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STUDY ON PERSONAL CHARACTERISTICS AND AFFORDANCE PERCEPTION: ANOTHER CASE STUDY

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ABSTRACT
Affordances could be regarded as an underlying value aspect for human-centered product, space, and service design. User activities in performing tasks are influenced by the way the user perceives the related surrounding context and environment and determined with user judgment preferences. Physical environment structures afford user activities when these are perceived. Thus, this paper addresses how user activities and perceived affordances are different reflecting personal creativity modes, which are determined by factual-intuitive perception inclination and subjective-objective decision preferences as well as introverted-extroverted nature. To design-in various affordance features for diverse users in varying contexts, understanding on relations between user personal characteristics and affordance perception would be helpful. We conducted a case study in a public space used by many general people. User activities and behaviors were analyzed in several specific tasks in the lobby and the entrance area of a building. User activities can be classified into several different groups for each task based on affordance features involved in their activities. These user activity differences are then compared with their personal creativity modes. This paper reports an on-going research in identifying links between affordance perception and personal characteristics.

Keywords: Personal Characteristics, Affordance Perception, Personal Creativity Modes, User Activity Analysis

1 INTRODUCTION
User activities in performing tasks are influenced by the way the user perceives the related surrounding environment and determined with user judgment preferences. Physical environment structures afford user activities when they are perceived. Also, user activities reflect their emotional situation. Affordance is a concept that is highly related to human perception, judgment and action. Thus it is to be used in designing various artifacts such as products, architectural structures, and space, as well as services. Norman mentioned 'unarticulated needs', which cannot easily be known with simple interviews, focus group interviews, surveys or questionnaires [1]. In reality, these unarticulated needs could be dug out by monitoring and analyzing user activities. Since affordance is also highly associated with activities of users, it is necessary to substantially consider the affordance and its linkages with human characteristics and emotions.

Norman mentioned that designers could communicate with end-users via the system images of products by describing designer's conceptual model and user's mental model [1, 2]. In his remark, the affordance, which was one of main system images of the products, was regarded as a tool to understand users and designers and to make bridge between them. In addition, the affordance is highly related to features of artifacts to drive certain user activities. However, users usually perceive the affordance associated with the features in diverse ways, and they may not recognize designer's original intents embedded in the features [3]. In other words, the user could perceive the affordances from the features which the designers did not originally intend. Therefore, it is necessary to consider the personal or emotional characteristics of users when designing the artifacts [4].

This paper addresses how user activities and perceived affordances are different reflecting personal creativity modes, which are determined by factual-intuitive perception inclination and subjective-objective decision preferences as well as introverted-extroverted nature. We conducted a case study in a public space used by many general people. User activities and behaviors were analyzed in several specific tasks in the lobby and entrance area of a building. The tasks were devised so that various affordance features could be relevant while eliminating other factors affecting the affordance perception than those due to user personal characteristics. User activities can be classified into several different groups for each task based on affordance features involved in their activities. These user activity differences are then compared with their personal creativity modes. For user of less common activities for some tasks, relevant personal cognitive characteristics have been identified.

2 BACKGROUND

2.1 Affordance

Affordance was coined by perceptual psychologist James J. Gibson [5] as follows: The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. It implies the interaction of the animal and the environment. Gibson's essential concept of affordance is that relationship exists in a pair of animal and environment and some parts of this relationship are the invariant features of the environment permitting the animal to do things. From the investigation of affordances of everyday things such as door, telephone and so on, it was argued that the form of everyday things provides strong clues to their operation as a result of the mental interpretation of them, where the mental interpretation is based on people's past knowledge and experiences [2].
Instead of Gibson' affordance, Norman introduced perceived affordance that is about characteristics in the appearance of an object that gives clues for its proper operations. From the user's perspective, he focused on three kind of user's emotional response to product [6]. Koutamanis mentioned that the affordances could be perceived by users differently from the designer's original intent [3]. As can be seen in Figure 1, the fence also provided the sitting affordance to the users. This could be due to the different affordance perceptions of the users possibly based on their different personal characteristics.

Figure 1. Perceived sitting affordances of a bench and fence [3]

Recently, research efforts to develop design theory and methodology reflecting the concept of affordance have been made. Maier and Fadel proposed the affordance-based design method to overcome the weaknesses of function-based design, thus to take the synergy between affordance and function based approaches for better design [7, 8]. They also introduced Affordance-Structure-Matrix (ASM) for evaluating what affordances are embedded in each component of a product. This matrix can illustrate correlations of affordances and also of components [9]. Galvao and Sato proposed Function-Task Interaction Method where product functions and user tasks were linked to identify affordances [10]. Brown and Blessing addressed the relationship between function and affordance [11]. Also, affordances in social interaction were introduced [12]. Affordance features are used in this research as a way to identify user and activity characteristics.

2.2 Personal Creativity Modes

Douglass J. Wilde of Stanford University developed Personal Creativity Modes Test (PCMT) based on the cognitive theory of Jung. PCMT has drawn a considerable attention since it can be used for promoting performances of creative design activities [13]. Personal creativity modes represent the different creativity modes of individuals, which are intrinsically related to their personal cognitive

preferences [14]. According to the cognitive theory of Jung, there are four aspects in the personal cognitive preferences including perceiving/judging preference, factual/conceptual perception, thinking/feeling judgment, and introverted/extroverted cognitive motivation. These four aspects can be deployed into eight different modes of creativity [13], as shown in Figure 2 and Table 1. The characteristics of each personal creativity mode have also been described in a more recent work [15]. At the Creative Design Institute, research work toward design creativity education is being conducted such that various underlying cognitive elements of design creativity, including personal creativity modes, and then develop training programs reflecting individual learner's characteristics to enhance design creativity [16, 17].

