A Phenomenological Model for Generating the Tasting Description of Japanese *Sake*

Hiroki Fukushima
Keio University, Japan

ABSTRACT

In this chapter, the author proposes a multifaceted representation model for the sensory domain of taste, especially the taste of sake. The author aimed to bridge the domain of taste and the domain of words, and, on the basis of the findings of the first-person-singular study, proposed that the pictorial description, together with the verbal description, can achieve the aim. As the results of the study, the author found the difference between the manner of description of the PTG (Primary Taste Group for sake: sweetness, umami, and acidity) and the STG (Stimulus Taste Group: astringency and dryness). The PTG tends to be described in curvy Shapes; in contrast, the STG tends to be represented in linear Patterns.

INTRODUCTION

The description process (typically by sommeliers) of tastes and odors is widely thought to involve the following assumptions:

1. The wine has some flavors,
2. The taster detects the flavors via olfactory receptors,
3. The taster selects one of the flavors,
4. The taster identifies the exact word for the flavor.

This can be called "a binomial model of the sense and the expressions," which leads to a myth: There would be a "right perception" and a "right expression." However, in actual situations, our perceptual representations of taste or smell are often vague, and a set of verbal expressions is not given. In this paper, we adopt a phenomenological model that claims that the taste of the *sake* does not exist in the *sake* itself: It *appears* or *arises* between *sake* and the subject (taster) as a personal image. In other words, the object (in this case, the taste of *sake* in the real world) cannot exist independently of the subject (the taster). In this paper, the author tries to deal with not the object itself, but the "experienced representation of the

object" from a first-person point of view, which highlights "my tasting experiences" as "I taste something." This paper seeks to develop a multi-faceted model for generating tasting representations.

BACKGROUND

The studies of the narrative are expanding toward various neighboring domains. shows the expanding structure of the narratology as "A comprehensive framework for research in narrative generation." In the framework, Ogata classifies the research into four phases; the Narrative generation systems, Interdisciplinary narratology, Narratological approaches to various fields, and Related studies in the broadest sense.

This study is an attempt and an illustration of the analyzation of the multi-faceted narratological description of the sensory information. More specifically, the aim of this study is to show the relationships between the two modes of description – the verbal description and the pictorial description – of the sense of taste. This study would be classified into the "Narratological approaches to various fields" in the Ogata's framework.

Among the inter-disciplinal domain of narratology, one of the most living areas would be the cognitive narratology. A series of cognitive scientific studies by Kanai et al. (Kanai & Kodama, 2010; Kanai & Ogata, 2004a, 2004b) has tried to reveal the relationships among story, non-story, or discourse, especially in films.

The author's study can be lined up in these cognitive narratological studies. Yet, the study presented in this chapter deals with rather lower – sensory level– cognition.

A natural language is generally an audiovisual-dominant symbol system. It categorizes the world into words: Cats are differentiated from dogs, which, in turn, are differentiated from wolves. Cats, dogs, and wolves are grouped together as a category of animals, which is different from fruit, which includes apples and oranges. Thus, a language operates according to the principle of differentiation. The principle works strongly or weakly in different domains because each domain has its intrinsic discriminable power. The discriminability of the sensory perception of taste is considerably weak, and thus, the number of words that name tastes directly is limited to not more than 10 words in the case of Japanese; these are the words for the *five basic tastes*, *astringency*, and *dryness,* plus a few words for complex tastes like *koku* (or '*rich taste*').

It can be said that producing the representations of taste has two difficulties: the lack of discriminability or differentiation and the lack of expressions for the domain of taste. However, the door to the verbal expression of the taste is not completely shut.

Majid and Burenhult (2014) did a study with speakers of Jahai (a language spoken by hunter-gatherers in the Malay Peninsula) and suggested that the long-held assumption that people are bad at naming smells is not universally true. Jahai has a dozen different words to describe smells of different qualities. In a comparative study, Majid and Burenhult found that Jahai speakers were better able to name odors differentially and concisely than their English-speaking counterparts. On the basis of the results, they claim that odors are expressible in language, as long as one "speaks the right language." What is, then, "the right language" to describe the sensory perception of taste?

The ability to verbalize taste is not exclusive to sommeliers and other professionals, but the question is: How do people bridge the gap between the sense of taste and the language they use? In other words, what kind of strategies do they employ to express something hard to verbalize?

When people describe tastes, it is a common strategy to say "taste *like a* banana." This strategy, even used by specialists like sommeliers, suggests that we tend to turn to a different source ("banana" in this case) (Wilson & Stevenson, 2006). Seto et al. (2003) collected a vast amount of expressions used to describe the perception of taste and smell, and showed that the number of expressions describing those perceptions directly is very limited, and that the metaphorical expressions are pervasively used instead.

