A CROSS-CULTURAL COMPARATIVE STUDY OF THOUGHT PROCESS
COGNITIVE DIVERSITY ACCORDING TO REGIONS AND MATHEMATICAL MINDS

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ABSTRACT

Contemporary designers are now factoring *Kansei* to meet their goals in the development of consumer products. We focused our attention on their recognition processes as a method to perceive the consumer's *Kansei.* The purpose of this research is to examine the cognitive diversity according to various regions and mathematical minds. We studied two different ways of recognizing images: attribute-oriented thought and relationship-oriented thought. Through fundamental experiment, it was found that 39 Japanese and 45 European subjects (33 Dutch and 12 English) had stronger tendencies in attribute-oriented thought than 45 Korean subjects. Despite regional similarities, the results for attribute-oriented thought of Japanese were much different from the results of Koreans. Next, we explored the mathematical minds (skill and interest) as other factors for creating attribute-oriented thought. 62 Japanese university students participated in this experiment. As results of experiment, there were no significant differences between mathematics-based majors and non-mathematics-based majors in attribute-oriented thought. However, when it comes to the case of students who were interested in mathematics, there was a notable inclination towards attribute-oriented thought compared to those who were not. Furthermore, the dissimilarities of attribute-oriented thought were bigger among males than females. The important findings of our research are that the cognitive inclinations of Japanese correspond greatly to the ones of European than the Koreans' inclination, and that the attribute-oriented thought of Japanese is driven by their mathematical interests more than their mathematical skills. Finally, we learned that mathematical interests could be one of the factors creating cognitive diversity, and that the cognitive diversity could be found more easily among males than females.

Keywords: *Recognition processes, Mathematical minds (skills & interests), Attribute-oriented thought, Kansei, Design*

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1. INTRODUCTION

We are at the stage for another leap forward in the development of new understanding and vision of emotional factors in design through innovative exploration. We focused our attention on their recognition processes as a method to perceive the consumer's *Kansei*. Harada (1998) provided a definition of "*Kansei*" through a questionnaire administrated to researchers of University of Tsukuba regarding the topic. The collected definition goes as follows: subjective and unexplainable function, innate nature and cognitive expression of knowledge and experience, Interaction of intuition and intellectual activities, evaluation ability reacting symbolically and intuitively, and mental function creating images [1]. According to this investigation, researchers included not only intuitive thoughts, but also *rational thoughts (cognitive expression of knowledge and intellectual activities)* in the *Kansei* definition. Therefore, we included 'recognition processes' in our *Kansei* study. Recognition processes have been studied in the field of humanities, social sciences, cognition science, and psychology as well as marketing, education, and interface design which need knowledge of specific groups' ways of thinking. We chose certain consumers who were from several different nations as experimental groups, and compared their recognition processes. Our goal was to determine if we could observe the divergences in recognition processes between Asian and European cultures.

Although there have been limited researches on cultural differences in recognition processes, there is data indicating that cultural differences do exist. For example, Chui (1972) examined such divergences in categorization between Chinese and American children, using pictures of artifacts, plants, and animals. A 28-item cognitive style test was constructed to serve as a measuring instrument. It contained 21 items adapted from the Sigel Cognitive Style Test (Sigel 1967) and 7 items from the study by Kagan et al. (1963) [2]. On each trial in Chui's study, the participants were presented with three pictures (e.g., a cow, a chicken, and grass), and were asked to group the two pictures they thought best belonged together. Participants were also asked to explain their choices (e.g., "Because they are both animals"). The participants' responses were classified as descriptive-analytic (identifying similar parts of stimuli and differentiating based on those similarities: e.g., "Because they are both holding a gun"), descriptive-whole (identifying whether a stimulus as a whole is similar to another whole stimulus: e.g., "Because they are both large"), inferential-categorical (categorizing based on inferences made about the stimuli that are grouped together; e.g., "Because they both have a motor"), and relational-contextual (categorizing based on functional and thematic relationships: e.g., "Because mother takes care of baby"). The reactions showed that the American children were most likely to respond using descriptive - analytic, descriptive - whole, and inferential - categorical categorizations than the Chinese children; that the Chinese children were superior to respond using relational -contextual categorizations than the American children [3]. Considered together, Chui's results suggest that Chinese children are apt to greatly categorize the stimuli by identifying relationships, whereas American children have a greater tendency to categorize them through recognizing similarities.

