Sound Symbolic Words Are More Easily Associated with Real Metal Than Imitation

Junya Yoshino*, Akira Yakata**, Yuichiro Shimizu***,
Masaharu Haginoya****, Maki Sakamoto*****

** The University of Electro-Communications, moxile.lab@gmail.com*
*** The University of Electro-Communications, akira.ryozan@gmail.com*
**** The University of Electro-Communications, y.shimizu@edu.hc.uec.ac.jp*
***** Calsonic Kansei Corporation, haginoya-m@ck-mail.com*
****** The University of Electro-Communications, sakamoto@inf.uec.ac.jp*

Abstract: In recent years many products such as electric appliances are made of imitation metals, which are lighter in weight and lower in cost than real metals. But imitation metals look and feel cheaper sometimes. This study proposes that differences in sound symbolic words associated with imitation and real metals can be used for metal texture design to make imitation materials look and feel like real materials. Japanese is known to have a large number of sound symbolic words for expressing textures. For example, sound symbolic words expressing a sense of smoothness often use the consonant /s/ in the first syllable as in "sara-sara". We conducted psychological experiments where participants were asked to look at a pair of imitation and real materials without touching them and answer sound symbolic words associated with them. For real materials, 1.49 words in average were answered per participant, while 1.07 words in average was answered per participant for imitation materials. Paired t-test showed that real materials were significantly more easily associated with sound symbolic words than imitation materials ($t(49) = 2.00$, $p < .01$). This result indicates that differences between imitation and real materials can be reflected on sound symbolic words.

Key words: metal texture design, real metal, imitation, onomatopoeia

1. Introduction

In recent years many products such as electric appliances and car interiors are made of imitation metals, which are lighter in weight and lower in cost than real metals. Although at a glance imitation metals may be hard to tell from real metals, they look and feel cheaper sometimes. At product development metal texture design is used to make imitation metals look closer to real metals. However, the reason why imitation materials feel different from real ones even if they are given the same texture design remains mystery and it is not clear what kind of design is effective to make them real.

Humans can infer material properties using all the senses, namely vision, touch, smell, taste, hearing. The present paper is about vision. There are many researches on how humans interpret visual input to estimate the properties of a surface, and how you tell the difference between peaches and nectarines or between unfinished and polished wood (Motoyoshi et al. [6], Ho et al. [3]). There are many visual attributes that help us to distinguish different surface materials, including lightness, colour and texture. Motoyoshi et al. [6], for example, pointed out

that concerning surface perception a simple characteristic of image statistics — the distribution of luminance values in an image, the ‘skew’ — is highly correlated with judgements of gloss and lightness.

However, the findings reported by previous studies have focused on material perceptions, but not emotional or sensuous perceptions of texture, and depend on experiments using pictures. Furukawa et al. [1] have focused on the emotional perception of metal texture and attempted to analyze features of human texture perception. However, the stimuli used in the experiment were image textures.

In order to pursue a new method to capture the emotional and sensuous material perception, this study focuses on onomatopoeia as sound symbolic expressions. The existence of synesthetic associations between sounds and sensory experiences (sound symbolism) has been demonstrated over the decades (e.g., Köhler [4], Sapir [8]). It is also known that the sensory-sound correspondence can be found not only in words referring to visual shapes, which was demonstrated in the landmark studies (e.g., mal/mil and buba/kiki for round and sharp shapes in Sapir [8] and Ramachandran & Hubbard [7], respectively), but also in those referring to tactile, smell, and taste sensations. Japanese is known to have a large number of onomatopoeic words and Hamano [2], for example, describes sound symbolic associations between the phonemes of Japanese onomatopoeic words and particular meanings as shown in Table 1.

Table 1. Examples of Sound Symbolic Associations Between Japanese Phonemes and Meanings (Hamano [2])

Vowel		Consonant	
/i/	line, extended in a straight line, light	/h/	Softness, weakness, delicate
/a/	flat, spreading, large surface	/s/	Smoothness, serenity, tranquility

And Watanabe et al. [9], [10] is investigating the sound symbolic associations between the phonemes of Japanese sound symbolic words for expressing tactile sensations and subjective evaluations of comfort/discomfort for touched objects. For example, onomatopoeic words expressing a sense of smoothness often use the consonant /s/ in the first syllable as in "sara-sara", while those expressing roughness often use /z/ in the first syllable as in "zara-zara". However, no research has attempted to use onomatopoeia to explore visual differences between real and imitative materials with the same texture design. The purpose of this study is to investigate the effectiveness of onomatopoeia in the measurement of visual metal texture and explore the possibility that differences in sound symbolic words associated with imitation and real metals can be used for metal texture design in order to make imitation materials look and feel like real materials.

2. Experiment

2.1 Materials and Design

In this experiment, we aimed to compare the number and type of onomatopoeia associated with real metal with imitation metal. Since Watanabe et al. [9], [10] points out that onomatopoeia is effective in understanding the sensibilities of human texture perception such as like or dislike and comfort or discomfort, we hypothesize that real metals are more easily associated with metal-like materials, namely imitations.

