Cognitive Effects of Synesthetic Metaphors Evoked by the Semantic Interaction

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Abstract

A synesthetic metaphor (e.g., *sweet touch*) is a metaphor that results from a combination of a modifier and a head, where both express different perceptual qualities. Most of the existing studies examine how the acceptability of synesthetic metaphors can be explained by the pairing of adjective modifier's and head noun's modalities. However, little attention has been given to cognitive effects evoked by synesthetic metaphors. This paper explores cognitive effects evoked by synesthetic metaphors for the Japanese language. Based on Abstract Performance Grammar (APG) proposed by Osgood (1980) we analyzed how semantic interactions between vehicle and topic of synesthetic metaphors function to shift the meanings of words to the positive pole or negative pole. In the experiment 3267 subjects were asked to evaluate meanings of 158 linguistic expressions by 7-point semantic differential scales. Results show that synesthetic metaphors, especially synesthetic metaphors modified by color adjectives, tend to evoke negative effects, which is against the rules predicted by APG model.

Keywords: synesthetic metaphors; Japanese language; Abstract Performance Grammar; semantic change patterns; negative effect.

Introduction

The phenomenon of synesthesia has gained increasing attention over the last ten years (Baron-Cohen & Harrison, 1997; Harrison, 2002; Cytowic, 2002). It has a neurological as well as a linguistic aspect. This paper focuses on the linguistic aspect. In contrast to synesthesia as a neurological phenomenon, synesthesia as a phenomenon in natural languages is not restricted to a small proportion of the population. According to prominent theories of metaphors (Black, 1962; Lakoff & Johnson, 1980), any metaphor results from a mapping of some concept from a source domain onto a concept of some target domain. In the case of synesthetic metaphors, the source domain is restricted to concepts of perception, which make up the perceptual domain. The classification of the perceptual domain can be made with the five senses: color, sound, touch, smell, and taste. Werning, Fleischhauer, & Beşeoğlu (2006) call the linguistic expressions as shown in (2) and (3) synesthetic metaphors, while example (1) is not a synesthetic metaphor because the modifier does not come from a perceptional domain. Furthermore, they classify example (2) into a weakly synesthetic metaphor and example (3) into a strongly synesthetic metaphor:

(1) The old woman had an open heart
(2) The rich man had a cold heart
(3) The stone statue had a cold smell

In (3) the target domain and the source domain both are from the perceptual domain, whereas in (2) only the source domain is. In this paper we do not differentiate between the linguistic expressions as shown in (2) and (3) and refer to them roughly as synesthetic metaphors.

As shown in examples (1)-(3), synesthetic metaphors are a kind of adjective metaphors, in which an adjective denoting the perception of some sense modality modifies a noun's modality. Metaphor studies in the domain of cognitive science, however, have paid little or no attention to adjective metaphors. Many existing studies have paid much attention to nominal metaphors such as "*My job is a jail*" (e.g., Bowdle & Gentner, 2005; Glucksberg, 2001; Jones & Estes, 2006; Utsumi, 2007) and predicative metaphors such as "He *shot down* all of my arguments" (e.g., Lakoff & Johnson, 1980; Martin, 1992).

Many studies focusing on synesthetic metaphors, including Werning, Fleischhauer, & Beşeoğlu (2006), have examined how the acceptability of synesthetic metaphors can be explained by the pairing of adjective modifier's and head noun's modalities. Ullmann (1967), in a very early study on synesthetic metaphors, proposes a certain hierarchy of lower and higher perceptual modalities. He claims that qualities of lower senses should preferentially occur in the source domain, while qualities of higher senses should be preferred in the target domain. His thesis of directionality thus asserts that a metaphor with a source domain lower in the hierarchy of sense modalities than the target domain should tend to be cognitively more accessible than a metaphor with the reverse direction of domains. After Ullman, Williams (1976) makes a more differentiated claim of directionality, in which a similar order of sense modalities is proposed. Recently, Yu (2003) highlights cross-linguistic differences, when he makes different directionality claims for different languages (English as compared to Chinese). Werning, Fleischhauer, & Beşeoğlu (2006) explore the factors that enhance the cognitive accessibility of synesthetic metaphors for the German language. Very few studies, however, have attempted to explore cognitive effects evoked by synesthetic metaphors. This paper explores cognitive effects evoked by synesthetic metaphors for the Japanese language.

