Detecting false metaphors in Japanese

Pawel Dybala[1], Rafal Rzepka[2], Kenji Araki[2], Kohichi Sayama[3]

[1] Jagiellonian University, Institute of Middle and Far Eastern Studies, Gronostajowa 3, Kraków, Poland
paweldybala@res.otaru-uc.ac.jp

[2] Hokkaido University, Graduate School of Information Science and Technology, Kita-ku, Kita 14 Nishi 9, Sapporo, Japan
{kabura, araki}@media.eng.hokudai.ac.jp

[3] Otaru University of Commerce, Department of Information and Management Science, Midori 3-5-21, Otaru, Japan.
sayama@res.otaru-uc.ac.jp

Abstract

In this paper we propose how to automatically distinct between two types of formally identical expressions in Japanese: metaphorical similes and metonymical comparisons. Expression like "*Kujira no you na chiisai me*" can be translated into English as "Eye small as whale's", while in Japanese, due to the lack of possessive case, it literally sounds as "Eye small as whale" (no apostrophe). This makes it impossible to formally distinguish between expressions like this and actual metaphorical similes, as both use the same template. In this work we present a system able to distinguish between these two types of expressions. The system takes Japanese expressions of simile-like forms as input and uses the Internet to check possessive relations between elements constituting the expression. We propose a method of calculating a score based on co-occurrence of source and target pairs in Google (e.g. "whale's eye"). An experimentally set threshold allowed the system to distinguish between metaphors and non-metaphors with the accuracy of 74%. We discuss the results and give some ideas for the future.

Keywords: NLP, AI, metaphor processing, similes, metonymies

1. Introduction

This paper summarizes our work on automatic distinguishing between metaphorical and metonymical (non-metaphorical) similes in Japanese. This research is a part of our larger project, aimed at constructing a conceptual network for processing Japanese metaphors.

Figurative speech is frequently present in our daily life. We often use metaphors if we need to explain a difficult word, to delicately suggest or emphasize something. Humans usually have no problems with creating and understanding such examples. However, metaphor processing is in fact a complex cognitive process (Lakoff, 1970) and constructing its computational model is a very challenging task.

The most popular theories on metaphor understanding are the categorization view (Glucksberg, 2001), the comparison view (Gentner, 1983) and three hybrid views – the conventionality view (Bowdle and Gentner, 2004), the aptness view (Jones and Estes, 2005) and the interpretive diversity view (Utsumi and Kuwabara, 2005). In our work, however, we use Ortony's conception of salience imbalance, which states that in metaphorical expressions certain highly salient properties of the metaphor source are matched with less salient properties of metaphor target. In other words, certain properties of the target, which are normally perceived as not very salient, become more salient by comparing the common ground between the target and the source (Ortony, 1979). In metaphorical comparison like this: "Billboards are like warts - they are ugly and stick out", very salient properties of "warts", such as "ugliness" or "sticking out", are at the same time not very salient (albeit not completely implausible) properties of "billboards" (Ortony, 1979).

Alike other existing research on metaphor processing, such as Masui et al. (Masui et al., 2008), in our work we focus on the simplest and the most popular metaphorical figure of speech – a simile. A simile differs from a metaphor in that the latter compares two unlike things by saying that the one thing is the other thing, while simile directly compares two things through some connective, usually " like", "as" or by specific verbs like "resembles". This genre is also present in Japanese – see Figure 1 for example.

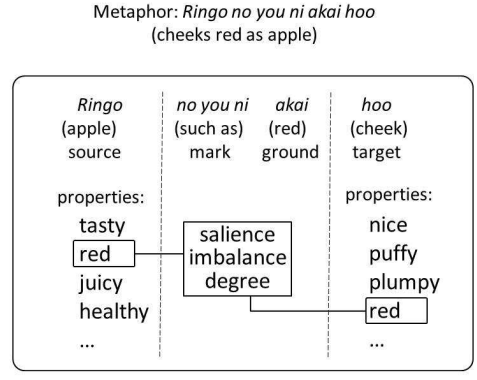

Fig. 1: Salience imbalance theory in Japanese metaphors

In metaphor processing research that use the salience imbalance theory (such as (Masui et al., 2008), metaphorical expressions are processed by first generation lists of target and source properties, and then comparing these lists in search of common grounds. An example of such process is shown on Figure 1.