In studies investigating the relationship between sensory perceptions and linguistic expressions, the notion of metaphor has been used in a broad sense, including similes (e.g., taste like a banana), the onomatopoeias or sound symbolic expressions (e.g., crispy), shapes expressing non-shape targets (e.g., a

"round" taste), synesthetic expressions (e.g., smooth taste), or other expressions based on other sensory domains. The important function of metaphors is using the information or knowledge of the other domain (the source domain) for understanding the target domain.

It seems that metaphor-based studies thus far have tended to focus on the relationship between the inter-sensory domains (e.g., the relationship between the olfactory domain and the tactile domain). In this study, the author is interested in a more holistic multi-faceted representation of taste, which combines both verbal and nonverbal representations. The combined representation takes the form of pictures.

MAIN FOCUS OF THE CHAPTER

Taste is not a set of elements. When we taste something, we taste it as a whole. There are some salient characteristics in the taste, and people detect them as the defining features of the taste. When we say "Something is sweet and sour," sweetness and sourness come to us as salient tastes. However, sweetness and sourness do not exhaust the taste we experience. In this paper, the author proposes a multi-faceted model for generating the tasting descriptions of *sake*.

The cognitive process of taste is embedded in the higher cognitive functions. Hence, the model includes not only the sensory domain, but also various other domains such as the verbal domain, the non-verbal domain, the instrumental domain as the extension of the body, and so on (see Figure 1).

Figure 1. The multi-faceted model for the tasting description

    In Figure 1, the domains are described separately. Yet, taste is something one experiences as a whole. Thus, one cannot be able to say that one domain is superordinate or subordinate to the other. Neither can one say that domain A includes domain B as a subset. In describing the taste of *sake*, we cannot resort only to sound symbolism characteristics of the auditory domain. The author argues that pictorial descriptions, complemented by verbal descriptions, can embrace the multi-faceted nature of *sake* tasting. A salient tasting feature is easily detected when one drinks a *sake*. For example, acidity may stand out in a certain *sake*. In that case, one may draw a picture with a thorn (or a *thorn* pictorial) along with some verbal explanations. The multi-faceted nature of *sake* tasting assumes that there can be multiple salient features or dots occurring simultaneously when one drinks a *sake*. A *thorn* pictorial is an intuitive representation of the experience of drinking a given *sake*. If the *thorn* representation has a structure, it is not a tree structure, but rather, it is a "semilattice structure" (Alexander, 1966). Alexander (1966) illustrates the difference as in Figure 2:

Figure 2. The tree structure and the semilattice structure (Alexander, 1966)

In Figure 2, the one on the left is a semilattice structure, in which there are no a priori links between dots, but there are only *potential possibilities* to link. The relationships *appear, arise or emerge* as the result of the action (i.e., the tasting of a *sake*).

The Pictorial Representations and the Verbal Representations

In this section, the author offers a way of generating the tasting descriptions of Japanese *sake*. In order to capture the multi-faceted nature of tasting, verbal representations alone do not suffice. Our proposal is that the primary way of describing taste should be pictorial representations. The representations dealt with in this study are not objective or static ones that can be measured through sensory techniques. Tasting a *sake* is a subjective experience, and describing the taste should be subjective, accordingly. This is why we call this approach "the first person singular approach." The act of describing the taste of *sake* requires the aggregate of the descriptions of the dynamic process—our sense-making process of every cup of *sake* that changes its face every time we drink.

In the following experimental study, the author himself became the participant or informant, and the analyst of the data produced by the participant. The informant produced a drawing or what we call "pictorial representation" and verbal descriptions every time he drank a *sake* of a different kind. The drawing and the accompanying words (verbal descriptions) together represented the experienced taste of *sake* on the part of the informant. Drawings are not conventionalized codes and may look quite arbitrary to a third person. There are no rules about how to analyze them. In other words, the informant has to become the analyst in order to make sense of the representation produced by the informant. This first-person-singular approach is appropriate when the top-down cognitive process is dominant, and the individual differences in terms of the conditions of tasting (i.e., the capacity of the oral cavity, or the way of moving tongues, etc.) influence the sensation of taste.

Methodology

Procedure
More specifically, the multifaceted descriptions of the taste of *sake* were given in the following steps:

Step 1: To write the basic data [brand name, the date of drinking] of *sake*.
Step 2: To taste a brand.
Step 3-a: To write some verbal description of the taste impressions.
Step 3-b: To draw a pictorial description(s) of the taste impressions (Some notes are added to the drawing to clarify the intended meaning of the drawing).
Step 4: To write additional data (e.g., the degree of confidence of the description).