Osgood (1980) is one of few studies exploring cognitive effects of nominal metaphors. Metaphor comprehension has been recognized as the process of finding relevant features that constitute the metaphorical meaning from the interaction between a source concept and a target concept, especially by interaction theorists (e.g., Black, 1962; Indurkhya, 1991; Tourangeau & Sternberg, 1982). Abstract Performance Grammar (APG) proposed by Osgood (1980) states the crucial rules to evoke semantic changes through fine semantic interactions in the processing of linguistic expressions. In this paper we will call such semantic changes 'cognitive effects'. According to Osgood, these effects on meaning are not deliberate conscious acts by the comprehender, but rather automatic feature interactions of which one is usually quite unaware.

The APG model enables us to see how such interactions function to shift the meanings of words within constituents and of phrases between constituents. In the analysis, the semantic features will be bipolar and reciprocally antagonistic in nature and be nonarbitrarily positive vs. negative in the signing (+/-) of their antagonistic poles. Thus in this paper we will see how semantic interactions between vehicle and topic of synesthetic metaphors function to shift the meanings of words to the positive pole or negative pole.

The APG rules for semantic feature interaction generate explicit predictions for potential metaphors and similes. Rule 1: when a feature has the same sign (non-zero) in vehicle and topic, (a) equal intensity of coding yields no change in topic meaning, (b) greater intensity in vehicle increases polarization in topic, and (c) lesser intensity in vehicle reduces polarization in topic. Rule 2: when a feature is signed (either + or -) in the vehicle but unsigned in the topic, the topic assumes the same intensity and polarity on the feature as the vehicle. Rule 3: when topic and vehicle have opposed signs (polarities) on a feature, (a) unequal codings yield reductions in intensity toward zero coding in the topic, (b) non-polar equal codings (e.g., +2 vs. -2) yield cancellation of that feature (i.e., zero coding) in the topic, and (c) polar equal codings (+3 vs. -3) yield the sense of anomaly.

While Osgood (1980) analyzes cognitive effects of nominal metaphors, we analyze cognitive effects of synesthetic metaphors and argue that semantic interactions between vehicle and topic of synesthetic metaphors tend to evoke negative cognitive effects, which contradicts the predictions of the APG model.

In this paper we analyze whether the semantic interaction between the vehicle and the topic caused changes to the negative semantic poles or the positive semantic poles. To observe detailed semantic change patterns of synesthetic metaphors evoked by the semantic interactions between the vehicle and the topic, we adopted modified rules of semantic interactions between vehicle and topic rather than the rules proposed by Osgood (1980). While the APG model proposed by Osgood (1980) considers absolute value as semantic intensity, we considered not absolute value but real value. Semantic changes predicted by the APG model are shown in Table 1.

Table 1: Predictions of semantic change

semantic intensity	predicted semantic change
T=V	no change (0)
T<V	change to +
T>V	change to -

The first column in Table 1 shows the classification of potential metaphors based on the value of topics (T) and vehicles (V) in the antagonistic (negative or positive) poles. The second column shows semantic changes predicted by the APG model. If the values of topic and vehicle are the same, their semantic interactions of synesthetic metaphors evoke no semantic change. If the value of topic is smaller than that of vehicle, their semantic interactions of synesthetic metaphors evoke semantic change to the positive pole. If the value of topic is larger than that of vehicle, their semantic interactions of synesthetic metaphors evoke semantic change to the negative pole. Figure 1(a) shows an example of no semantic change (0), Figure 1(b) shows an example of a semantic change to the positive pole, and Figure 1(c) shows an example of a semantic change to the negative pole.

△: vehicle □: topic ○: metaphor

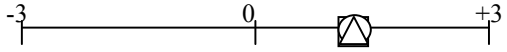


Figure 1(a): an example of no change (0)

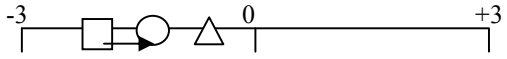


Figure 1(b): an example of change to +

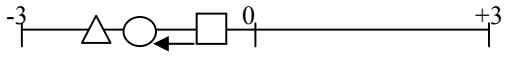


Figure 1(c): an example of change to -

Method

Participants

Participants were recruited through Macromill, Inc., an organization that maintains a panel of more than 533,579 people who have agreed to participate in web-based online survey research. 3267 Japanese males and females, aged 20-75, agreed to participate in our experiment.