In our research we use commonly known notions of metaphor elements: source (phrase to which target is compared), target (phrase compared to the source), ground (common ground between source and target) and mark (formal indicator of simile, like "such as" in "A such as B") – see Figure 1 for example.

One common problem with Japanese similes is that there are two types of formally identical expressions in Japanese: metaphorical similes and metonymical

comparisons. Expression like "*Kujira no you na chiisai me*" can be translated into English as "Eye small as whale's", while in Japanese, due to the lack of possessive case, it literally sounds as "Eye small as whale" (no apostrophe). In other words, they use exactly the same template ("A *no you na* B" – "A such as B"), which makes it impossible to formally distinguish between them. Table 1. depicts this on two examples.

Template:	source (noun)	***no you ni* (such as)**	ground (adjective)	target (noun)
Metaphor:	*Ringo* (apple)	***no you ni***	*akai* (red)	*hoo* (cheek)
Metonymy:	*Kujira* (whale)	***no you ni***	*chiisai* (small)	*me* (eye)

Table 1. Example of metaphorical simile and metonymical comparison realising the same template

Thus, in metonymical expressions, what seems to be the source of the metaphor is actually an abbreviation of the whole phrase (therefore we call it "metonymy"). "*Kujira*" ("whale") in "*kujira no you na chiisai me*" ("Eye small like whale's") is an abbreviation (metonymy) for "*kujira no me*" ("whale's eye") – however, due to the fuzzy nature of Japanese possessive particle "*no*" (which can be an indicator of possessive as well as other relations between words), formally it represents the same template as actual metaphorical similes, like "*Ringo no you ni akai hoo*" ("Cheeks red as apple").

This ambiguity may cause problems in metaphor processing in NLP. As shown in Figure 1, many existing works focus on generation of source and target description. However, if a system that performs such processing cannot distinguish between metaphors and metonymies, it can mistakingly generate descriptions and search for common grounds for wrong sources. An example of such incorrect and correct processing is shown on Figure 2.

Therefore, not distinguishing between these two formally identical types of expressions may cause numerous problems in research on metaphors. However, many existing works in this field tend to treat Japanese metaphorical and metonymical similes as metaphors. This problem is present also in existing Japanese metaphor dictionaries, including those most popular, like Retorika (Hangai, 1994) or Nakamura's "Dictionary of metaphorical expressions" (Nakamura, 1995). The latter, for instance, includes examples as: "*Hirame no you na me*" (Eyes like halibut's) or "*Kani no you na kanashii kaotsuki*" (Face sad as crab's), which, according to the above given explanation, are clearly not metaphors, but a metonymical similes.

Also Onai's dictionary (Onai, 2005), which we used to construct our corpus of metaphors (see 2) does not distinguish between these two types of expressions. In fact, all the examples analyzed in this research were taken from this dictionary.

This problem is also present in research works. Tokunaga and Terai (2008) claim that expressions like "*Hana no you na nioi*" ("Scent like flower's") is a metaphor, whereas it is a metonymy. Terai et al. (2006) analogically state that „*Oni no you na hyoujou*" („Expression like devil's") is a classical metonymy.

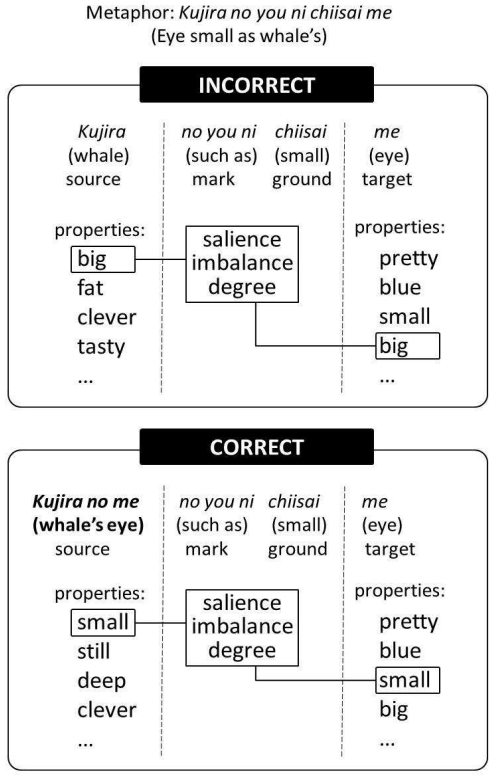

Fig. 2 Example of incorrect metaphor processing caused by not distinguishing between metonymies and metaphors, and its correct version after metonymy recognition.

