treat minimal pairs that differ only in [voice] as very similar, which indicates that they know that a disagreement in [voice] does not disrupt perceptual similarity as much as other manner features.[5] In other words, Japanese speakers know the varying perceptual salience of different features.

2.3.3 Sensitivity to similarity contributed by voicing in sonorants

The third piece of evidence that speakers resort to psychoacoustic similarity is that speakers are sensitive to similarity contributed by voicing in sonorants—

[5] The following question was raised during my talk at Sophia University: wouldn't we be able to explain the high O/E ratios of the minimal pairs differing in [voice] by saying that they are orthographically similar? Indeed, Japanese orthography distinguishes these minimal pairs by a diacritic (two raised dots). While orthography may play a role, the high combinability of minimal pairs differing in [voice] is attested in pun and rhyming patterns of other languages (Eekman, 1974; Steriade, 2003; Zwicky, 1976; Zwicky & Zwicky, 1986), suggesting that orthography is not the only factor. Moreover, in Japanese orthography, [h] and [b] are distinguished by the same diacritic, but the O/E ratio of this pair is 2.6, which is lower than the values of pairs differing in voicing in Table 2. I thus conclude that orthography cannot be the only reason for the high combinability of consonants differing in [voice].

Table 3: The combinability of voiced and voiceless obstruents with sonorants.

	Voiced obstruents	Voiceless obstruents
Paired with sonorants	63 (**18.2%**)	30 (**6.0%**)
Total	346	497

a phonologically inert/redundant feature. Table 3 shows how often Japanese speakers combine sonorants with voiced obstruents and voiceless obstruents in our database.

63 out of 346 tokens of voiced obstruents are paired with sonorants, whereas 30 out of 497 tokens of voiceless obstruents are paired with sonorants. The probability of voiced obstruents corresponding with sonorants (.18; $s.e.$=.02) is higher than the probability of voiceless obstruents corresponding with sonorants (.06; $s.e.$ = .01) ($z = 5.22, p < .001$). Table 3 thus suggests that Japanese speakers treat sonorants as being more similar to voiced obstruents than to voiceless obstruents

The claim that speakers use psychoacoustic similarity when forming puns correctly predicts sonorants are closer to voiced obstruents than to voiceless obstruents. First, both sonorants and voiced obstruents have low frequency energy during the constriction, but voiceless obstruents do not. Second, Japanese voiced stops, especially [g], are often lenited intervocalically, resulting in formant continuity, much like sonorants (see Kawahara, 2006; Kawahara & Shinohara, 2009, for acoustic evidence). For these reasons, voiced obstruents are acoustically more similar to sonorants than voiceless obstruents are.

On the other hand, if speakers were using featural, rather than psychoacoustic, similarity, the pattern in Table 3 is not predicted, given the behavior of [+voice] in Japanese sonorants. Phonologically, voicing in Japanese sonorants behaves differently from voicing in obstruents: Japanese requires that there be no more than one "voiced segment" within a stem, but only voiced obstruents, not voiced sonorants, count as "voiced segments". Previous studies have thus proposed that in Japanese, [+voice] in sonorants is underspecified (Itô & Mester, 1986), sonorants do not bear the [voice] feature at all (Mester & Itô, 1989), or sonorants and obstruents bear different [voice] features (Rice, 1993). No matter how we featurally differentiate voicing in sonorants and voicing in obstruents, sonorants and voiced obstruents do not share the same phonological feature for voicing. Therefore, the featural similarity view—augmented with underspecification or structural differences between sonorant voicing and obstruent voicing—makes an incorrect prediction that sonorants are equidistant from voiceless obstruents and voiced obstruents.

2.3.4 Sensitivity to similarity to ϕ

As a final piece of evidence for the importance of psychoacoustic similarity, Kawahara & Shinohara (2009) show that consonants that correspond with ϕ are those that are psychoacoustically similar to ϕ. In some imperfect puns, consonants in one phrase do not have a corresponding consonant in the other phrase (i.e. one syllable is onsetless), as in *Hayamatte ϕayamatta* 'I apologized without thinking carefully'. (3) lists the set of consonants whose O/E ratios with ϕ are larger than 1 (recall that these are consonants which are paired with ϕ more frequently than expected).