Materials

We conducted a pre-experiment to choose materials used for the experiment. 30 Japanese males and females, aged 21-25, participated in the pre-experiment. Materials used for the pre-experiment were 250 Japanese synesthetic metaphors. They were made by combining 25 Japanese adjectives denoting perceptions of the five sense modalities with 11 Japanese nouns; *color* ('iro' in Japanese), *tezawari* ('touch'), *voice* ('koe'), *taste* ('aji'), *smell* ('nioi'), *feeling* ('kimochi'), *dream* ('yume'), *uneasiness* ('fuan'), *greed* ('yokubou'), *affection* ('aijou'), and *manner* ('taido'). 25 Japanese adjectives denoting the perceptions of the five sense modalities are shown in Table 2.

Table 2: List of adjectives used for the experiment

color	touch	sound	taste	smell
yellow 'kiiroi'	*light* 'karui'	*noisy(1)* 'urusai'	*tasty* 'oishii'	*sweet-smelling* 'kaguwashii'
blue 'aoi'	*hard* 'katai'	*noisy(2)* 'yakamashii'	*sweet* 'amai'	*stinking(1)* 'kinakusai'
red 'akai'	*soft* 'yawarakai'	*noisy(3)* 'sawagashii'	*bitter* 'shibui'	*stinking(2)* 'kusai'
black 'kuroi'	*hot* 'atsui'	*quiet* 'shizukana'	*hot* 'karai'	*smelly* 'namagusai'
white 'shiroi'	*cold* 'tsumetai'	*loud* 'kandakai'	*sour* 'suppai'	*fragrant* 'koubashii'

Participants were asked to evaluate how easily they understand each metaphor. The ratings were made on 7-point scale ranging from -3 (very difficult) through 0 (not sure whether difficult or easy) to +3 (very easy). They were also asked to evaluate how conventional they felt each metaphor to be. The ratings were made on a 7-point scale from -3(not at all conventional) through 0 (not sure whether convention) to +3 (highly conventional). We selected metaphors with mean value from -2.0 to +2.0 in both scales. This procedure reduced the possibility that differences of cognitive effects evoked by synesthetic metaphors could result from differences of accessibility or conventionality among materials used for the experiment. As a result 158 Japanese synesthetic metaphors were chosen as materials used for the experiment.

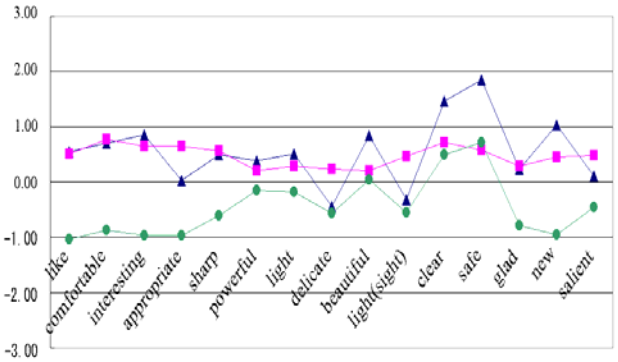
Procedure

3267 participants were classified into 10 groups. 18-20 linguistic expressions were assigned to each group. The linguistic expressions assigned to one group were randomly assigned to each participant in that group (e.g., linguistic expressions assigned to group 1 were randomly assigned to each participant belonging to group 1).

Participants of group 1 and 2 were each assigned 18 adjectives and nouns and the remaining 8 groups were assigned 19 or 20 metaphorical expressions per participant. They were asked to rate the assigned expressions against the following 15 SD scales; *dislike – like, uncomfortable – comfortable, not interesting – interesting, not appropriate – appropriate, dull – sharp, weak – powerful, heavy – light, coarse – delicate, ugly – beautiful, dark – light, unclear – clear, scary – safe, sad – glad, old – new,* and *not salient – salient*. The ratings were made on a 7-point scale ranging from -3 through 0 to +3. We regarded the value -3 as the negative semantic pole and the value +3 as the positive semantic pole.