Figure 3 is an example of the multifaceted description of the perceived taste of a *sake*.

Figure 3. An example of the multifaceted description of the taste of a sake (the brand = Tedorigawa; the date = March 3, 2017)

This pictorial description itself is unintelligible to a third person. For one thing, words are given in Japanese. In this paper, the author translates Japanese descriptors (within the pictorial description) into English when needed. Another, more serious, reason is that the drawing(s) are open to interpretation. As shown in the following section, a post-hoc analysis of drawings showed that there were certain elements identifiable in the drawings produced to describe the tastes of different *sakes*. With those elements, the author-analyst is able to minimize the arbitrariness of interpretation.

The Elements of the Pictorial Descriptions

Table 1 shows a summary of the elements of the pictorial descriptions the author-informant produced.
    The descriptions can be generally classified into Line, Shape, Form and Pattern as shown in the rightmost column of Table 1. Lines can be either straight or curved, where straight lines include line segment, angle, and straight arrow, and curved lines are classified into wave lines, free curves, and curved arrows.
    The classification of shape is for the 2D figures including circle, oval, free liner shape, free curve shape, solid arrow, and thorn shape. For 3D figures, the author set a class of form, which includes sphere, curvy 3D form, and form of cloud. In addition, there are some descriptions as patterns: the pattern with dots, the pattern with lines, the pattern with curves, the pattern with scribbles, the pattern with chevrons, and the pattern filled in by a color.

Table 1. The elements of pictorial descriptions

Element	Property	Example
Line	Straight	line segment angle straight arrow
	Curve	wave line free line curved arrow
Shape (2D)		circle oval free liner shape free curve shape solid arrow thorn
Form (3D)		sphere curve form cloud
Pattern		dots

		lines scribble chevron curve filled in

The Semantic Features of the Pictorial Description

If there is a set of elements in the pictorial descriptions, then what does each element mean? As regards this question, the author found three major types of semantic features:

- Element of taste
- Symbolic description of taste
- Outline of taste

These features basically represent the expressions of the perceived tastes of *sake* in terms of the possible shapes of the mouth. Some semantic features describing additional information (not the taste itself) were also found. Those features are related to:

- Direction
- Axis
- Timeline
- Movement
- Power
- Part of the body
- Indication
- Point of view

Let us illustrate with the drawings of *Tedorigawa* (a brand name of *sake*) in Figure 4. As shown in the figure, we can identify seven elements: shape (oval), line (curved arrow), pattern (scribble), part of the body (line showing the tongue), pattern (pattern with lines), movement (movement to the throat [line]), and axis (front-to-back movement in the mouth [arrow]).

Figure 4. Example of the elements of the pictorial descriptions (the brand = Tedorigawa)

The semantic features that the author offered here would contribute to answering the question of "what is described by an element." For example, the oval shape within the drawing represents the nature of taste, and the scribbles show a taste of "woody astringency."

The Roles of the Pictorial Descriptions and the Verbal Descriptions

In the preceding section, the author proposed a set of elements and semantic features for analyzing the pictorial descriptions. Verbal descriptions are also important indicators of the taste of a *sake*. In this section, as a step toward the analysis of the relationships of the multiple representations, the author analyzes the relationships between the pictorial descriptions and the verbal descriptions. The relationships that the author focus on here address the following question: What is described verbally, and what is described pictorially?

Descriptions of the taste of *sake* can be made a) pictorially and verbally, b) only pictorially, or c) only verbally. Table 2 shows four possible cases of descriptions. A is a case where verbal descriptions are also shown pictorially; there is a correspondence between a verbal descriptor and its pictorial drawing. B is a case where verbal descriptions are not expressed in the pictorial representation given by the informant, while C is a case where only pictorial descriptions are given and there are no corresponding verbal descriptions. D contains neither drawings nor verbal descriptions, and is irrelevant here. In this paper, the author compares A and B.

Table 2. The relationships between pictorial description and verbal description

		Verbal Description	
		Described	Not Described
Pictorial Description	**Described**	A	C
	Not Described	B	D

In order to examine the differences and the characteristics of A and B, the author divided all the verbal descriptions manually into two parts (see Table 3). The dividing process is based on the one-to-one correspondence of a word to an element of the picture. Thus, the extracted sentences are not complete sentences; hence, the "Number of Sentences" of case A and case B are blanked in Table 3.