After 30 years, Sara J. Unsworth, Christopher R. Sears and Penny M. Pexman (2005) examined some similar experiments. In their researches, Chinese and Western participants were asked to look at sets of three pictures (e.g., a tire, a car, and a bus), and to decide which two pictures of each set best belonged together. Chinese participants were equally likely to group items together if they shared a relationship (e.g., tire-car) and if they shared a category (e.g., bus-car), whereas Western participants were more likely to group items together if they belonged to the same category [4]. These results are similar to Chui's study; American children are more likely to classify items together if they are more similar to each other, and that Chinese children are more likely to classify items if they share a relationship.

Based on the results of these two studies, people from different cultural background should have diverse recognition processes. In the first experiment, we examined whether we could observe the differences in recognition processes among Japanese, Korean, Dutch, and British participants, and whether they show any remarkable contrasts between two regions (Asia vs. Europe). In terms of recognition processes, we examined two different ways of recognizing images: attribute-oriented thought vs. relationship-oriented thought. Meanwhile, we assumed that mathematical minds including Arithmetic and Geometric thought would be involved in attribute-oriented thought, which would identify Arithmetic and Geometric similarities (e.g., numbers, shape, or structure) among stimuli in our experiment. With a focus on this assumption, we hypothesized mathematical minds as the factors creating attribute-oriented thought; for this matter, we set the question: Who are more likely to have attribute-oriented thought, students skilled at mathematics or those fond of mathematics? In the second experiment, our goal was to explore these possibilities.

2. INVESTIGATION OF REGIONAL DIFFERENCES IN RECOGNITION PROCESSES

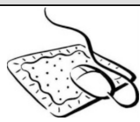
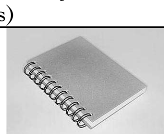
2.1. Goal and Methods

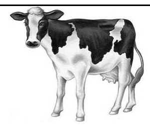
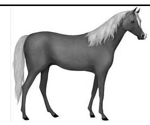
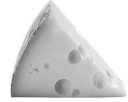
When operating a product, it is important to understand the user-interface. Especially images of icons or buttons have crucial roles as elements for understanding the interface. The scope of this study focused on understanding a diverse tendency among people from different countries on image recognition. As a method of the research, an experimental instrument was developed. Sigel and Chui, developmental psychologists, presented a proper method to test the recognition processes on categorization. We applied their organization method of stimuli, and developed new measuring instrument (Table 1). We presented (object 'A') which is similar to the 'target' in attributes. The responses of the participants were expected as descriptive (identifying similarities identified on the basis of manifest objective attributes; e.g., a pencil and a brush are grouped together "Because they have similar shape"), inferential - categorical (categorizing based on inferences made about the stimuli that are grouped together; e.g., a mouse and a mobile phone are grouped together "Because they both have a mechanism"). As for object (B), it is familiar with the 'target' in mutual relations. In this case, the responses of the participants were expected as relational - contextual (categorizing based on functional and thematic relationships; e.g., a girl and a hand mirror are grouped together "Because a girl takes care of her face with a hand mirror"). The images used as the stimuli were considered to be the images of icons or buttons in products (Table 2).