(3) [w]: 6.25, [r]: 4.59, [h]: 3.72, [m]: 2.54, [n]: 1.49, [k]: 1.39

Kawahara & Shinohara (2009) argue that the consonants listed in (3) sound similar to ϕ. First, since [w] is a glide, the transition between [w] and the following vowel is not clear-cut, which makes the presence of [w] hard to detect. Myers & Hanssen (2005) demonstrate that given a sequence of two vocoids, listeners may misattribute the transitional portion to the second vocoid, which effectively shortens the percept of the first vocoid. Thus, due to the blurry boundaries and consequent misparsing, the presence of [w] may be perceptually hard to detect.

Next, Japanese [r] is a flap, which involves a ballistic constriction (Nakamura, 2002). The short constriction makes [r] sound similar to ϕ. Third, the propensity of [h] to correspond with ϕ is expected because [h] lacks a superlaryngeal constriction and hence its spectral properties assimilate to neighboring vowels (Keating, 1988), making the presence of [h] difficult to detect.

Fourth, for [m] and [n], Kawahara & Shinohara (2009) speculate that the edges of these consonants with flanking vowels are blurry due to coarticulatory nasalization, causing them to be interpreted as belonging to the neighboring vowels. Downing (2005) argues that the transitions between vowels and nasals can be misparsed due to their blurry transitions, and that the misparsing effectively lengthens the percept of the vowel. As a result of misparsing, the perceived duration of nasals may become shortened.

Finally, [k] extensively coarticulates with adjacent vowels in terms of tongue backness (de Lacy & Kingston, 2006). As a result it fades into its environment and becomes perceptually similar to ϕ.

To summarize, speakers pair ϕ with segments that sound similar to ϕ—especially those that fade into their environments—but not with consonants whose presence is highly perceptible. Stridents like [s] and [ʃ], for example, do not often correspond with ϕ because of their salient long duration and great intensity of the noise spectra (Wright, 1996). Coronal stops coarticulate least with surrounding vowels (de Lacy & Kingston, 2006) and hence they perceptually stand out from their environments. These consonants are unlikely to correspond with ϕ.

On the other hand, featural similarity does not offer a straightforward explanation for the set of consonants in (3). One may point out that (3) includes sonorants, with the exception of [h] and [k], but there is no sense in which sonorous consonants are similar to ϕ phonologically (Kirchner, 1998). We should in fact not consider ϕ as being sonorous; although languages prefer to have sonorous segments in syllable nuclei (Dell & Elmedlaoui, 1985; Prince & Smolensky, 1993/2004), no languages prefer to have ϕ nuclei. Sonority thus fails to explain why speakers prefer to pair ϕ with the set of consonants in (3). Rather the list of consonants in (3) includes sonorants because their phonetic properties make them sound like ϕ.

2.4 Summary and discussion

Japanese speakers perceive similarity between sounds based on acoustic information, and use that knowledge of psychoacoustic similarity to compose imperfect puns. I have presented four kinds of arguments: (i) context-dependent salience of the same feature, (ii) relative salience of different features, (iii) similarity contributed by a phonologically-inert feature, and (iv) similarity between consonants and ϕ.[6]

Finally, let me discuss non-trivial parallels which we found between the imperfect pun patterns and phonological patterns. For example, in Japanese imperfect puns, [m] and [n] are more likely to correspond with each other than [p] and [t] are, just as in other languages' phonology in which [m] and [n] alternate with each other (i.e. nasal place assimilation) while [p] and [t] do not (Jun, 2004; Mohanan,

[6] The next step would be to obtain a matrix of perceived similarity through a psycholinguistic experiment (e.g. a similarity judgment task, an identification/discrimination experiment under noise) and use that matrix to analyze the pun patterns. This is one of the open lines of future research, which an interested reader is more than welcome to take on.

1993). In both verbal art and phonology, nasal pairs are more likely to correspond with each other than oral consonant pairs.

Similarly, in the pun pairing patterns, minimal pairs that differ in voicing are more likely to correspond with each other than other types of minimal pairs that differ in nasality and continuency. This patterning parallels cross-linguistic observation that a voicing contrast is more easily neutralized than other manner features (Kenstowicz, 2003; Steriade, 2001). In both cases, a voicing mismatch between two corresponding elements is tolerated, more so than a mismatch in other features.

