Probing knowledge of similarity through puns

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Theoretical background

- Some kind of similarity seems important in shaping phonological patterns.
- Intuitively, speakers can change /A/ to [B] if A and B are "sufficiently similar" (Steriade, 2001, *et seq*).
- But what do we really mean by "sufficiently similar"?
- More formally, what is knowledge of similarity that speakers deploy to shape phonological patterns?

Perceptual similarity

- Speakers can change /A/ to [B] if A and B are perceptually similar (Steriade, 2001).
- Japanese voicing example (Nishimura, 2003). If there are two voiced obstruents within the same stem:

bo**dd**o → ba**tt**o	*cf.* ba**d**o → *ba**t**o
ba**gg**u → ba**kk**u	*cf.* ba**g**u → *ba**k**u
do**gg**u → do**kk**u	*cf.* da**g**u → *da**k**u

A hypothesis (Kawahara, 2006, 2008)

- A voicing contrast is less perceptible in geminates than in singletons.
  - DD is sufficiently perceptually similar to TT.
  - D is perceptually dissimilar to T.
- There may be something special about voicing in voiced geminates.

The acoustic evidence

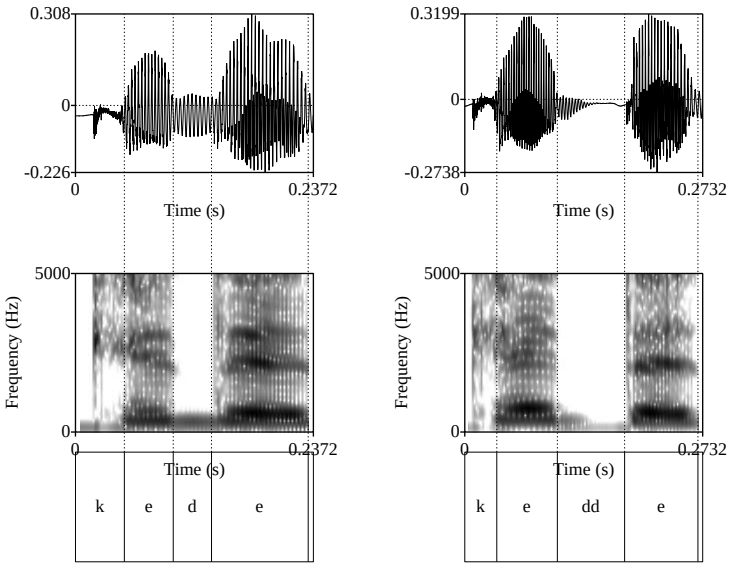


Figure: Closure voicing

The perceptual evidence (Kawahara, 2006)

- An identification experiment under noise.
- 17 native speakers of Japanese judged the voicing quality of intervocalic consonants.
- d', which represents a perceptual distance, is calculated for voicing contrasts in singletons and geminates:
- d'(sing)=3.79 vs. d' (gem)=.71.

Other examples

- Nasals are more likely to assimilate in place than oral consonants (Jun, 1995): nasal pairs are sufficiently similar whereas oral pairs are "too different".

- A voicing contrast is more likely to neutralize than other manner contrasts (Steriade, 2001): minimal pairs differing in voicing are similar enough to be interchangeable.

Summary

- The less the perceptual change, the more likely it occurs.
- In other words, speakers exert stronger grammatical pressure against a larger perceptual change.
- I attempt to provide further support for this principle from the perspective of imperfect puns (*dajare*).

Part I: Consonantal similarity (Kawahara & Shinohara, 2009)

- Now we turn to puns...
- Japanese speakers traditionally create puns by combining two similar sounding words or phrases.
- Examples: *Arumikan-no ue-no aru mikan*, *Aizusan-no aisu*, *okosama-o okosanai-de*.
- Corresponding sounds do not need to be identical, but nevertheless need to be "similar" (Cutler & Otake, 2002; Shinohara, 2004; Kawahara, 2007; Steriade, 2003; Zwicky & Zwicky, 1986).