That said, there have been some attempts to distinguish between these two types of expressions. Tazoe et al. (2003) proposed a system that automatically detects what they call literals (metonymies). The system is pattern based and uses noun categorization based rules to calculate whether inputted expression is a metaphor or a metonymy. Its accuracy was shown to be on 80% level, which is slightly better than in our system (74%). However, the system we proposed does not require any patterns that would be specifically designed for the purpose of metonymy detection (see also discussion in Section 6).

This paper is composed as follows. In Section 2 we describe the data set we use in this research. Next we introduce our system (Section 3), describe a small scale experiment conducted to evaluate its performance (Section 4), show its results (Section 5), discuss them (Section 6) and conclude the paper (Section 7).

2. Data set

2.1. Onai's dictionary

In this project we use a corpus of Japanese metaphors based on Onai's Great Dictionary of Japanese Metaphorical and Synonymic Expressions (Onai, 2005). The dictionary contains metaphors selected from Japanese modern literature and Japanese translations of foreign works. The dictionary contains approximately 30,000 metaphorical entries.

According to the author, the dictionary was compiled to assist in finding interesting and sophisticated expressions that can be used instead of common phrases.

From the metaphors included in the dictionary we automatically selected similes, using the set of templates

described in 2.2. From this group, for the need of this particular study we selected simple similes that realize the pattern: "noun - mark - adjective – noun", as presented in Table 2.

To conduct the experiment described in this paper, from this group we randomly selected 100 similes. All were annotated as "metaphors" or "metonymies" by two Japanese linguists (see Table 3 for summary).

noun source	mark	adjective ground	noun target
Koori no you ni tsumetai te (Hand cold as ice)			
koori (ice)	*no you ni* (as)	*tsumetai* (cold)	*te* (hand)
Kujira no you na chiisai me (Eye small as whale's)			
kujira (whale)	*no you na* (as)	*chiisai* (small)	*me* (eye)
Chi no you ni akai kuchibiru (Lips red as blood)			
chi (blood)	*no you ni* (as)	*akai* (red)	*kuchibiru* (lips)
Maruta mitai na futoi ryouashi (Legs fat as log)			
maruta (log)	*mitai na* (as)	*futoi* (fat)	*ryouashi* (legs)

Table 2. Examples of metaphors that realize the template: "noun - mark - adjective – noun"

Metonymies:	36
Metaphors:	64
Total:	**100**

Table 3. Data set summary

2.2. Templates set

To extract similes from the metaphor corpus (see 2.1), we manually prepared a set of 81 templates frequently used in Japanese metaphors. Every template includes metaphor's source, target, ground and mark. Each template has also POS tags, which means that the same marks are used multiple times, as shown below on the example of mark "*mitai*" ("as", "alike"):

noun - *mitai na* - noun (noun - such as - noun)
verb - *mitai na* - noun (verb - such as - noun)
noun - *mitai ni* - verb (noun - such as - verb)
noun - *mitai ni* - adjective (noun - such as - adjective)
verb - *mitai ni* - verb (verb - such as - verb)
verb - *mitai ni* - adjective (verb - such as adjective)

3. System

The system described in this section uses online and offline resources to distinguish between metaphorical similes and metonymical comparisons in Japanese. Its algorithm's outline is shown on Figure 3.

The system's input is a Japanese metaphor (simile). First the system uses templates (see 2.2) to extract source, target, mark and ground from the inputted expression. Next, it tries to determine whether an "is-a" or "has-a" relationship exists between the target and source. If, for instance, input is "*Zou no you na chiisai me*" ("Eye small as elephant's"), the system will check if "zou" ("elephant") can have a "me" ("eye"). To do so, we initially intended to perform a co-occurrence check in the Internet or offline corpora and query the phrase "*zou no me*" ("elephant's eye"). However, as mentioned above, Japanese particle "*no*" performs also other functions as possessive, and thus it is problematic to define which meaning of it is used in this particular expression. For example, expression "*gin no kami*" can mean "Silver's hair", but also "silver hair", depending on the context.