Third, voicing in sonorants promotes similarity with voiced obstruents, and this finds its parallel in linguistic similarity avoidance patterns. Arabic, for example, avoids pairs of similar adjacent consonants, and sonorants are treated as more similar to voiced obstruents than to voiceless obstruents (Frisch et al., 2004). Finally, when consonants correspond with ϕ, speakers choose those that fade into their environment. Again, this pattern finds a parallel in phonology: when speakers epenthesize a segment, they typically choose segments that are perceptually least intrusive (usually glottal consonants for consonants and schwa or high vowels for vowels) (Kwon, 2005; Steriade, 2001; Walter, 2004). Based on these results we can conclude that non-trivial parallels exist between verbal art patterns and phonological patterns.

3 Positional effects

In the previous section, I hope to have established two points: (i) speakers minimize the difference between corresponding elements in puns as well as in phonology, and (ii) the similarity is defined in terms of psychoacoustic features. We now turn to two experiments that address the issue of *positional effects* in imperfect puns (Kawahara, Shinohara, & Yoshida, 2008). The analysis in section 2 does not take into consideration *where* in the punning words mismatches occur. However, we would think that positions of mismatches should matter, because in phonology positions of changes matter (Beckman, 1998; Steriade, 1994). In particular, speakers avoid making changes in phonetically and psycholinguistically prominent positions, such as stressed syllables, long vowels, word-initial syllables, and root segments (Beckman, 1998). The question that arises is, therefore, "In puns, would speakers avoid mismatches in phonetically and psycholinguistically strong positions?" By addressing this question, this project aims to further advance the claim that non-trivial parallels exist between pun patterns and phonological patterns. Concretely, we will observe that the principle of position faithfulness—avoidance of disparities in prominent positions—exists both in phonology and in puns.

3.1 Initial positions

3.1.1 Introduction

I start with the discussion of initial syllables. It is well known that speakers maintain more contrasts in initial syllables than in non-initial syllables (Beckman, 1998). For example, in Sino-Japanese, while initial syllables can contain a variety of consonants, second syllables only allow [t] and [k] (Kawahara, Nishimura, & Ono, 2002; Tateishi, 1990). Similarly, mid vowels are found only in initial syllables in Tamil (Beckman, 1998). Assuming that all possible contrasts are allowed in the input *as per* Richness of the Base (Prince & Smolensky, 1993/2004), we can say that speakers avoid changing input specifications particularly in initial syllables in phonology. In Sino-Japanese, if there were an underlying form like /sasu/, then speakers avoid changing the initial [s] but not the final [s] (resulting in, say, [satu]). The theory of *positional faithfulness* directly captures this observation by positing that underlying contrasts in initial syllables are protected by special positional faithfulness constraints (Beckman, 1998).

The privilege of initial syllables may be due to their psycholinguistic salience (see Beckman, 1998; Hawkins & Cutler, 1988; Smith, 2002, for an overview). Initial syllables play an important role in lexical access (word recognition); for example, hearing initial portions of words help listeners to retrieve the whole words (Horowitz, Chilian, & Dunnigan, 1969; Horowitz, White, & Atwood, 1968; Nooteboom, 1981). In "tip-of-the-tongue" phenomena, speakers can guess what the first sound is more accurately than non-initial sounds (A. Brown, 1991; R. Brown & MacNeill, 1966), and word-initial sounds help retrieve the whole word efficiently (Freedman & Landauer, 1966). Listeners detect mispronunciations in non-initial positions faster than those in initial syllables (Cole, 1973; Cole & Jakimik, 1980)—once listeners hear initial syllables, they anticipate what is coming next, so that they can detect mispronunciations quickly. Because of their psycholinguistic prominence, speakers avoid disparities in initial syllables, which are noticeable.[7]

[7]It has also been shown that the effects of sound symbolism—particular images associated with particular sounds—are stronger in initial syllables than in non-initial syllables (Kawahara,

Table 4: A correspondence theoretic illustration of the parallel between phonology and pun formation. The left figure (a)=phonological input-output correspondence. The right figure (b)=surface-to-surface correspondence in pun.

Input	/	s_i	a_j	s_k	u_l	/	Word 1	[	s_i	a_j	s_k	u_l	]
		|	|	|	|				|	|	|	|	
Output	[	s_i	a_j	t_k	u_l	]	Word 2	[	s_i	a_j	t_k	u_l	]
a. IO mapping							b. Pun pairing						

Due to their psycholinguistic prominence, speakers avoid mismatches in initial syllables in phonology. If the same principle governs pun formation, speakers should avoid mismatches in initial syllables in imperfect puns as well. Correspondence Theory (McCarthy & Prince, 1995) allows us to illustrate the parallel in a particularly clear manner, as in Table 4.[8] In this theory, segments at two levels of representations (e.g. input and output) stand in correspondence, and their identity is required by a set of faithfulness constraints. As the left-hand figure (a) shows, speakers can allow a disparity word-internally (i.e. /s_k/-[t_k]) but not word-initially (i.e /s_i/-[s_i]), as is the case in Sino-Japanese. Likewise, as in figure (b), in composing puns speakers may avoid having an non-identical correspondence word-initially much more so than word-internally. What we will observe is precisely this.