Table 1: Recognition processes and measuring instrument

Sorting methods of recognition processes by Sigel & Chui			Descriptive-Analytic or whole	Inferential-Categorical	Relational-Contextual
Measuring instrument	Applied organization method of stimuli	Target	A ;Object which is similar to 'target' in attributes: shape, function, structure, category		B ;Object which is familiar with 'target' in mutual relations
	Sample				

Table 2: Instrument for measuring of recognition processes

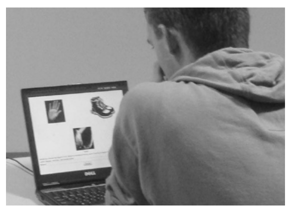
Q.	Target	A ;Object which is similar to 'target' in attributes	B ;Object which is familiar with 'target' in mutual relations
1			
	Target-A: similar shape and similar kinds (machines) Target-B: contextual relationship (operate a mouse)		
2			
	Target-A: similar structure and similar kinds (parts of body) Target-B: contextual relationship (wear shoes)		
3			
	Target-A: similar shape and similar kinds (tools for drawing) Target-B: contextual relationship (write on a note pad)		
4			
	Target-A: similar structure and similar kinds (faces) Target-B: contextual relationship (see a hand mirror)		
5			
	Target-A: similar shape and similar kinds (containers) Target-B: contextual relationship (drink coffee)		

6			
	Target-A: similar shape and similar kinds (animals) Target-B: causation (cheese is made from milk)		

2.2. Assumption

We chose Japanese and Korean university students as Asian participants. Both countries are located in Eastern Asia. British and Dutch university students were selected as European participants. Both countries are situated in Western Europe. Among these participants, design majors who are familiar with perceiving images were selected (Table 3). Based on the results of precedent studies (Chiu and Sara et al.), it was predicted that the Japanese and Korean subjects representing 'Asians' would have a tendency to lean towards relationship-oriented thought (object 'B') more than Dutch and British subjects, as it was shown in the Chinese study. And Dutch and British subjects representing the Westerner would tend to recognize objects by identifying similar attributes (object 'A') in contrast to Japanese and Korean subjects. The question was offered as follows: *between A and B, which one is the closest to the target?* Right side of Table 3 shows a scene from the experiment (e.g. question 2).

Table 3: Participant's Characteristics

Cultural Area	Asia		Europe		Screen of experiment
Region	Eastern Asia		Western Europe		
Nationality	Japanese	Korean	Dutch	British	
Univ.	TSUKUBA	KOOKMIN	TU-D, TU-E	RCA	
Major	Field of Design				
Numbers of Participants	39	45	33	12	a scene
	21Female, 18 Male	20Female, 25 Male	15 Female, 18 Male	3Female, 9 Male	
	129				

2.3. Analysis

This experiment is about the comparison of tendencies between attribute-oriented thought and relationship-oriented thought. The answer to the question is either choice of 'A' (An object which is similar to the 'target' in attributes) or 'B' (An object which is familiar with the 'target' in mutual relations). Therefore, the analysis of inclination is obtained through *Chi-square (χ^2) Test* (with a standard of '$P < 0.05$'). The following table 4 shows the analysis of the recognition tendency among nationalities; we analyzed the selection ratio (%) of object 'A'. According to the result, there were significant differences in question 1, 3 and 6. In addition, we compared both genders to observe whether there were any differences. The results from the comparison showed significant differences in question 3 and 6 for females and in question 1, 2, 3, 4 and 6 for males (Table 5).

Table 4: The comparison of the recognition tendency among nationalities

Q.	Selection ratio (%) of object 'A'(Object which is similar to 'target' in attributes)					χ test
	39 Japanese	45 Korean	33 Dutch	12 British	Average	P value
1	***30.77***	***4.44***	***21.21***	***50.00***	***20.93***	***0.0012***
	Korean < Japanese, Dutch, British / Dutch < British					
2	71.79	51.11	63.64	75.00	62.79	0.1905
	Korean < Japanese					
3	***58.97***	***13.33***	***42.42***	***33.33***	***36.43***	***0.0002***
	Korean < Japanese, Dutch					
4	35.90	37,78	51.52	75.00	44.19	0.0665
	Korean < Dutch, British / Japanese< British					
5	46.15	28.89	51.52	41.67	41.09	0.1981
	Korean < Dutch					
6	***51.28***	***28.89***	***72.73***	***75.00***	***51.16***	***0.0005***
	Korean < Japanese, Dutch, British					