Question and approach

- Again, what do we mean by "similar"?
- Perceptually similar? *as per* Steriade (2001)?
- A traditional 'introspection-based' approach does not seem appropriate to answer this question (Shattuck-Hufnagel, 1986).
- One can (only?) answer this question with a statistical/experimental approach.

Method

- We collected 2371 examples of imperfect puns from online websites as well as through elicitation.
- We defined pun domains as sequences of moras with matching vowels: okosama-o okosanaide.
- We counted a number of mismatched consonant pairs (e.g. [m-n] pair in the above example; 535 consonant pairs in total—other pairs are discussed later).

O/E ratios

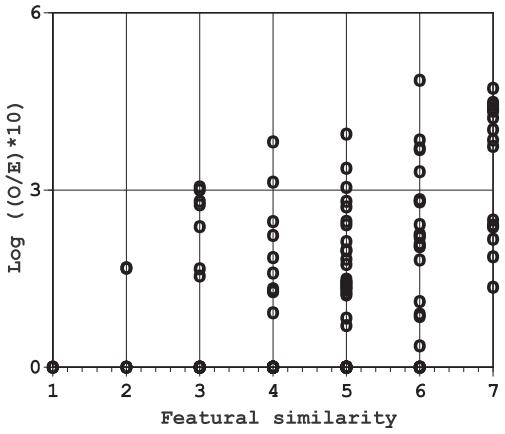
- We need a measure of combinability of two consonants—the likelihood of two consonants making a pun pair.
- Suppose that an [A]–[B] pair occurs more often than an [A]–[C] pair, can we say that the [A]–[B] pair is more combinable than the [A]–[C] pair?
- Not necessarily, because [B] might simply be more frequent than [C].
- O/E values provide a nice measure. They are observed frequency relativized with respect to expected frequency.

O/E ratios cont'd

- If O/E > 1, the pair is observed more often than expected (overrepresentation).
- If O/E < 1, the pair is observed less often than expected (underrepresentation).

- To statistically establish the relation between similarity and combinability in puns, we started out with a simple version of featural similarity.
- Featural similarity is defined in terms of the number of shared feature specifications (Bailey & Hahn, 2005, and others).

Correlation



Combinability and (featural) similarity correlate with each other ($r_s = .497, p < .001$)

Evidence for perceptual similarity

Featural similarity accounts for some broad patterns, but it ultimately fails to capture some of the detailed aspects of pun pairings:

1. Contextual effect of [place].
2. Different saliency of different features.
3. The effect of a phonologically inert feature.
4. Similarity with ϕ.

Evidence I: Contextual effects

- Nasals are more likely to assimilate in place than oral consonants (Mohanan, 1993).
- A [place] contrast is known to be less salient in nasal consonants than in oral consonants (Boersma, 1998; Jun, 1995; Pols, 1983; Mohr & Wang, 1968).
- The parallel in the pun pattern:

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

Evidence I: Contextual effects

- Speakers indeed consider the [m-n] pair as more similar than any other kind of oral consonant minimal pair.
- The contribution of [place] to similarity differs depending on whether it is hosted by nasals or oral consonants.
- The featural similarity model cannot explain this observation.

Evidence 2: Saliency of different features

- A [voice] contrast is less perceptible than [nas] and [cont] contrasts (Steriade 2001 and other earlier psycholinguistic works).
- Again the parallel in pun pattern:

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

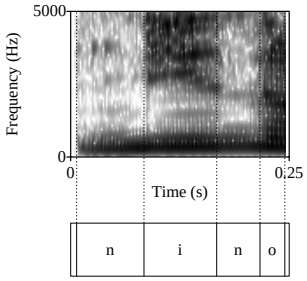
Evidence 3: Effect of phonologically inert features

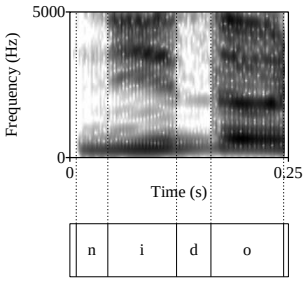
	Voiced obstruents	Voiceless obstruents
Paired with sonorants	63 (**18.2%**)	30 (**6.0%**)
Total	346	497

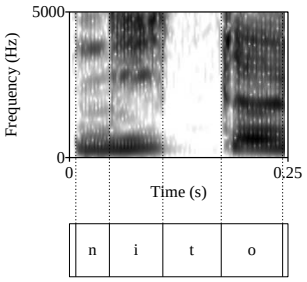
- Speakers combine sonorants more often with voiced obstruents than with voiceless obstruents.