3.1.2 Method

In order to control for factors other than positional effects, we performed well-formedness judgment experiments. The first experiment tested whether speakers avoid mismatches in initial positions. The stimuli were pairs of words that contain a pair of sounds that minimally differ in voicing ([t-d], [d-t], [k-g], [g-k], [s-z], [z-

Shinohara, & Uchimoto, 2008).

[8]Several authors have proposed a correspondence theory of rhymes (Hayes & MacEachern, 1998; Holtman, 1996; Steriade, 2003; Steriade & Zhang, 2001; Yip, 1999).

s]).[9] 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 sun root.').[10] Additional filler items were interwoven with the target questions. The participants rated both the funniness and the acceptability of each pun pair on a 1-to-4 scale for both questions. We used the two different ratings to separate perceptions of wellformedness from comedic value. 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 an alminum can.') and one example which clearly is not (*Hana-yori dango* 'Foods are more important than love.'). 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* as a good pun or considered *Hana-yori dango* as a perfect pun.

3.1.3 Results and discussion

Figure 2 illustrates the result of the rating experiment—it plots the average wellformedness ratings for the puns that have initial syllable mismatches and those that have internal syllable mismatches. A within-subject t-test reveals that speakers judged mismatches in initial syllables less acceptable than those in non-initial syllables ($t(28) = 2.69, p < .05$). In other words, speakers avoid mismatches in a psycholinguistically prominent position. Therefore, the principle of positional faithfulness is observed both in puns and in phonology: the parallel illustrated in Table 4 is experimentally supported.

[9] 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 and therefore it was impossible to find minimal pairs that match in accents for all speakers.

[10] We also included pairs which contained mismatches in final syllables in our experiment (Kawahara, Shinohara, & Yoshida, 2008). 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 (see in particular Nooteboom, 1981). It may be that recency effects (Gupta, 2005; Gupta, Lipinski, Abbs, & Lin, 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.

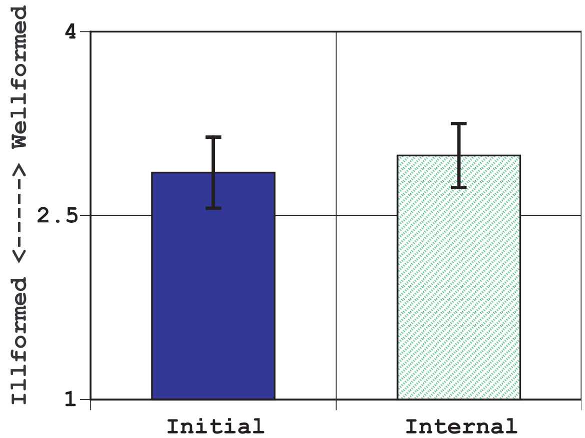

Figure 2: Wellformedness of puns with initial mismatches and those with internal mismatches. The error bars represent 95% confidence intervals across the 29 participants.

3.2 Long vowels

3.2.1 Introduction

We have observed that speakers avoid mismatches in initial positions. We can thus conclude that the principle of positional effects is in effect in the formation of imperfect puns. This conclusion can be reinforced if we observe a different type of positional effect. We investigated whether speakers avoid disparities in long vowels, because they do so in phonology (Kirchner, 1998; Steriade, 1994). Hindi for example allows a surface nasality contrast in long vowels, but not in short vowels (see Steriade, 1994, for references and other cases). A hypothetical underlying /tããtã/ would map to [tããta], as illustrated in the left-hand figure (a) in Table 5. In general, we observe in phonology that speakers avoid making changes—or neutralizing contrasts—in long vowels more often than in short vowels. The question is thus whether we observe the same principle in pun pairings, as in the right-hand figure (b) in Table 5.

Table 5: A correspondence theoretic illustration of the parallel between phonology and pun formation. The left figure (a)=phonological input-output correspondence. The right figure (b)=surface-to-surface correspondence in pun.