Table 5: The comparison of the recognition tendency among nationalities by gender

Q.	Selection ratio (%) of object 'A'(Object which is similar to 'target' in attributes)					χ test
	21 Japanese Female	20 Korean Female	15 Dutch Female	3 British Female	Average	P value
1	19.05	10.00	33.33	33.33	20.34	0.3594
2	66.67	75.00	66.67	66.67	69.49	0.9333
3	***61.90***	***10.00***	***26.67***	***33.33***	***33.90***	***0.0051***
4	23.81	45.00	60.00	33.33	40.68	0.1704
5	52.38	35.00	60.00	33.33	47.46	0.4513
6	***47.62***	***25.00***	***73.33***	***33.33***	***45.76***	***0.0405***
Q.	18 Japanese Male	25Korean Male	18 Dutch Male	9 British Male	Average	P value
1	***44.44***	***0.00***	***11.11***	***55.56***	***21.43***	***0.0002***
2	***77.78***	***32.00***	***61.11***	***77.78***	***57.14***	***0.0104***
3	***55.56***	***16.00***	***55.56***	***33.33***	***38.57***	***0.0198***
4	***50.00***	***32.00***	***44.44***	***88.89***	***47.14***	***0.0335***
5	38.89	24.00	44.44	44.44	35.71	0.4808
6	***55.56***	***32.00***	***72.22***	***88.89***	***55.71***	***0.0085***

2.4.Discussion: the regional differences in recognition processes

It was considered that there are differences in recognition processes between Asian and European cultures through experimental results. In comparison of the tendency of recognition processes among nationalities, the selection ratio (%) of object 'A' was different according to the types of questions (Refer table 4). We found the remarkable dissimilarities related to nationalities in some inquiries: between Korean and Japanese in question 1, 2, 3 and 6, between Korean and Dutch in question 1, 3, 5 and 6, between Korean and British in question 1, 4, and 6, between Dutch and British in question 1 and between Japanese and British in question 4. Especially, there were no differences between Japanese and Dutch. These tendencies show Japanese, Dutch and British subjects have stronger tendencies in the selection of object 'A' than Korean subjects (table 6).

Table 6: The questions which have the remarkable cognitive dissimilarities related to nationalities

Nationality	Japanese	Korean	Dutch	British
Japanese				
Korean	1, 2, 3, 6			
Dutch	-	1, 3, 5 ,6		
British	4	1, 4, 6	1	

As our assumption, these results indicate that European subjects are more likely to have attribute-oriented thought than Korean subjects. However, the tendencies between the Japanese and Koreans differed from our expectations; the Japanese tendencies of attribute-oriented thought were greater than Korean subjects. In spite of the regional similarities, the recognition tendency of Japanese subjects did not correspond with Korean subjects; there were relative correlations between Dutch and British in all inquiries except question 1, whereas, there were some corresponding tendencies between Japanese and Korean in question 4 and 5. Next, we considered the recognition tendencies among four nationalities in relation to gender. In the result, we found that there were three types of questions that showed similar inclination between females and males; no significant differences in both genders (Q. 5); notable differences in the subjects (Q. 3 and 6); significant differences in males (Q. 1, 2, and 4). Finally, the differences of recognition processes among nationalities were stronger among males (Refer table 5).

2.5.Conclusion of the first experiment

We examined if we could observe differences in recognition processes between Asian and European participants. We found a possibility that European and Japanese subjects have stronger tendency in attribute - oriented thought than the Korean subjects. Also, it was found that the cognitive diversity among nationalities were more noticeable for the male participants than the female participants.