Table 3. The verbal descriptions in cases A and B

	All Data	Case A	Case B
Tokens	5,551	2,558	2,918
Types	1,053	597	745
Number of Sentences	125	-	-
Number of Brands of *Sake*	58	58	58
Average Frequency	2.80	2.33	2.13
Frequency SD	5.87	4.11	3.78

In this study, the characteristic words of the two cases were determined using the Jaccard coefficient method. The Jaccard coefficient measures the similarity between finite sample sets and is defined as the size of the intersection divided by the size of the union of the sample sets:

Jaccard Coefficient: $(X \cap Y) / (X \cup Y)$
X: The frequency of the word "X"
Y: The frequency of the word "Y"

The Jaccard index takes a value range from 0 to 1 (0% to 100%): The higher percentage, the more similar the two word sets. For data analysis, the author used the KH Coder (Higuchi, 2004) as a coding and calculating tool.

General Tendency

In this section, referring to the Jaccard index, the author examines the general tendency of the characteristic words in case A and case B. In this study, the words that take over 0.075 of Jaccard index are regarded as characteristic words. Table 4 and Table 5 list the characteristic words in case A and case B, respectively.

Table 4. The characteristic words in (case A)

	Words (Japanese)	PoS	Total Freq.	Freq. in (A)	Jaccard Index
1	tongue (shita)	noun	55	37	0.446
2	spread (hirogaru)	verb	18	15	0.221
3	last (saigo)	noun	24	15	0.203
4	back (oku)	noun	21	14	0.194
5	surface (hyomen)	noun	13	12	0.171
6	mouth (kuchi)	noun	17	12	0.157
7	center (chushin)	noun	16	11	0.134
8	tip of tongue (shitasaki)	noun	11	9	0.129
9	Alcohol (arukooru)	noun	14	9	0.123
10	Nose (hana)	noun	17	9	0.119
11	come in (hairu)	noun	10	8	0.119
12	astringency (shibumi)	noun	10	8	0.114
13	throat (nodo)	noun	13	8	0.113
14	acid (san)	noun	14	8	0.113
15	astringent (shibu)	noun	14	8	0.108
16	entrance of the throat (nodomoto)	noun	7	7	0.105
17	shape, form (katachi)	noun	9	7	0.105
18	space (kuukan)	noun	7	6	0.091
19	expand (nobiru)	verb	8	6	0.090
20	mid point (man-naka)	noun	6	5	0.076
21	round (marui)	adj	6	5	0.076
22	wave (yureru)	verb	6	5	0.076
23	hard (katai)	adj	6	5	0.076
24	keep (tamotsu)	verb	6	5	0.076
25	go up (agaru)	verb	6	5	0.076

Note.[1]

Table 5. The characteristic words in (case B)

	Words	PoS	Total Freq.	Freq. in (B)	Jaccard Index
1	taste (aji)	noun	56	29	0.341
2	feel (kanjiru)	verb	29	16	0.225
3	acidity (san)	noun	24	13	0.188
4	umami (umami)	noun	25	13	0.186
5	feeling (kanji)	noun	11	10	0.170
6	swallow (nomikomu)	verb	11	9	0.150

7	sweetness (amami)	noun	17	9	0.136
8	think (omou)	verb	9	8	0.136
9	stay (nokoru)	verb	8	7	0.119
10	outline (rinkaku)	noun	14	7	0.108
11	drink (nomu)	verb	6	6	0.103
12	feeling (inshou)	noun	7	6	0.102
13	sake (sake)	noun	8	6	0.100
14	clean (kirei)	adj	8	6	0.100
15	sweet (amai)	adj	8	6	0.100
16	rice (kome)	noun	8	6	0.100
17	little (sukoshi)	adv	9	6	0.098
18	umamiful (umai)	adj	10	6	0.097
19	fizzy (happou)	noun	11	6	0.095
20	upper side (ue)	noun	12	6	0.094
21	tranceparency (toumei)	adj	12	6	0.094
22	flavor (kaori)	noun	12	6	0.094
23	dence (koi)	adj	6	5	0.085
24	thought as (omoeru)	verb	6	5	0.085
25	go through (nukeru)	verb	8	5	0.082
26	light (karui)	adj	9	5	0.081

Note.[2]

In these tables, words are classified according to their parts of speech: nouns, verbs, and adjectives. In the below, the author takes a closer look at the function of nouns and verbs.

Nouns for Taste

A main function of nouns in the tasting descriptions can be thought as pointing out the element of the tastes of a *sake*. Beside the verbal descriptions, the element of taste is described in the pictorial descriptions. A comparison of Table 4 and Table 5 shows that there are clear differences between the high frequency words in the two cases. The following is the list of the salient words for taste drawn from Table 4 and Table 5.