Perceptual explanation

- The fact that sonorants are more combinable with voiced obstruents than with voiceless obstruents might be related to:
  - Low frequency energy.
  - Intervocalic lenition of voiced stops to approximants (Kawahara, 2006).







But phonologically...

- The [+voice] feature of Japanese sonorants is inert: it does not trigger Lymans Law:
  - Japanese does not allow two occurrences of voiced consonants within single stems. But only voiced obstruents count as voiced consonants.
  - The [+voice] feature on sonorants is underspecified (Itô & Mester, 1986), sonorants do not bear [voice] at all (Mester & Itô, 1989) or sonorants and obstruents bear different [voice] features (Rice, 1993).

Evidence 4: Similarity with ϕ.

- The list of consonants that often correspond with ϕ:
  [w]: 6.25, [r]: 4.59, [h]: 3.72, [m]: 2.54, [n]: 1.49, [k]: 1.39.
- These are consonants that blend into their environments, and hence are perceptually close to ϕ.
  - [w] blends into surrounding vowels (Myers & Hansen, 2005).
  - [r] is very short (Nakamura, 2002).
  - [h] again blends into surrounding vowels (Keating, 1988).
  - [m] and [n] have blurry transitions (Downing, 2005).
  - [k] coarticulates with surrounding vowels (de Lacy & Kingston, 2006).

Summary of Part I

- Speakers minimize the perceptual disparities between two corresponding elements in puns.
- Here we find non-trivial parallels with purely phonological patterns.
  - Place assimilation asymmetry and the perceptibility of nasal and oral consonants.
  - Neutralizability of [voice] with respect to other features.
  - Speakers epenthesize perceptually least intrusive segments.

Part II: Vowel mismatch (Kawahara & Shinohara, 2008)

- Speakers can combine two words minimally different in one vowel.
- For example, *shibuya-wa shibiya* and *haidegaa-no zense-wa haedekka*.
- We collected 547 examples of such mismatched vowels, calculated the O/E ratios for each pair, and took their reciprocals as distance between the five vowels.

Vocalic distances

Distances of the five vowels are calculated as the reciprocals of O/E ratios.

Table: The O/E ratios of the five vowels.

	a	e	o	i	u
a	0	1.60	2.13	0.72	0.78
e		0	0.74	1.90	0.55
o			0	0.46	1.54
i				0	2.06
u					0

Vowel mismatch

Two dimensional representations of the distance matrix:

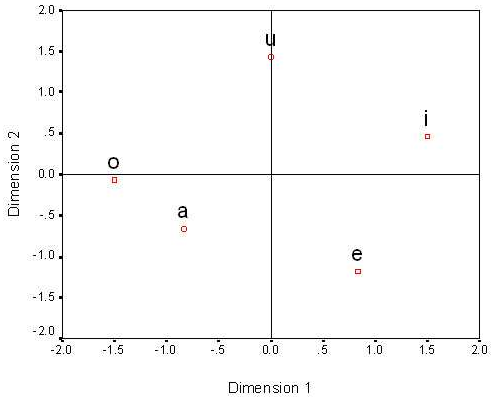


Figure: An MDS analysis of the vowel distance matrix computed based on combinability in puns.

Vowel mismatch

- Evidence for psychoacoustic similarity.
  1. [a] is closer to [o] than [e].
  2. [i] and [u] are closer to each other than [o] and [e].
- These patterns match with acoustic properties of Japanese vowels (Keating & Huffman, 1984; Nishi, Strange, Akahane-Yamada, Kubo, & Trent-Brown, 2008)
- The distance matrix statistically correlates with a distance matrix created based on euclidean distances of F1/F2 bark values of Hirahara and Kato (1992) ($r = .647, p = .043$).