3. EXPLORATION OF MATHEMATICAL MINDS AS FACTORS THAT CREATE ATTRIBUTE-ORIENTED THOUGHT

3.1.Goal and Methods

In spite of the regional similarities, the Japanese tendencies of attribute-oriented thought were greater than Korean subjects. We thought that there may be other factors that create attribute-oriented thought of Japanese beyond regional characters. In the second experiment, we examined the mathematical minds as other factors creating attribute-oriented thought. The following is a definition of 'mathematics' in dictionary; the science of numbers and shapes; Branches of mathematics include Arithmetic, Algebra, Geometry and Trigonometry; Geometry is a branch of mathematics that deals with the measurements and relationships of line, angle, surface and solids in particular object or shape, and Arithmetic is a type of mathematics that deals with the adding, multiplying, etc. of numbers [5]. We assumed that mathematical minds including Arithmetic and Geometric thought might be associated with attribute-oriented thought which identifies Arithmetic and Geometric similarities (e.g., numbers, shape, or structure) among stimuli in our experiment. Based on this assumption, we examined attribute-oriented thought as other factors that create attribute-oriented thought of Japanese.

As a method of study, we investigated the mutual relations between attribute-oriented thought and the mathematical minds; for measuring of attribute-oriented thought, we used the instrument (refer Table 2) which was developed in our first study. In terms of mathematical minds, we regarded mathematical minds from the two points of view; one is the mathematical skill which can be cognized objectively and the other is the personal mathematical interest which might be defined neutrally. As for *Mathematical Skill*, we needed the objective judgment of the participant's ability for mathematics. Therefore, we looked for a method that helps to evaluate mathematical skills of participants objectively; e.g., a mathematic-based major in universities require high-leveled mathematical skills. We considered two groups of majors as a standard for comparing participant's mathematical skills; mathematics-based majors for people who have an ability of high-leveled mathematics and non-mathematics-based majors for people who have an ability of low-leveled mathematics. Regarding *Mathematical Interest*, participants were asked about their degree of interest: e.g., like, dislike or neutral.

62 Japanese university students participated in present experiment. We divided their majors into two groups as mathematic-based majors vs. non-mathematic-based majors and asked their mathematical interest (Table 7). In line with our assumptions, *mathematics-based majors and students who liked mathematics* will have stronger tendencies of attribute-oriented thought than *non-mathematics-based majors* and *students who dislike mathematics*. In present experiment, we examined these possibilities.

Table 7: Participant's major and mathematical interest

	Mathematics-based		Non-mathematics-based	
Major	Environmental Systems, Computer Science, Medicine, International Relations, Earth Science, Engineering System, Psychology, Applied Science and Technology, Information Science, Law Psychology, Education, Physics, Biology, Knowledge Information - library Science,		Sports, Applied Linguistics, Japanese Classic, Japanese History, Japanese Culture, Comparison Culture, Cultural Anthropology, Creature-Resources, Nursing, Sociology, Economy, Art, English Studies	
Numbers of people	Female	Male	Female	Male
	10	22	24	6
Like	5	14	9	3
Dislike	5	4	6	2
Neutral	0	4	9	1
Sum	32		30	
	62			

3.2.Analysis

The tendencies of attribute-oriented thought (Selection ratio of object 'A') between *32 mathematic-based majors* and *30 non-mathematic-based majors* were analyzed. In the results of the *Chi-square Test,* there were no significant differences between two groups in all questions. Additionally, we compared both genders to observe whether any differences would be found. As a result, there were no significant differences in all questions among females, but there were significant differences in question 2(χ^2 =9.282) and 5(χ^2 =6.212) among males (Table 8).