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

a. IO mapping

b. Pun pairing

3.2.2 Method

The method is almost identical to the previous experiment, except that we had four practice questions (in addition to the two examples used in the previous experiment, *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 non-pun). 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.

3.2.3 Results

Figure 3 compares the wellformedness of puns with long vowel mismatches and those with short vowel mismatches. As expected, speakers rated those with long mismatches as worse than those with short mismatches ($t(25) = 3.83, p < .001$). In this regard, speakers avoid mismatches in long vowels more than mismatches in short vowels. Mismatches in long vowels are perceptually salient because of their long duration (Steriade, 2003), and hence avoided by the participants.

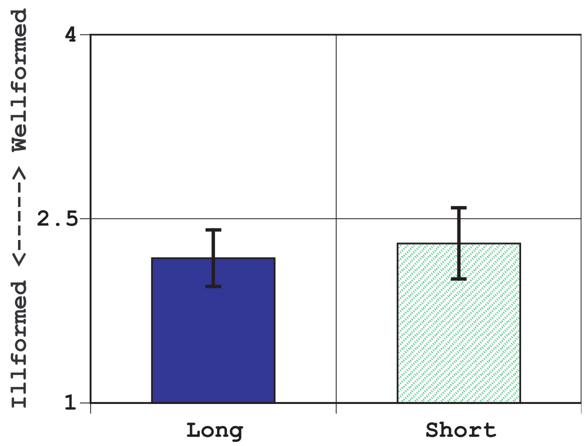

Figure 3: Wellformedness of puns with long vowel mismatches and short vowel mismatches. The error bars represent 95% confidence intervals across the 26 participants.

3.3 Summary and discussion

The two experiments reported in this section show that speakers avoid mismatches in phonetically and psycholinguistically prominent positions in Japanese puns, just as they do so in phonological patterns. This finding further supports the claim that phonological and pun patterns are governed by the same principles.

In addition to finding that positional effects do exist in puns, our results bear on one current theoretical debate: the issue of positional faithfulness theory versus positional markedness theory. To account for patterns of positional neutralization patterns, in which some contrasts only surface in certain positions, the positional faithfulness theory postulates that speakers avoid changes in strong positions (Beckman, 1998): "Avoid input-output mismatches in strong positions". On the other hand, the positional markedness theory postulates that speakers avoid having contrasts in weak positions (Zoll, 1998): "Do not have contrasts in weak positions". As I discussed above, the principle of positional faithfulness can explain our results because we observe that speakers avoid mismatches in strong positions. On the other hand, the positional markedness theory has nothing to say about the results because it evaluates the wellformedness of one form only, but not the relation between two forms.

4 Further issues: other patterns

In addition to the two projects summarized above, there are other types of puns that are worth investigating. In this section, I provide an overview of other interesting types of pun patterns, which can and should be pursued in future research. I strongly hope that this discussion stimulates further researches on imperfect puns. If readers are interested, please contact the author at `kawahara@rci.rutgers.edu`.

4.1 Vowel mismatches

Speakers can combine two words minimally different in one vowel to create a pun sentence, as in (4).

(4) Haideggaa-no zense-wa hae dekka?
Heidegar-GEN previous life-TOP fly copula
'Is Heidegger a fly in his previous life?'

In this example, *Haideggaa* and *haedekka* are paired, even though the second vowels are not identical ([i] vs. [e]). We collected 547 examples of this sort—those that involve pairing of two words that minimally differ in one (short) vowel—and calculated the O/E ratios for each pair. We then took their reciprocals as distances between the five vowels, and created a distance map using an MDS (Multi-Dimensional Scaling) analysis. The results appear in Figure 4.

In Figure 4, the five vowels are configured in a way that closely resembles the vowel space. Moreover, as argued in section 2, speakers seem to use psychoacoustic similarity—rather than featural similarity—to create puns. The distance matrix obtained from our analysis in fact statistically correlates with a distance matrix created based on euclidian distances using F1 and F2 Bark values reported in Hirahara & Kato (1992) ($r = .647, t(8) = 2.40, p = .043$).