Part III: Positional effects (Kawahara & Shinohara, to appear)

- We have seen that speakers minimize the differences between corresponding segments in imperfect puns, just as in phonology.
- Then it may be that positions of mismatches matter: in phonology, speakers avoid mismatches between inputs and outputs in phonetically and psycholinguistically prominent positions (Beckman, 1998; Steriade, 1994).

Experiment I: Psycholinguistic prominence

The first experiment tested whether speakers avoid mismatches in initial positions. Initial syllables play an important role in word recognition.

- Hearing initial portions of words help listeners to retrieve the whole words (Horowitz, Chilian, & Dunnigan, 1969; Horowitz, White, & Atwood, 1968).
- In "tip-of-the-tongue" phenomena, speakers can guess the first sound more accurately than non-initial sounds (A. Brown, 1991; R. Brown & MacNeill, 1966).
- Also, in tip-of-the-tongue situations, initial sounds help retrieve the whole word (Freedman & Landauer, 1966).

Psycholinguistic prominence cont'd

- Listeners are faster when detecting mispronunciations in non-initial positions (Cole & Jakimik, 1980; Cole, 1973)—once they hear initial syllables, they anticipate what's coming next.
- Sound symbolism—particular images associated with particular sounds—is stronger word-initially than non-word-initially (Bruch, 1986; Kawahara, Shinohara, & Uchimoto, 2008).

Phonological privilege of initial positions

Initial syllables exhibit a privileged status in phonology.

- 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).
- If there were an underlying form like /sasu/ (*as per* Richness of the Base), then speakers avoid changing the initial [s] but not the final [s] (perhaps to [satu]).
- In other words, speakers would avoid making changes in initial syllables.

Correspondence Theory

In terms of Correspondence Theory (McCarthy & Prince, 1995):

In phonology (input-output correspondence):

Input	/	s_i	a_j	s_k	u_l	/
Output	[	s_i	a_j	t_k	u_l	]

Likewise in pun formation (surface-to-surface correspondence):

Word 1	[	s_i	a_j	s_k	u_l	]
Word 2	[	s_i	a_j	t_k	u_l	]

Method 1

- The experiment was a wellformed judgement task.
- The stimuli were pairs of words that contain a pair of sounds that minimally differ in voicing ([t-d], [d-t], [s-z], [z-s], [k-g], [g-k]).
- To control for the distance between corresponding words, they were always separated by one-mora particle.

- Two conditions:
  - Initial mismatches (e.g. *sasetsu-ni zasetsu* 'I gave up turning left').
  - Internal mismatch (e.g. *hisashi-ni hizashi* 'Sunlight on the sun roof').

Method 2

- We asked two questions: how funny it is and how acceptable it is as a pun pair in a 1-4 scale.
- We included the first question, so that the participants would tease apart these questions.

- The questionnaire started with two sample questions, with one example which is clearly an example of a Japanese imperfect pun and one example which clearly is not.
- 37 speakers participated in this study, but we excluded eight of them because they did not consider the good example as a good pun or considered the bad example as a good pun.

Result

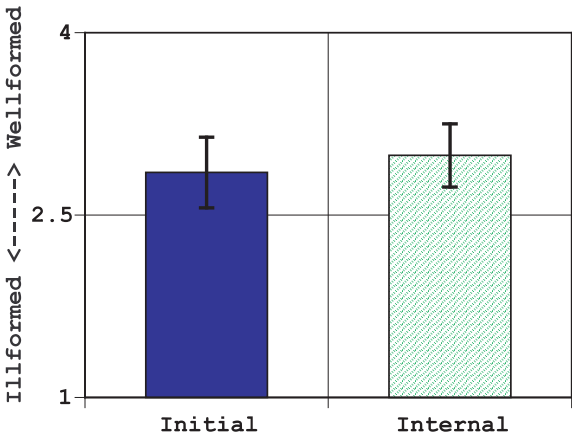


Figure: Wellformedness of puns with initial mismatches and those with internal mismatches. The error bars = 95% CIs.