Table 8: Comparison of attribute-oriented thought by major

Q.	Selection ratio (%) of object 'A'(Object which is similar to 'target' in attributes)			χtest
	32 Mathematics -based majors	*30 Non- mathematics -based majors*	Average	P value
1	56.25	66.67	61.29	0.4001
2	84.38	73.33	79.03	0.2858
3	59.38	46.67	53.23	0.3162
4	65.63	43.33	54.84	0.0780
5	75.00	60.00	67.74	0.2067
6	81.25	76.67	79.03	0.6577
Q.	Mathematics -based majors (10 females)	Non- mathematics -based majors (24 females)	Average	P value
1	70.00	62.50	64.71	0.6767
2	70.00	83.33	79.41	0.3810
3	50.00	50.00	50.00	1.0000
4	50.00	45.83	47.06	0.8245
5	80.00	70.83	73.53	0.5809
6	90.00	83.33	85.29	0.6170
Q.	Mathematics -based majors (22 males)	Non- mathematics -based majors (6 males)	Average	P value
1	50.00	83.33	57.14	0.1436
2	**90.91**	**33.33**	**78.57**	**0.0023***
3	63.64	33.33	57.14	0.1837
4	72.73	33.33	64.29	0.0742
5	72.73	16.67	60.71	0.0127*
6	77.27	50.00	71.43	0.1899

Next, the tendencies of attribute-oriented thought between *31 students who like mathematics* and *17 students who dislike mathematics* were analyzed. In the results, students who like mathematics had stronger tendencies towards attribute-oriented thought than students who dislike mathematics in question 3 (χ^2 =4.697), and 4 (χ^2 =6.947). And, we compared both genders to observe whether any differences would be found. As a result, there were no differences in all questions among females, but there were significant differences in question 2 (χ^2 =6.933), 3 (χ^2 =5.247), 4 (χ^2 =5.033) and 5 (χ^2 =6.933) among males (table 9)

Table 9: Comparison of attribute-oriented thought by mathematical interest

Q.	Selection ratio (%) of object 'A'(Object which is similar to 'target' in attributes)			χtest
	31 people who like Mathematics	*17 people who dislike Mathematics*	Average	P value
1	61.29	58.82	60.42	0.8673
2	83.87	64.71	77.08	0.1308
3	***67.74***	***35.29***	***56.25***	***0.0302****
4	***74.19***	***35.29***	***60.42***	***0.0084****
5	80.65	64.71	75.00	0.2226
6	87.10	70.59	81.63	0.3287
Q.	14 females who like Mathematics	11 females who dislike Mathematics	Average	P value
1	64.29	63.64	64.00	0.9732
2	78.57	81.82	80.00	0.8403
3	64.29	45.45	56.00	0.3464
4	64.29	36.36	52.00	0.1654
5	81.82	71.43	76.00	0.5460
6	85.71	81.82	84.00	0.7920
Q.	17 males who like Mathematics	6 males who dislike Mathematics	Average	P value
1	58.82	50.00	56.52	0.7078
2	***88.24***	***33.33***	***73.91***	***0.0085****

3	***70.59***	***16.67***	***56.52***	***0.0220****
4	***82.35***	***33.33***	***69.57***	***0.0249****
5	***88.24***	***33.33***	***73.91***	***0.0085****
6	88.24	50.00	78.26	0.0509

3.3.Disscussion: mathematical skills and interests as factors that create attribute-oriented thought

There were no significant differences of attribute- oriented thought between two major groups in all six questions (Refer table 8); these results indicate that there were no cognitive differences by mathematical skills (high-leveled vs. low-leveled). This result differed with our assumption. However, some considerable differences of attribute- oriented thought by mathematical interest (like vs. dislike) were shown in question 3 and 4. Especially there were significant differences in question no. 2, 3, 4 and 5 among males. These results correspond with our assumption to some degree.