There are two primary reasons to believe that psychoacoustic similarity, rather than featural similarity, shapes the pun patterns here. First, in Figure 4, [a] is closer to [o] than [e], although [a] differs from both [o] and [e] in terms of two features (the [a-o] pair disagrees in [low] and [round]; the [a-e] pair disagrees in [low] and [back]). The proximity of [a] to [o] receives a straightforward explanation from a psychoacoustic point of view, because both [a] and [o] have low F2 (Hirahara & Kato, 1992; Keating & Huffman, 1984). Moreover, in Hirahara & Kato's experiment, where they tested the influence of F0 on vowel perception,

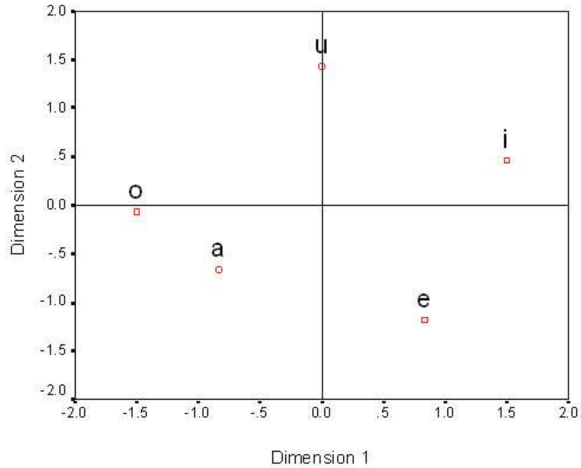

Figure 4: An MDS analysis of the vowel distance matrix computed based on combinability in puns. The distances between the five vowels are calculated as reciprocals of O/E ratios.

they found that raising the F0 of original [a] can result in the percept of [o], but not that of [e].

Second, in Figure 4, [i] and [u] are much closer to each other than [e] and [o] are—this pattern again receives a straightforward explanation because in Japanese [u] is less rounded than [o] is, and hence has higher F2, making it closer to front vowels.[11] Again, in Hirahara & Kato's experiment, raising the F0 of the original [i] could result in the percept of [u], whereas applying the same operation to [e] did not result in the percept of [o].

While we seem to have good evidence that speakers use psychoacoustic similarity when they compute similarity between vowels, in order to further strengthen this point, the matrix should be compared with a perceptual map obtained by some method (a similarity judgment task, a confusion experiment under noise etc).

[11]One may argue that Japanese [u] is phonologically [-rounded] and thus [u] is closer to [i] than [o] is to [e] in terms of distinctive features. However, Japanese [u] is arguably [+rounded] phonologically, because [u] turns preceding /h/ into a rounded, bilabial fricative [ɸ].

4.2 Metathesis

There are a few more other patterns that are yet to be analyzed. For example, some examples of puns can involve metathesis of moras, as in (5) where the order of [ma] and [ne] is reversed:

(5) Shimane-no shinema.
Shimane-GEN cinema
'A cinema in Shimane.'

Given examples like (5), we should investigate what kind of moras/syllables can metathesize with each other. If our hypothesis that speakers minimize the perceptual disparities between corresponding segments is correct, then we should find examples where [ABC] and [ACB] are perceptually similar ([A], [B], [C] stand for CV-moras) (cf. Blevins & Garrett, 1998; Hume, 1998). We have collected some examples that involve metathesis—ideally, one should collect more examples and see what kind of metathesis patterns are common.

4.3 Syllable intrusion

Finally, sometimes speakers combine two words in which one word contains one mora/syllable which is not contained in the other word, as in (6)

(6) Bundoki-o bundottoki.
protractor-ACC take away
'Take away a protractor (from him).'

We would like to know what kind of syllables can be 'inserted'. We have collected examples of this sort, and it seems to us that the majority of the examples fit in one of the three following categories: (i) the intruded syllable has a high vowel (e.g. *Fujiki Naoto-wa fushigi-na o***hi***to* 'Fujiki Naoto is a strange person.'), (ii) the intruded syllable has a vowel identical to the preceding or following vowel (e.g. *Kamigata-ga kami ga***kat***ta* 'My hair-do was divinely done.', and (iii) the intruded syllable is an affix or a particle (e.g. *Kurisumasu-wa kuri***de***sumasu* 'I will have chestnuts for Christmas'). Out of the 149 examples we have collected, 144 fit in one of these patterns. The data are yet to be analyzed to see if these observations are robust, and moreover if the principle of the maximization of psychoacoustic similarity is responsible for shaping these patterns (high vowels, copy vowels, and affixal vowels are similar to ϕ?).

5 General summary

Speakers minimize perceptual disparities between corresponding segments in puns. In this sense, we find non-trivial parallels between pun pairing patterns and phonological patterns. In this paper, I hope to have demonstrated that we can probe our knowledge of similarity through studying puns. Pun patterns are understudied—they thus provide an untapped resource for future research.

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