Result

Figure 2 shows an example of the mean values of vehicle, topic and metaphor of *red voice* 'akai koe'.



△: vehicle □: topic ○: metaphor

Figure 2: an example *red voice* 'akai koe'

We classified all the mean values of vehicles and topics rated on the 15 SD scales into T=V, T<V, and T>V, considering the APG predictions given in Table 1. Using t-test (two-tailed, the alpha level .05), we regarded the cases which have no significant difference between the mean value of T and V as T=V. The other codes such as T<V and T>V fall to the cases which have significant differences between the mean values of T and V. The total number falling under each classification is given as 'sum' in the far right column of Table 3.

In order to compare the actual semantic changes resulting from our experiment with the semantic changes predicted by APG model, we classified the actual semantic changes resulting from our experiment as shown in Table 3. We conducted t-test (two-tailed, the alpha level .05). We regarded the cases which have no significant difference between the mean values of T and metaphor as 'no change' (0) and the cases which have significant differences between them as changes either to the negative pole (-) or to the positive pole (+).

Table 3 shows the comparison between the predicted semantic changes and the actual semantic changes observed through our experiment.

Table 3: Comparison between predicted semantic changes and actual semantic changes

semantic intensity	predicted change	actual change			sum
		0	+	—	
T=V	0	331	17	261	609
T<V	+	366	230	76	672
T>V	-	119	9	961	1089
sum		816	256	1298	2370

numbers = cases of SD scales

As for the cases which were predicted as no change (0), the proportion of the cases showing the same change as the APG prediction was significantly higher than that showing change different from the APG prediction, χ^2 (1, N=609) = 4.612, $p < .05$. Among the cases which showed change different from the APG prediction, the proportion of the cases showing the change to - was significantly higher than those which showing the change to +, χ^2 (1, N=278) = 214.158, $p < .001$.

As for the cases which were predicted to change to +, the proportion of the cases showing the same change as the APG prediction was lower than that showing the different change, χ^2 (1, N=672) = 66.881, $p < .001$. This finding suggests that actual semantic changes do not obey the prediction of changing to +.

As for the cases which were predicted to change to -, the proportion of the cases showing the same change as the APG prediction was significantly higher than that showing the different change, χ^2 (1, N=1089) = 637.180, $p < .001$. This result suggests that actual semantic changes obey the prediction of changing to -.

In order to see the tendency for synesthetic metaphors to evoke positive or negative effects, we classified all the cases showing different changes from the APG prediction either into positive effect or negative effect. The cases showing no change as against the prediction of changing to - were regarded as evoking a weakly positive effect, and were classified into the positive effect category in the same way as those which changed to + against the prediction of changing to -. The cases showing no change against the prediction of changing to + were regarded as evoking weakly negative effect, and were classified into the negative effect category in the same way as those which changed to – against the prediction of changing to +. As a result, 848 cases which showed changes different from the APG prediction were classified into 145 positive effect cases and 705 negative effect cases. A Chi-square test showed that the cases showing negative effect were significantly more frequent than those showing positive effect, χ^2 (1, N=848) = 367.175, $p < .001$. This result suggests that semantic interactions between vehicle and topic of synesthetic metaphors tend to evoke a negative effect.

In addition, we analyzed the tendency of negative effect among the types of synesthetic metaphors. Table 4 shows the number of cases classified either into positive effect or negative effect.

Table 4: Comparison among the 5 types of synesthetic metaphors

	positive effect	negative effect	sum
color	4	312	316
touch	47	84	131
sound	41	64	105
taste	19	145	164
smell	34	98	132
sum	145	703	848

numbers = cases of SD scales

A Chi-square test with Bonferroni correction (the alpha level .005) were conducted among the five types of synesthetic metaphors.