Next, we considered the attribute-oriented thought by mathematical skills and interests in relation to gender. As a result, we found similar inclinations between mathematical skills and interests; there were no significant differences among females in all questions, but there were significant differences among males; in mathematical skills (Q. 2 and 5); in mathematical interests (Q. 2, 3, 4 and 5). This result confirmed that the effect of mathematical skills and interests towards attribute-oriented thought were more noticeable for males than females (Refer table 8 and 9). Lastly, to observe what caused these inclinations among the participants, we examined the ratio (%) of mathematical interest by majors. As a result, a large number of mathematics-based majors (28.13%: 9 participants in all 32 participants) disliked mathematics. Meanwhile, a great number of non-mathematics-based majors (40%: 12 participants in all 30 participants) liked mathematics (Figure 2).

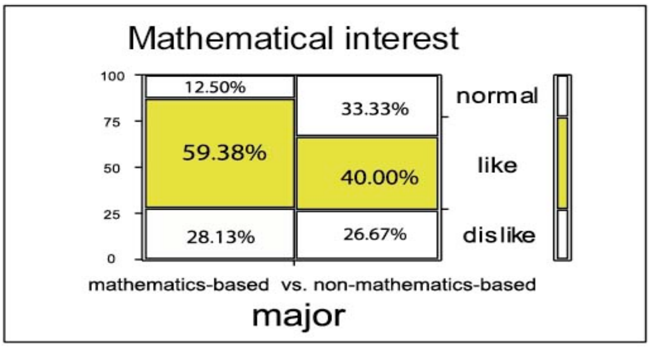


Figure 2: Mathematical interest by major

These tendencies show that there is no interrelated connection between mathematical skills and interests: e.g., high-leveled mathematical skills vs. mathematical liking. From this result we could cognize a possibility that *Kansei* in mathematical interests influence attribute-oriented thought more than mathematical skills.

3.4.Conclusion of the second experiment

We examined the influence of mathematical minds (skills and interests) as the factors on attribute-oriented thought. 62 Japanese university students participated in this experiment. There were no significant differences between 32 mathematic-based majors and 30 non-mathematic-based majors towards attribute-oriented thought. However, some considerable differences with attribute-oriented thought by mathematical interest (like vs. dislike) were viewed and these tendencies were stronger among males than females. Finally, we found a great possibility that attribute-oriented thought may be associated with mathematical interest more than mathematical skills.

4. CONCLUSION

In recent years, many researchers of fields such as product marketing, and user-interface design are focusing their attentions on the consumer's *Kansei*. We studied recognition processes as a method to gain the consumer's *Kansei* information. We dealt with various regions and its mathematical minds as factors creating cognitive divergence.

Firstly, we investigated various regional differences towards recognition processes (attribute-oriented thought vs. relationship-oriented thought). As a result, European subjects had greater tendencies in attribute-oriented thought than Korean subjects. This inclination was similar to the results of precedent studies (Chiu and Sara et al.) related to the regional comparison (the East vs. the West). However, in spite of their regional similarities, Japanese subjects had greater tendencies in attribute-oriented thought than Korean subjects.

Secondly, we examined the mathematical minds (skills and interests) as other factors that create attribute-oriented thought beyond regional character. 62 Japanese university students participated in this experiment. There were no significant differences between mathematics-based majors and non-mathematics-based majors towards attribute-oriented thought. However, in the case of male students who were interested in mathematics, there were some notable inclinations in attribute-oriented thought compared to those who were not.

Based on these two experiments, we found the following remarkable cognitive inclinations; Japanese and European subjects had stronger inclinations in attribute-oriented thought than Korean subjects; *Kansei* in mathematical interests of Japanese influence attribute-oriented thought more than mathematical skills do; the differences in cognitive inclinations are more noticeable for male than female participants. Through these cognitive inclinations, we have learned that mathematical interests could be one of the factors creating cognitive diversity, and that the cognitive diversity could be found more easily among males than females. To confirm these cognitive inclinations, further experimentation and research with diverse groups of participants are needed. This research will be handled in depth in future studies. While cross-culture become an important issue for the product design in the global economy, the intersection of design and culture become a key issue that both the local design and the global market will be worthy of more in-depth study.

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