Furthermore, a previous study on the texture of the lacquer (Lee et al. [5]) pointed out that the experts evaluate the characteristics of the material more finely than the non-experts. Participants in our experiment, therefore, were

20 experts (18 men and 2 women working over 5 years in the department dealing with the metal surface design) and 30 non-experts (18 men and 11 women). The experiment was performed using the box set up with a light color temperature of 5500K, where a pair of real metal and imitation metal was place, as shown in Figure 1. The experiment was conducted in an environment where we are supposed to see metals in our everyday life

Figure 1. Experiment Environment

The experimental stimuli were 15 pairs of real metals and imitation metal-like materials with the same surface texture design as shown in Figure 2. In Figure 2 the material right is imitation and the material left is real metal, but the place of materials is changed per participant. The experimental stimuli were made by Calsonic Kansei Corporation. The imitation metal-like materials were made with a synthetic resin.

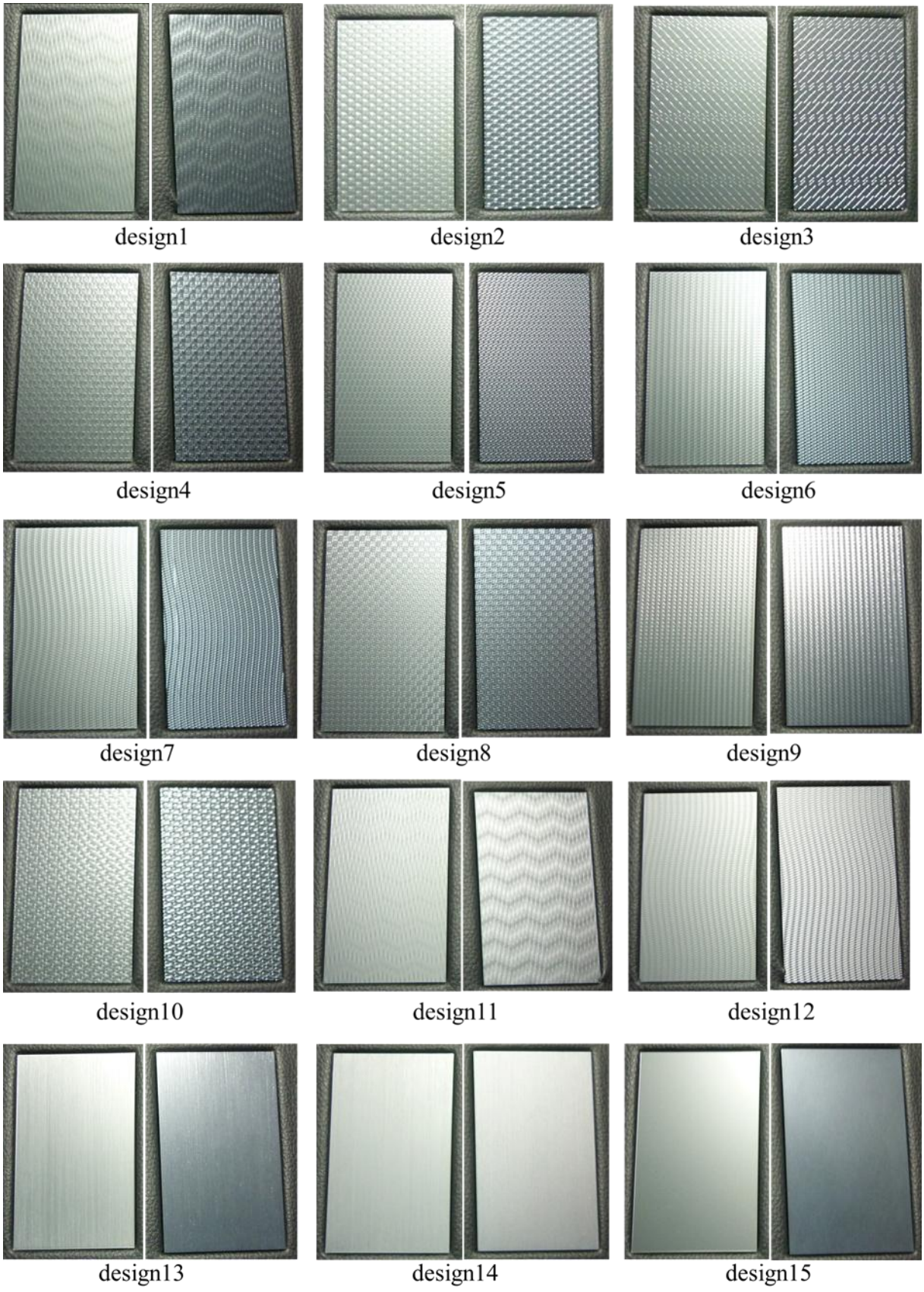

Figure 2 Experimental Stimuli

2.2 Procedure of Experiment

Participants in the experiment were given instruction on the procedure and a brief explanation of onomatopoeia with some examples of onomatopoeic expressions which were assumed to be used for anything other than metal. Participants were asked to sit in front of the box with their forehead placed on the board attached to the box, as shown in Figure 3. Then, they were asked to observe a pair of real metal and imitation metal-like material, and answer onomatopoeic expressions associated with them as many as they like during 20 seconds of response time. The participants were instructed not to touch the materials because touching reveals the difference between real metals and imitations and the purpose of this study is to explore visual differences between real and imitative materials with the same texture design.