Case A: *Alcohol, Astringency, Acid, Astringent*
Case B: *Taste, Acidity, Umami, Sweetness, Flavor*

In the tasting descriptions of *sake*, the feeling of "alcohol" can be interpreted as "dry taste." In the case of wine, the taste of *astringency* (*tannic taste*) is one of the most important tastes that gives wines some "*body*." As for *sake*, on the other hand, the *astringency* is basically an undesirable taste, and it has traditionally been thought of as one of the "off-flavors." Recently, especially the past 10 years or so, a little bit of *astringency* in *sake* has become welcomed by *sake* fans, for it can make the *outline* of *sake* clearer.

From the comparison of the salient words as mentioned above, it can be inferred that the elements of taste that are described both pictorially and verbally (case A) do not refer to the fundamental taste of *sake*. On the other hand, the elements described only verbally (case B) directly refer to the primary elements for the taste of *sake*. *Sake* is made of rice, and hence, the *sweetness* of the sugar of rice and the *umami* from fermented rice is the primary elements of the taste of *sake*. Both sweetness and umami appeared in case B.

The *astringency* and *alcohol* (*dry taste*) are not included in the basic five tastes (sweet, sour, salty, bitter and umami); rather, they are "mouth feelings" or stimuli in the mouth. Those characteristics are

often described along with a pattern with *lines* (see Figure 5). The words "acid" and "acidity" are semantically related, and yet, there is a difference in describing the taste of *sake*: The word *acid* in case A describes "acid as the perceived stimulation," and *acidity* in case B means "the acidity as the experienced taste."

Figure 5. Tasting descriptions of Fukumitsuya

Figure 6. Tasting descriptions of Sohgen

It is not common or possible to draw pictures about the nature of taste when one tastes sweetness or umami. As shown in Figure 6, the taste of sweetness or umami is described verbally, and the drawing only shows the position or movement or shape of the taste.

The author draws a tentative conclusion that the taste itself is conceptualized verbally rather than pictorially, and that the mouth feels, or the stimulating tastes can be described, pictorially along with verbal descriptions.

Nouns for Space and Body Parts

Of the words used to describe the taste of *sake*, let us take a look at the words of high frequency relating to space and the body part. Here again, a comparison is made between the two cases A and B.

Case A: *Tongue, Back of-, Surface, Mouth, Center, Tip of tongue, Nose, Throat, Entrance of throat, Middle point*
Case B: *Upper side*

These words are often used together as in "I feel white astringency on the *surface of the tongue,*" and "The sweet flavor spreads into the *back of the nose.*"

Some descriptions consisted of only the figure of taste, and others included the body parts independently of the figure of taste. Thus, the body parts can be described both verbally and pictorially. Still, there are some differences in the method of description. The pictorial descriptions intuitively show the point or position of the mouth.

For example, in the pictorial description of Figure 7, the midpoint of the *tongue* and the *throat* is covered with the *patterns of lines*. The verbal description corresponding to this was "around the back side

of the root of the tongue." The author has identified more than 100 expressions (such as *tongue, back of the tongue, middle point of the tongue*…) for indicating body parts (especially points in the mouth and nose) in the verbal descriptions.

Figure 7. Tasting descriptions of Kaga no Tsuki

Verbs

The characteristic verbs for each case (A and B) are the following:

Case A: *Spread, Expand, Wave, Keep, Going up*
Case B: *Feel, Swallow, Think, Stay, Drink, Thought as, Go through*

The number of verbs is limited, but one can identify some tendencies in their function. In case A, the characteristic verbs (e.g., spread, going up) represent the "movement" of the taste in the mouth. In contrast, the characteristic verbs (e.g., swallow, drink) of case B represent the "action" of the body or the impression of the taste. The movement of the taste can refer to the changing process of tasting in time and space.

The author suggests that sound symbolic expressions are also used for modifying the changing process (Fukushima et al., 2016). For example, Japanese "fuwatto," which roughly means "softly," is a highly symbolic word that goes with "hirogaru" ("spread"), thus saying "fuwatto hirogaru" (spread softly).

Thus, these findings suggest that the multiple descriptions (i.e., sound symbolism, drawings, verbal descriptions) can be strategically applied in order to represent rather abstract referents such as movements or changing processes of the taste.

The Multiple Descriptions of Taste

On the basis of the preceding discussion, the author examines the detailed relationships between the verbal description and the pictorial description in more detail in this section.

In order to show the relationships between the two descriptions, the author examined the correspondence of the element of taste and the element of the picture (i.e., what element of taste is described as what element of the picture). In Figure 8, acidity goes with E1 (circle shape), "sweetness" goes with E2 and E3 (circle shape and pattern with lines), and "astringency" goes with E4 (scribbled pattern).

Note that, as illustrated in Figure 8, one taste can be described by multiple elements (i.e., E2, E3); thus, the number of elements is more than that of the element of taste.