The result showed that synesthetic metaphors created from adjectives denoting 'color' evoked the most negative effect. They evoked significantly more negative effect than the other four types of synesthetic metaphors, χ^2 (1, N=447) = 109.763, $p < .001$ for color vs. touch; χ^2 (1, N=421) = 117.848, $p < .001$ for color vs. sound; χ^2 (1, N=480) = 25.203, $p < .001$ for color vs. taste; χ^2 (1, N=448) = 71.947, $p < .001$ for color vs. smell. Differences among color adjectives, *yellow* 'kiiroi', *blue* 'aoi', *red* 'akai', *black* 'kuroi', and *white* 'shiroi', were not observed.

The second most negative effect was observed for synesthetic metaphors created from adjectives denoting 'taste'. They evoked significantly more negative effect than 'touch', 'smell' or 'sound'; χ^2 (1, N=295) = 24.746, $p < .001$ for taste vs. touch; χ^2 (1, N=296) = 9.993, $p < .005$ for taste vs. smell; χ^2 (1, N=269) = 27.859, $p < .001$ for taste vs. sound. The negative effects were especially observed among synesthetic metaphors created from *sour* 'suppai', *bitter* 'shibui', and *hot* 'karai'.

Significant defferences among synesthetic metaphors created from adjectives denoting 'touch', 'sound', and 'smell' were not observed; χ^2 (1, N=236) = .250, $p = .617$ for touch vs. sound; χ^2 (1, N=263) = 3.160, $p = .075$ for touch vs. smell; χ^2 (1, N=237) = 4.775, $p = .029$ for sound vs. smell. As for 'touch', synesthetic metaphors showing negative effect were observed more frequently among those created from *hard* 'katai' and *cold* 'tsumetai' than those created from *light* 'karui', *soft* 'yawarakai', and *hot* 'atsui'. As for 'smell', the negative effects were observed among those created from *stinking (1)* 'kinakusai', *stinking (2)* 'kusai', and *smelly* 'namagusai'.

Discussion

The possibility of cognitive universality

Our research showed that synesthetic metaphors tend to evoke a negative effect. The most negative effect was evoked by synesthetic metaphors created from 'color'. This result is interesting because according to Sakamoto (2005) and Wierzbicka (1996) color adjectives such as *yellow* 'kiiroi', *blue* 'aoi', *red* 'akai', and *white* 'shiroi' themselves do not have explicit negative meaning. Wierzbicka (1996) states, for example, that the meaning of yellow is based on our experience of something yellow like the sun, and the meaning of blue is based on our experience of something blue like sky.

The result of our research is not accidental and is consistent with Sakamoto (2005). Sakamoto (2005) analyzes meanings of composite expressions of nouns modified by color terms (red, blue, yellow, black, and white) collected from a Japanese corpus containing literary texts. She found a number of Japanese color metaphors whose meanings are not predictable from those typically associated with color terms pointed out by Wierzbicka (1996). The result suggests that color terms tend to modify nouns with negative images and color metaphors emphasize negative images. To verify the result of corpus-based analysis, she conducted psychological experiments using Japanese color metaphors composed of nouns with neutral images. Japanese respondents were asked to name images associated with those color metaphors and their answers were compared with images evoked by color terms. Results showed that color metaphors were associated with negative and different images from those of color terms.

Previous studies indicate that this tendency of synesthetic metaphors created from 'color' adjectives is not peculiar to Japanese. Sakamoto (2003 and 2005) analyzes German 'color' metaphors collected from German poetry by Georg Trakl (Trakl, 1964). Trakl uses colors in a very striking way throughout the poem. The followings are examples of color metaphors created from *blue* 'blau' in German; *the blue cry* 'die blaue Klage', *in the blue evening the figure of the dead* 'im blauen Abend der Toten Gestalt', the blue bell ring of the evening 'die blaue Glocken des Abends', and *A blue animal is scared of death* 'Ein blaues Tier will sich vorm Tod verneigen'. These expressions emphasize negative images working in negative contexts (e.g. about death). The last example evokes metaphorically negative image by describing an animal as blue. The following examples are of color metaphors created from white 'weiß'; *white sorrow* 'weiße Traurigkeit', *The white voice talked to me: Kill yourself!* 'Die weiße Stimme sprach zu mir: Töte dich!', and *The white offsprings dark future…* 'Die weißen Enkel dunkle Zukunft…'. These expressions also emphasize negative images working in negative contexts (e.g. about death). The followings are examples of color metaphors created from deep red 'purpurn'; *deep red plague* 'purpurne Seuche', *The deep red curses* 'Die purpurnen Flüche', *in deep red dreams pain and agony* 'in purpurne Träume Schmerz und Plage', *gloom and deep red laugh* 'Schwermut und purpurnes Lachen', and *the deep red sufferings* 'die purpurnen Marten'. These expressions also emphasize negative images.