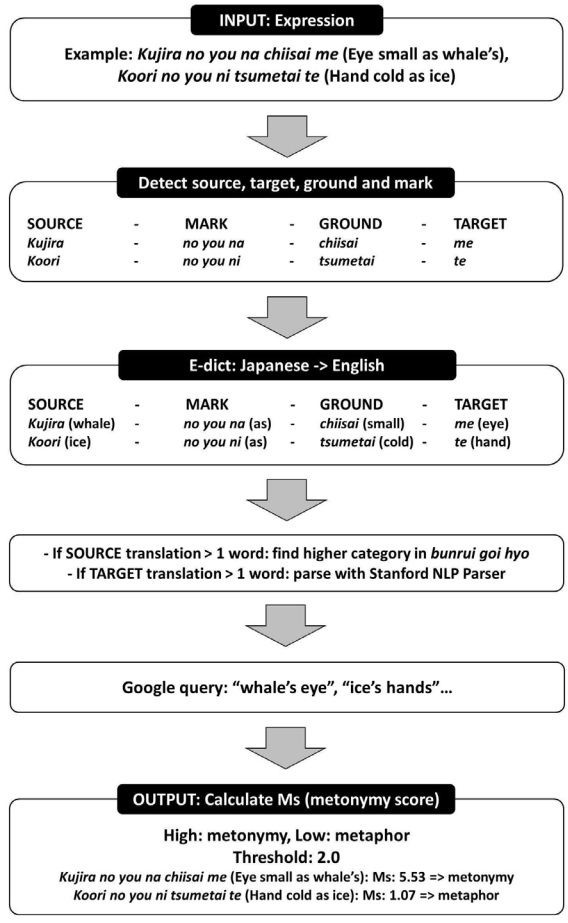

Fig. 3 Metonymy detection system – algorithm outline

Thus, we decided to perform this query in English, which does not have such issues. To do that, we use E-dict Japanese-English dictionary (Breen, 1995). After translating source and target to English, the system queries the phrase "source's target" (in the example above – "elephant's eye") in Google (www.google.com). In some cases in E-dict, English translations of Japanese words have more than one word. For example, word "*hazakura*" is translated as "cherry tree in leaves". Querying such long phrases in Google is pointless and returns none or very few results. Thus, we decided to introduce two additional rules to the algorithm:

1) if English translation of the source has more than one word, the system uses *Bunrui goi hyou* (2004), a Japanese thesaurus dictionary, to check which category the Japanese word (source) belongs to. Next the system translates the category name to English and uses it in Google query, instead of the original phrase. If the translation of the category name is also longer than one word, the system repeats this operation and checks one more category above. Example of this is shown below:

Metaphor: *Uguisu no you ni kawairashii koe*
(Voice sweet as Japanese bush warbler's)
Source: *uguisu* (Japanese bush warbler)
Number of words in source's translation: 3
Source belongs to category: *chourui* (birds)
Query phrase: "bird's voice"

2) if English translation of target has more than one word, the system uses Stanford NLP Parser (Socher et al., 2013) to extract the root of inputted phrase, as in this example:

Metaphor: *Kodomo no you na shinken na kaotsuki.*
(Facial expression serious as child's)
Target: *kaotsuki* (facial expressions)
Number of words in target's translation: 2
Target phrase's root: expression
Query phrase: "child's expression"

Thus, the system preprocesses the phrases to be queried in Google. The assumption was that if the phrase "source's target" has high hit rate, it is highly likely that the relationship between these two is commonsensically possessive. The phrase "elephant's eye", for example, has over 100, 000 matches, which means that, according to the Internet, elephants tend to have eyes.

However, at this stage we faced a serious noise problem, caused by the fact that Google queries are by default case insensitive. In the above-mentioned example, the results for "elephant's eye" include those actually related to the visual organ that can be possessed by elephants, as well as hits for a famous restaurant "Elephant's Eye". This can significantly hinder the outcome of this process, as in the example where the input is "*koori no you ni tsumetai te*" ("hand cold as ice"), for which the system queries the phrase "ice's hand". The hit rate in this case should be close to zero, as, commonsensically speaking, ice does not have hands. However, with Google's case insensitivity, in this case results also include those for "Ice's hands", where "Ice" is someone's surname or nickname. Due to this noise, this expression ("hand cold as ice") can be mistakingly detected as a metonymical comparison (non-metaphor).