Figure 8. An example of the multiple elements (brand: Ibuki)

In total, 175 pictorial elements for taste were detected. The tastes were classified into *sweetness*, *umami*, *acidity*, *astringency*, *dry*, *salty*, *bitter*, *fizzy*, *aging*, *flavor*, *fruity*, and *roast*. Here, the synonyms or inflection word types are integrated into one cover term (e.g., *dry*, alcohol to "*dry*")[13]. Figure 9 shows the correspondence matrix between the elements of pictorial description and the words of taste.

From the matrix in Figure 9, the tastes of *sweetness*, *umami*, and *acidity* seem to have common patterns. The tastes of astringency and dryness also seems to share the patterns. Thus, the author identifies the two groups; PTG (the Primary Taste Group) for *sweetness*, *umami*, and *acidity* and STG (the Stimulating Taste Group) for astringency and dryness. Words describing other tastes were rarely used, and hence, they are excluded from the grouping.

The composition rates (%) of each group are shown in Figure 10. The two graphs here show contrasting differences in the elements of Shape and Pattern. The difference can be summarized as follows:

1. **PTG:**
   a. *Shape (57%)*, especially in *free-curve* shape, is mostly frequently used.
   b. *Sweetness* and *acidity* are often represented as *ovals*.
   c. Other frequent shapes include *curve*, *curved arrow*, and *scribbled* pattern.
   d. Curvy figures tend to be preferred.

2. **STG:**
   a. *Pattern* (58%), especially the *line pattern* and *scribbled* pattern, is most frequently used.
   b. *Dry* is described mainly in the *thorn* shape, *line* pattern, and *scribbled* pattern.
   c. Linear shape tends to be preferred.

Figure 9. Matrix of the frequency of the taste and the elements of the drawings

Figure 10. The composition rates of the elements of the PTG and STG

FUTURE RESEARCH DIRECTIONS: APPLICATION

As an application of this study, the author is interested in the narratological domain of human creativity aid. Some fundamental studies on the method and the theory of narrative generation model applying human creativity aid (Hori 1994, 2004, 2007). In this section, the author attempts to offer a creativity aiding strategy for generating the descriptions of the sense of taste.

We express what we experience. Some experiences are easy to describe and some are otherwise. The author assumes that tasting is a difficult area to describe. One is satisfied with what one tastes, feeling that one does not need to put the experience in words. However, there is an interplay of experience and expression: Expression can enhance experience, and vice versa. This suggests that learning how to express increases the discriminating power when one tastes something. If so, it is worthwhile to devise a way of expressing one's taste.

In the training for sommeliers, the most basic practice is to name the flavors of the various objects. Using a real object or a set of flavor chips, sommeliers practice pointing out the correspondence of the flavors and names. As for the language system, this flavor-identification process corresponds to the categorical function of the noun. However, even if a sommelier can name all of the elements of the taste with a full set of nouns, that sommelier cannot explain the events occurring in his or her mouth. In order to give an account of the taste as events, the verbs are indispensable.

One of the most important functions of verbs is to describe the changings of an object in time and space. Additionally, verbs have a role of describing the relationships of objects. Without these functions, the descriptions for taste would be a mere enumeration of comments, such as "there are tastes of…," or "I feel the taste of…."

Yet, how to use verbs to help people describe the taste of something is an open question. In this paper, the author argues that drawings are an effective representational tool of the taste of *sake*. Pictorial descriptions were produced intuitively in the experiment explained above. However, the author was able to extract a set of elements even in those drawings. If those elements are incorporated into the production of more refined icons, the icons will be beneficial.

Verb-oriented Tool for Tasting Sake

As pragmatic implications of this study, the author developed a "verb-oriented tool for tasting *sake*" (see Figure 11) with which one can discriminate the taste of *sake*. The tool was developed in the following way.

First, the author listed the verbs for tasting descriptions for *sake*, using the *sake* tasting corpus of the listed verbs; the following words were excluded from analysis: words of low frequency (under four times), and functional verbs[4]. As a result, 86 verbs were extracted (see lower half of Figure 11).

Next, the author manually organized the verbs into some clusters, based on the similarity of the meaning of verbs. In this process, the hierarchical clustering method in KH Coder and the affinity diagram were referred to. From this clustering, 24 verb clusters were given.

In order to link the sense of taste and the corresponding verb, the author drew a picture that represented the common image of the verbs within a cluster.

The picture consists of two color elements. The abstract figures in the charts stand for the elements of the taste. The two colors give a difference of the "main taste" and the "sub taste." Here, the figure of dot

pattern shows the main taste. The user will substitute an element of taste for a figure. In this way, the author produced pictures for all the clusters（Figure 11).