Speakers judged mismatches in initial syllables less acceptable than those in non-initial syllables ($z = 2.59, p = .01$ by a non-parametric Wilxocon signed-ranks test).

Discussion

Speakers avoid mismatches in a psycholinguistically prominent position, both in phonology and pun formation.

Phonology

Input	/	s_i	a_j	s_k	u_l	/
Output	[	s_i	a_j	t_k	u_l	]

Pun formation

Word 1	[	s_i	a_j	s_k	u_l	]
Word 2	[	s_i	a_j	t_k	u_l	]

The principle of positional faithfulness is observed both in puns and in phonology.

Experiment II: Introduction

The second experiment 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. As a result, long vowels are more dispersed than short vowels (Hirata & Tsukada, 2003; Hisagi, Nishi, & Strange, 2008).

Phonological privilege of long vowels

- Hindi for example allows a surface nasality contrast in long vowels, but not in short vowels (Steriade, 1994).
- A hypothetical underlying /tããtã/ would map to [tããta].
- In phonology speakers avoid making changes—or neutralizing contrasts—more in long vowels than in short vowels.

Correspondence Theory again

In phonology (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	]

In 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	]

Method

- The design had two 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]) $\times$ 2 lengths (short vs. long).
- An example of a crucial pair was: *jookuu-no jookaa* 'A joker in the sky' vs. *rippu-ga rippa* 'Lips are good'.

- Other details were identical to Experiment 1, except that we had four sample questions (two good examples and two bad examples).
- 26 speakers participated in the study.

Result

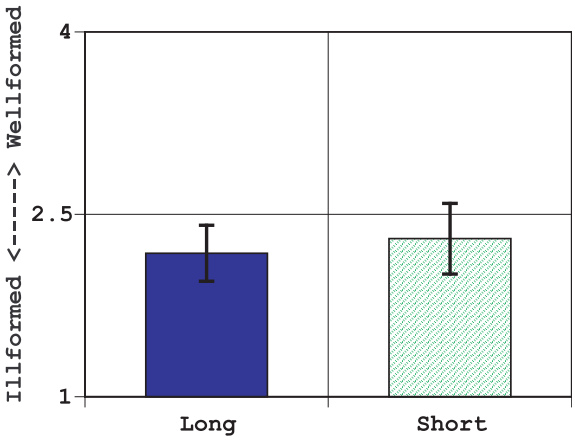


Figure: Wellformedness of puns with long vowel mismatches and short vowel mismatches.

Speakers rated those with long mismatches as worse than short mismatches ($2.93, p < .001$).

Discussion

Japanese speakers avoid mismatches in long vowels more than mismatches in short vowels

Phonology

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	]

Pun formation

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

Mismatches in long vowels are perceptually salient because of their long duration (Steriade, 2003), and hence avoided by the participants.

Summary and discussion of Part III

- Speakers avoid disparties between corresponding elements more in prominent positions (initial syllables, long vowels) than in non-prominent positions.
- The same principle holds both in puns and in phonology.
- We again found non-trivial parallels between phonology and pun patterns.

General summary and discussion

- Japanese pun patterns have been understudied, but they have much to tell us about our linguistic knowledge of similarity.
- I hope our research stimulates further studies on Japanese puns.

Overall summary

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

Acknowledgements

Part I is based on Kawahara & Shinohara (2009). Part II is reported in more detail in Kawahara & Shinohara (2008). Part III is based on Kawahara & Shinohara (to appear) and Kawahara, Shinohara, & Yoshida (2008), which themselves are based on a BA thesis by Nobuhiro Yoshida. I would like to thank Donca Steriade, whose colloquium talk at UMass Amherst inspired me to take on this general project. I also owe to John Kingston, John McCarthy, Joe Pater, and anonymous reviewers of several journals for their comments. There is a summary website for this project on the author's website. The website contains many open issues for future research.

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