Therefore, although initially we planed to base only on simple Google hit rates for inputted phrases, in order to deal with this noise we decided to introduce a method of calculating what we call the "metonymy score" (Ms). The score is calculated as follows:

$$\text{Ms} = \log \text{HitRate} \times \frac{s\_s}{s\_s + s\_b + b\_s + b\_b}$$

"HitRate" is the inputted phrase's hit rate in Google, "s_s" (abbreviation from "small_small") is the occurance of the inputted phrase where both source and target begin with small letters, in first 100 snippets for the particular query (or less, if hit rate < 100). The reason for taking only 100 snippets into consideration is that checking all of them would be time consuming, especially for phrases with very high hit rate. "s_b" ("small_big") is the occurrence of the inputted phrase where source begins with small letter, and target begins with capital. "b_s" ("big_small") is the occurrence of the inputted phrase where source begins with capital, and target begins small letter. Finally, "b_b" ("big_big") is the occurrence of the inputted phrase where both source and target begin with capital.

The reason we use logarithm is that the difference in hit rate does not change gradually. The difference between HitRate = 1 and HitRate = 2 is 1, but in fact it doubles, while between HitRate = 10000 and HitRate = 10001 it is still 1, but it is of not so high importance.

The right part of the formula represents what percentage of all phrases found in snippets is s_s.

Below we present the score calculation for the two examples mentioned above:

Example 1:

Input: *Kujira no you na chiisai me.*
(Eye small as whale's)
Source: *kujira* (whale)
Target: *me* (eye)
Ground: *chiisai* (small)
Mark: *no you na* (such as)
Metonymy or metaphor? metonymy
Query phrase: "whale's eye"
Hit rate: 11 500
s_s: 39
s_b: 0
b_s: 8
b_b: 19
Ms: 5.53

$$\text{Ms} = \log 11500 \times \frac{39}{39 + 0 + 8 + 19}$$

Example 2:

Input: *Koori no you ni tsumetai te.*
(Hand cold as ice)
Source: *koori* (ice)
Target: *te* (hand)
Ground: *tsumetai* (cold)
Mark: *no you ni* (such as)
Metonymy or metaphor? metaphor
Query phrase: "ice's hand"
Hit rate: 3380
s_s: 10
s_b: 0
b_s: 63
b_b: 3
Ms: 1.07

$$\text{Ms} = \log 3380 \times \frac{10}{10 + 0 + 63 + 3}$$

4. Experiment

To verify our approach, we conducted an experiment in which we calculated Ms (metonymy scores) for 100 phrases from our metaphor corpus, that realize the pattern: "noun - mark - adjective - noun" (see Section 2.2). The threshold to distinguish between metaphors and non-metaphors was experimentally set to 2.0, which means that if Ms was below 2.0, input was recognized as metaphor, and if Ms was equal to or higher than 2.0, input was recognized as metonymy.

The results were compared to annotations (metaphor / metonymy) made by our experts.

5. Results

The experiment showed that our system can distinguish between metaphors and metonymies with the accuracy of 74%. Results are shown in Table 4.

Expressions recognized correctly		Expressions recognized incorrectly	
74/100 (74%)		36/100 (36%)	
Metonymies	Metaphors	Metonymies	Metaphors
31/36 (86.1%)	43/64 (67.2%)	5/36 (13.9%)	21/64 (32.8%)
	Accuracy	74%	
	Precision	59.6%	
	Recall	86.1%	
	F measure	0.704	

Table 4. Experiment results

6. Discussion and future work

The experiment results show that the proposed system detects metonymies with fairly high accuracy of 74%. This is slightly lower than the above mentioned system by Tazoe et al. (2003) (accuracy of 80%). That system, however, used complex sets of rules based on noun categorization. The set was prepared specifically for that study. In our system, however, we do not use any tools or resources that were developed for the purpose of this research. The algorithm is much more simple and yet it achieved comparable level of accuracy (only 6% difference).

Worth mentioning is the fact that from 30 inputted expressions for which the Ms (metonymy score) was 0, 29 were actually not metomies (metaphorical similes). Thus, it can be stated that expressions for which Ms = 0 are recognized as metaphors with 96.7% accuracy.

That said, the overall results could be higher and there is still place for improvement. With Ms threshold set to 2.0, 21 metaphors were mistakingly recognized as metonymies, and 5 metonymies were mistaken for metaphors. The analysis of results and stages of processing revealed that there are two main reasons of system failures: 1) cultural differences and 2)conceptual differences between languages.

1) Cultural differences in metaphors occur when the source metaphor (here: Japanese) contains elements that are specific to that particular culture. For example, expression "*Daruma no you na marui me*" ("Eye round as Daruma's"), was falsely recognized by our system as a metaphor, as the phrase "daruma's eye" has low hit rate in Google. Daruma is a traditional Japanese doll with round eyes English speakers may not be familiar with.