Figure 3. The way participants observe stimuli

3. Results

The average number of onomatopoeic words obtained from real metal were 1.50 (1.36 as for professional and 1.59 as for non-professional), while the average number of onomatopoeic words obtained from imitation metal were 1.07 (0.94 as for professional and 1.16 as for non-professional). We conducted t-test (two-tailed, 5 % level) to see whether there is a significant difference between the average number of onomatopoeic words, namely 1.50, obtained from real metal and the average number of onomatopoeic words, namely, 1.07, obtained from metal-like materials.

As a result of two-tailed t-test (both sides, 5% level), there was a significant difference between them; $t(49)=8.87, p<.01$ (total), $t(19)=6.61, p<.01$ (professional) and $t(29)=6.28, p<.01$ (non-professional). This result shows that real metals are more easily associated with onomatopoeia than metal-like materials. This result suggests that, even if they have the same surface design, real metals are more easily associated with emotional texture perceptions and more easily evoke onomatopoeia, which is said to be directly associated with intuitive and emotional perception.

Furthermore, we compared types of onomatopoeic words obtained from non-experts with those obtained from experts. We regarded the word that was replied most as the representative word for the material. Table 2 shows the representative onomatopoeic words obtained from non-experts and experts for each material. Tactile onomatopoeic words such as zara-zara (rough texture) seem to be obtained from non-experts more than from experts and experts seem to reply more visual-oriented onomatopoeic words such as "teka-teka" expressing brightness. Therefore, we conducted a statistical analysis whether tactile onomatopoeic words are more easily replied by non-experts than experts. As a result, tactile onomatopoeic words replied by non-experts are significantly more frequent than those replied by experts; $\chi 2(1,N=75)=16.835$, $p<.01$. This result suggests that although experts engaged in metal texture design focus on visual design of metal surface, non-experts, namely people in general, perceive material properties recalling experiences through touch.

Table 2. The representative onomatopoeias associated with each material

	non-professional		professional	
design	real metal	imitation	real metal	imitation
1	zara-zara	tsuru-tsuru	une-une gira-gira teka-teka	sara-sara
2	boko-boko	tsuru-tsuru	kira-kira gira-gira	sara-sara
3	zaku-zaku	pika-pika	kaku-kaku	kira-kira
4	boko-boko	tsuru-tsuru	gira-gira	kira-kira
5	zara-zara	tsuru-tsuru	gira-gira zara-zara	kira-kira
6	zaku-zaku	sara-sara	zara-zara	tsuru-tsuru
7	zara-zara	sara-sara	une-une pikapika	zara-zara
8	zara-zara	sara-sara	zara-zara	sara-sara
9	zara-zara	sara-sara tsuru-tsuru	gira-gira	kira-kira
10	boko-boko	sara-sara zara-zara tsuru-tsuru	kira-kira pika-pika	zara-zara kira-kira
11	zara-zara	tsuru-tsuru	giza-giza	sara-sara
12	zara-zara	sara-sara	une-une	zara-zara
13	tsuru-tsuru	tsuru-tsuru	zara-zara	sara-sara tsuru-tsuru
14	tsuru-tsuru	tsuru-tsuru	sara-sara	sara-sara
15	tsuru-tsuru	tsuru-tsuru	tsuru-tsuru	tsuru-tsuru

4. Conclusion

This study suggests that differences in sound symbolic words associated with imitation and real metals can be used for metal texture design to make imitation materials look and feel like real materials. Through psychological experiments where participants were asked to look at a pair of imitation and real materials without touching them

and answer sound symbolic words associated with them, we showed that real materials were significantly more easily associated with sound symbolic words than imitation materials. This result indicates that, even if they have the same surface design, real metals are more easily associated with emotional texture perceptions and more easily evoke onomatopoeia, which is said to be directly associated with intuitive and emotional perception.

Furthermore, we compared onomatopoeic words obtained from non-experts with those obtained from experts. As a result, tactile onomatopoeic words replied by non-experts are significantly more frequent than those replied by experts. This result suggests that although experts engaged in metal texture design focus on visual design of metal surface, non-experts, namely people in general, perceive material properties recalling experiences through touch. The findings of this study suggest that differences in sound symbolic words associated with imitation and real metals can be used for metal texture design to make imitation materials look and feel like real materials and give suggestions to experts engaged in metal texture design.

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