Figure 11. Sake tasting chart (a verb-oriented tool for tasting sake)

Each drawing or icon is intuitively easy to understand even without lengthy explanations. To use this tool or chart, the standard procedures involve the following steps:

Step 1: Taste a *sake* and describe the elements of the taste and flavor verbally.
       (e.g., "I can see fresh acidity and fruity sweetness.")
Step 2: Choose the main taste to describe.
       (e.g., "I feel strong sweetness, but I instead want to express the acidity.")
Step 3: Select a picture, and put the main taste into the figure of dots
       (e.g., "H or U seem good... I'll choose H so that I can express the movement of the acidity.")
Step 4: Select a verb from the list of verbs.
       (e.g., "Fresh acidity makes the fruity sweetness firm.")

The picture is color-coded because even though the pictures might be similar, the verbal expressions can differ by their focusing effect. For example, the pictures L and O represent a similar composition, but they have contrasting focuses: L focuses on a small element−hiding behind a large element−as the main element. On the other hand, O highlights the larger elements. In this way, one event of tasting can be described in various manners.

The author believes in the effectiveness of using this verb-oriented tool when tasting and describing the taste of *sake*. However, it is needless to say that the author's belief must be empirically tested.

CONCLUSION

In this study, the author proposed a multi-faceted representation model for the sensory domain of taste—especially the taste of *sake*. The multi-faceted model includes not only the cognitive process of the subject (taster), but also the properties of the object and the environmental information.

The starting point of the model is not the information of the object. Rather, from the phenomenological stance, or more specifically from the viewpoint of the first-person-singular study, we set the emergence of the sensory experience as the origination of the model. In this model, the sensory experience emerges, appears, or arises as the aggregate of the dynamic process within the subject, the object, and the environment.

Yet, revealing the whole multi-faceted structure of a cup of *sake* would be impossible, for the "all elements of the whole structure" cannot be defined a priori. Thus, a study of multi-faceted structure needs some focusing point. In this study, the author focused on the relationships between the verbal descriptions and non-verbal descriptions.

The author discovered the following general tendencies based upon analysis of the parts of speech:

1. The sensation of taste itself is conceptualized verbally rather than pictorially.
2. The mouth feels, or the stimulating tastes can be described, pictorially as the symbolic descriptions.
3. The body parts can be described both verbally and pictorially. In particular, the pictorial descriptions intuitively show the point or position of the mouth.
4. The movement of the taste tends to described both pictorially and verbally. In contrast, the movement of the body parts tends to be described only verbally.

Further, as the results of the examination of the relationships between the pictorial elements and the words of verbal description, the author found the following differences between the manner of description of the PTG (Primary Taste Group: *sweetness*, *umami*, and *acidity*) and the STG (Stimulus Taste Group: *astringency* and *dryness*):

   1. PTG:
       a. Shape (57%), especially in *free-curve* shape, is mostly frequently used.
       b. Sweetness and *acidity* are often represented as *ovals*.

        c. Other frequent shapes include *curve*, *curved arrow*, and *scribbled* pattern.
        d. Curvy figures tend to be preferred.
2. STG:
        a. Pattern (58%), especially the *line pattern* and *scribbled* pattern, is most frequently used.
        b. Dry is described mainly in the *thorn* shape, *line* pattern, and *scribbled* pattern.
        c. Linear shape tends to be preferred.

Verbal expression is limited when it comes to describing the area of the sensory perception of taste. The author sought to bridge the domain of taste and the domain of words, and, on the basis of the findings of the first-person-singular study, proposed that the pictorial description, together with the verbal description, can achieve the aim. Because of the nature of the study, it is not possible to generalize, and yet, if the first-person-singular studies are accumulated, one will be able to compare and contrast the data to see if there are generalizable tendencies when people describe the taste of *sake*, for example.

In this study, in order to reveal the coverage area of the verbal descriptions and the pictorial descriptions, the author examined the correspondence of the verbally described element of taste and the element of the picture (i.e., what element of taste is described as what element of the picture).

This kind of interpretation seems valid only for drawings in which the elements are identical. In many cases, however, the pictorial tasting descriptions are more complex, and the elements of the drawing do not correspond to the elements of the verbal descriptions on a one-to-one basis. In this case, the pictorial representation should be interpreted holistically, with the use of the available pictorial and verbal description.

This study proposed a multi-faceted model, focusing on the verbal description domain and non-verbal description domain. The model would contribute to opening the gate to studies of the multiple representations, in contrast to the former studies of literal metaphors. Other questions worthy of future research are how the verbal representation relates to other non-verbal representations (i.e., gestures or facial expressions) and how the environmental information (i.e., circumstances or instruments for drinking) interacts with the representation of *sake*. This study is a first step in steering the research of taste toward taste as human-experience.