These German examples suggest that the negative cognitive effect evoked by synesthetic metaphors created from 'color' adjectives could be universal. The result of our research suggests that cognitive effects of synesthetic metaphors are worth exploring for various languages.

In what processes are the cognitive effects evoked?

In this paper we have shown that semantic interactions between vehicles denoting different perceptual domains and topics of synesthetic metaphors tend to evoke negative cognitive effect and that there were differences among the types of synesthetic metaphors. This raises the question as to why and in what processes such cognitive effects are evoked.

One possible explanation for differences among the types of synesthetic metaphors would be accessibility different among the types of synesthetic metaphors studied by many previous studies. According to Ullmann(1967)'s thesis of directionality, a metaphor with a source domain lower in the hierarchy of sense modalities than the target domain should tend to be cognitively more accessible than a metaphor with the reverse direction of domains. Figure 3 shows the directionality proposed by Williams (1976).

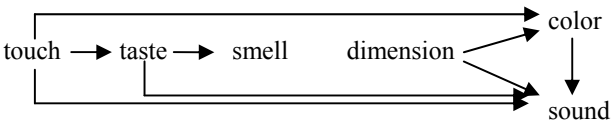


Figure 3: Directionality of synesthetic metaphors

Our finding that the 'color' synesthetic metaphors evoke the most negative effect may be related to the fact that color is located in the highest position of the hierarchy. However, the second most negative effect was evoked by synesthetic metaphors created from 'taste', which is located in a low position in the hierarchy. Furthermore, in our pre-experiment we asked participants to evaluate how easily they understand the metaphors proposed for the experiment materials. The ratings were made on 7-point scale ranging from -3 (very difficult) through 0 (not sure whether difficult or easy) to +3 (very easy). We also asked them to evaluate how conventional they felt the proposed metaphors. The ratings were made on 7-point scale from -3(not at all conventional) through 0 (not sure whether convention) to +3 (highly conventional). We selected metaphors with mean value from -2.0 to +2.0 in both scales. Through this procedure we reduced the possibility that differences of cognitive effects evoked by synesthetic metaphors could result from differences of accessibility or conventionality among materials used for the experiment. Therefore, different effects evoked by the five types of synesthetic

metaphors cannot be explained by differences in acceptability among the types of synesthetic metaphors.

Various theories such as categorization theory (Glucksberg, 2001; Glucksberg & Keyser, 1990) and comparison theory (Gentner, 1983; Gentner et al., 2001) are proposed to explain the mechanism of metaphor comprehension. We believe that one probable theory that can explain the processes in which the cognitive effects of synesthetic metaphors are evoked would be a two-stage categorization theory proposed by Utsumi & Sakamoto (2007a) and (2007b). The intuitive idea behind two-stage categorization is that correspondence between the properties literally expressed by the adjective and the properties to be mapped onto the target concept would be indirect, mediated by an intermediate category, rather than direct as predicted by the categorization theory. The argument is tested by means of computer simulation in which three algorithms for adjective metaphor comprehension, i.e., two-stage categorization, categorization and comparison, were compared in terms of how well they mimic human interpretation of adjective metaphors. The simulation result was that the two-stage categorization theory is a more plausible theory of adjective metaphors than other theories. Since the synesthetic metaphor is a kind of adjective metaphor, cognitive effects of synesthetic metaphor could be evoked in some processes of two-stage categorization.

Conclusion

In this paper we analyzed how semantic interactions between vehicle and topic of synesthetic metaphors function to shift the meanings of words to the positive pole or negative pole. We have shown that synesthetic metaphors, especially synesthetic metaphors modified by color adjectives, tend to evoke negative images, which contradicts the rules predicted by APG model. We hope that this research sheds new light on cognitive studies of synesthetic metaphors and studies of metaphor comprehension.

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