2) Conceptual differences between languages occur when what is commonly called "way of thinking" differs between languages. For example, "*Kobato no you na adokenai kao*" ("Face innocent as squab's") was mistaken for metaphor, while it is a metonymy. The reason for this is that in English it is not very natural to say that birds have faces, and thus phrase "squab's face" did not score high on Google. In Japanese, however, saying that birds have faces is perfectly natural.

To improve the system and avoid such errors in the future, we plan to use ontology check, as we did in one of earlier stages of the system algorithm (see 3). If the system will be able to check that Daruma is a doll, it could easily alter the query (to "doll's eye") and produce more accurate results.

We are also planning to check all snippets, not only 100, as in this version of the system. This will significantly extend the processing time, but should lead to improvement in system's accuracy.

6. Discussion and future work

In this paper we introduced our system that automatically distinguishes between Japanese metaphorical similes and metonymical comparisons. The system works with 74% accuracy, which is fairly encouraging.

The results of this work can be useful not only in metaphor processing, but also in machine translation. Google translator (www.translate.google.com), for instance, is not able to translate metonymies, as it does not distinguishes between them and actual metaphors. To the authors' best knowledge, neither does any other existing MT system.

References

Bowdle, B., and Gentner, D. (2004). The career of metaphor. In: *Psychological Review*, 111(1), pp.193-216.

Breen, J. (1995). *Building an electronic Japanese- English dictionary*. In: Japanese Studies Association of Australia Conference, Brisbane, Australia.

Dybala, P., Ptaszynski, M., Rzepka, R., Araki, K., and Sayama, K. (2013). Metaphor, Humor and Emotion Processing in Human-Computer Interaction. In: *International Journal of Computational Linguistics Research*, Vol. 4, Issue 1 (March), pp. 1-13.

Gentner, D. (1983). Structure mapping: A theoretical frame- work for analogy. In: *Cognitive Science*, 7. pp. 155-170.

Glucksberg, S. (2001). *Understanding figurative language: From metaphors to idioms*. Oxford University Press.

Hangai, Y. (1994). *Retorika: Hiyu hyougen jiten (Rhetorica: figurative expressions dictionary).* Hakusuisha.

Jones, L., and Estes, Z. (2005). Metaphor comprehension as attributive categorization.In: *Journal of Memory and Language*, 53, pp. 110-124.

Lakoff, G., and Johnson, M. (1980). *Metaphors We Live By*. University of Chicago Press.

Masui, F., Kawamura, Y., Fukumoto, J. Isu, N. (2008). *MURASAKI: Web-based Word Sense Description System. In: Proceedings of ITC-CSCC 2008*, Shimonoseki, Japan, pp. 1285-1288.

Nakamura, A. (1995). *Hiyu hyougen jiten (Metaphorical expression dictionary)*. Kadokawa shoten.

National Institute for Japanese Language. (2004). Bunrui Goi Hyo: revised and enlarged edition Dainippon Tosho.

Onai, H. (2005). *Great Dictionary of 33800 Japanese Metaphors and Synonyms* (in Japanese). Kodansha.

Ortony, A. (1979). Beyond literal similarity. *Psychological Review* 86, pp. 161-180.

Socher, R., Bauer, J., Manning, Ch. D., and Ng, A. Y. (2013). *Parsing With Compositional Vector Grammars*. In: Proceedings of ACL 2013.

Tazoe, T., Shiino, T., Masui, F., and Kawai, A. (2003). The metaphorical judgement model for "Noun B like Noun A" Expressions (in Japanese). Journal of Natural Language Processing, Vol.10, No.2, pp.43-58.

Terai, A., Nakagawa, M., Tokunaga, T. (2006). *Hiyu rikai katei ni okeru souhatsu tokuchou no shinri jikken ni yoru kenshou* (Experimental examination of emerging characteristics in metaphor understanding), 23. Meeting of Japanese Cognitive Science Society, pp. 388-389.

Tokunaga, T., and Terai, A. (2008). *Hiyu rikai no tame no gengo shori (Language processing for metaphor understanding),* Gekkan Gengo, 37 (8), pp. 46-53.

Utsumi, A., and Kuwabara, Y. (2005). *Interpretive diversity as a source of metaphor-simile distinction. In: Proceedings of the 27th Annual Meeting of the Cognitive Science Society*, pp. 2230–2235.