REFERENCES

Alexander, C. (1966). A city is not a tree. *Design*, 46–55.

Fukushima, H., Mutsumi, I., & Shigenori, T. (in press). The usage mechanism of Japanese ideophones in the description of taste: Morphological and co-occurrence analysis of the description words of wines and sakes. *International Journal of Computational Linguistics Research*.

Higuchi, K. (2004). Quantitative analysis of textual data: Differentiaiton and coordination of two approches. *Sociological Theory and Methods*, *19*(1), 101–115.

Hinton, L., Nichols, J., & Ohala, J. J. (2006). *Sound symbolism*. Cambridge, England: Cambridge University Press.

Hori, K. (1994). A system for aiding creative concept formation. *IEEE Transactions on Systems, Man, and Cybernetics*, *24*(6), 882–894.

Hori, K. (2004). Do knowledge assets really exist in the world and can we access such knowledge?: Knowledge evolves through a cycle of knowledge liquidization and crystallization. *LNAI 3359, Springer*, 1–13.

Hori, K. (2007). *Sozo katsudo shien no riron to oyo [Theories and applications of creativity support]*. Tokyo: Ohmsha.

Kanai, A., & Kodama, K. (2010). Film edit design: Story and irrational cutting. *Cognitive Studies*, *17*(3), 444–458.

Kanai, A., & Ogata, T. (2004a). Aspect of non-story processing and film rhetoric composition in the narrative generation mechanism. In *Proceedings of The Ninth International Symposium on Artificial Life and Robotics* (Vol. 1, pp. 162–165).

Kanai, A., & Ogata, T. (2004b). Non-story processing on the film rhetoric composition system. In *Proceedings of 18th Congress of the International Association of Empirical Aesthetics* (pp. 433–436).

Peirce, C. S. (1974). *Collected papers of Charles Sanders Peirce*. Cambridge, MA: Harvard University Press.

Seto, K. (2003). *Kotoba wa aji wo koeru (Words excel the taste)*. Tokyo: Kaimeisha.

Shigenori, T., & Masahiro, F. (1998). *<Imizukeron> no tenkai (The evolution of the <sense-making theory>)*. Tokyo: Kinokuniya.

Shinohara, K., Yamauchi, N., Kawahara, S., & Tanaka, H. (2016). Takete and Maluma in action: A cross-modal relationship between gestures and sounds. *PLOS ONE 11*(9), e0163525.

Wilson, D. A., & Stevenson, R. J. (2006). Learning to smell. *Baltimore: Johns Hopkins UP*.

Reference List of the Sake Corpus and Wine Corpus

Real Wine Guide. (2007–2009). *RWG*, vol. 19–26.

Hasegawa, K. (2015). *Nihonshu techo* [*Sake handbook*]. City: Gakken Publishing.

Kimishima, S. (2011). *Nihonshu kanzen guide* [*Perfect sake guide*]. City: Ikeda.

Matsuzaki, H. (2000). *Nihonshu guide book* [*Sake guide book*]. City: Shibata.

SSI. (2010). *Nihonshu techo* [*Sake handbook*]. Tokyo: Shoseki.

Yamamoto, Y. (2014). *Gensen nihonshu techo* [*Selected sake handbook*]. City: Sekai Bunka-sya.

Dancyu, Vol. 2, 3 (2015), Vol. 3 (2016), President.

Pen. (2015). Vol. 11, CCC Media House.

KEY TERMS AND DEFINITIONS

***Sake*:** an alcoholic beverage (so-called "Japanese rice wine") made by fermenting rice. The primary tastes of *sake* are sweetness, umami, and acidity. The flavor is fine and thin; the high-class *sake* "Ginjohshu" has a fruity flavor like a banana, a melon, or an apple.

Multi-faceted representation: A manner of representation proposed in this study. It consists of multiple representations, such as sensory representation, verbal representation, and non-verbal representation.

PTG (the Primary Taste Group): An operational taste group for sweetness, umami, and acidity. These tastes are primaly elements of the taste of sake.

STG (the Stimulating Taste Group): An operational taste group for astringency and dryness. These tastes are thought as supplemental taste for sake. A sutable amount of astringency gives sake the outline of the taste. And dryness is an important factor of the afterflavor. However, too much astringency or dryness would spoil the taste of sake

ENDNOTES

[1] Table 4. *Note*. The classification of words according to the part of speech is made on the basis of original Japanese expressions.

[2] Table 5. *Note*. The classification of words according to the part of speech is made on the basis of original Japanese expressions.

[3] The integrated synonym list is: "dry" (dry, alcohol), "acidity" (acid, acidity, the taste of acid)

[4] "suru," "naru," or "aru" in Japanese, which correspond to "do" or "be" in English.