The personal creativity modes of users may have significant influence on their activities when they are asked to carry out certain tasks. When they are conducting the given tasks, they perceive many affordances and show diverse activities according to their personal characteristics. In other words, users perceive the same affordances in many different ways according to their personal characteristics and carry out various activities to accomplish the given tasks. Therefore, this paper discusses the relations between individual personal characteristics and affordances which users perceive. This research helps to design products, space and services to effectively provide the necessary affordances to the users based on their emotional and personal characteristics.

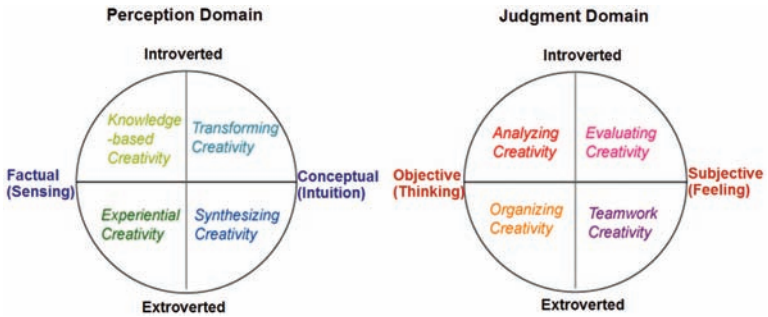


Figure 2. Eight Personal Creative Modes

Table 1. Explanations for Eight Personal Creativity Modes [15]

PERCEPTION		JUDGEMENT	
Synthesizing Creativity	▪ rearranging various elements into new configurations ▪ seeing external patterns, trends, and relationships ▪ exploring profitable new things and methods	**Organizing Creativity**	▪ organizing and managing people and projects to achieve goals ▪ managing resources efficiently and enforcing specifications ▪ setting deadlines, defining procedures, and breaking bottlenecks
Transforming Creativity	▪ transforming external objects as imagery things ▪ speculating project and product future ▪ imagining hard-to-describe images and futuristic possibilities	**Analyzing Creativity**	▪ internal reflective reasoning on relations among data and theories ▪ clarifying ideas through analyzing by internal reasoning ▪ comparing results with goals and standards
Experiential Creativity	▪ discovering new ideas and phenomena by direct experience ▪ providing prompt, practical responses to crisis and emergencies ▪ building and testing models and prototypes	**Teamwork Creativity**	▪ building environment to support human values ▪ detecting and fixing team interpersonal problems ▪ harmonizing team, client, and consumer
Knowledge-based Creativity	▪ finding elements of solution in catalogs, handbooks, or class notes ▪ getting or having existing facts and know-how ▪ detecting and correcting mistakes	**Evaluating Creativity**	▪ using personal values to distinguish between good and bad ▪ governed by a person's own values - aesthetic, ethical, moral and spiritual ▪ evaluating human factors and people's needs

3 CASE STUDY - EXPERIMENT

The case study was conducted to investigate the relationships between personal characteristics and affordance perception in a building lobby. The personal creativity modes of participating students were identified and their activities under the given tasks were monitored. And then, their activities were analyzed, and their relations with the personal creativity modes were studied by considering the perceived affordance. This experiment was conducted in a similar manner with the experiment of a previous paper [4] so that the two experiments may support each other.

3.1 Participants and User Tasks

For the case study, ten freshmen students of Sungkyunkwan University participated to do simple tasks. It is assumed that these students share similar cultural and societal backgrounds for the given simple tasks. The research space was the Research Complex 2 Building in the University, and area A is composed of area B and area C. Area A is lobby area of the building, area B is entrance area and area C is sidewalk area outside. Although the building is in the campus, the students are not familiar with this building because they do not have classes in this building. The students activities were observed with camera. The task sessions were conducted individually, and each took about 10-20 minutes.

Each student was asked to wait while reading a book, eating the snack and drinking a cup of beverage (task T-1). Afterwards, they were asked to sketch an impressive scene on a given piece of paper (task T-2). Finally, they were asked to shake sand out from their shoes (task T-3). For task T-1, 10 students participated in area A. For task T-2, 10 students participated in area A. For task T-3, six students carried out the task in area B or C. The detailed user tasks associated spaces and participants are summarized in Table 2 and Figure 3.

Table 2. Tasks, spaces and participants

Tasks, Spaces and Participants

Task No.	Tasks	Space	Participants	No. of participants
Task 1	Reading a book & Eating the snack / Drinking a cup of beverage	Area A	S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8, S-9, S-10	10
Task 2	Sketching impressive scene on a piece of paper	Area A	S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8, S-9, S-10	10
Task 3	Shaking sand out from the shoes	Area B,C	S-1, S-2, S-3, S-4, S-5, S-6	6

Figure 3. Floor plan of the experiment space

3.2 Activities and Related Affordances

We extracted affordances by observing the students' activities under the given tasks. The method of extracting affordances using user interaction state changes is described in [18]. From the three tasks, 23 different activities were observed as shown in Table 3. A total of 12 affordances were extracted from the activities of the students as follows:

- Look-ability, Walk-ability, Sit-ability, Support-ability, Place-ability, Read-ability, Eat-ability, Drink-ability, Lean-ability, Draw-ability, Hold-ability, Tap-ability

Three kinds of affordance features were identified: physical features of the building lobby, student's human body elements and their belongings. For instance, some students placed books on a stool or on a couch located in the lobby, while some students placed books on their thigh or on their own bags.

Table 3. Activities and related affordances

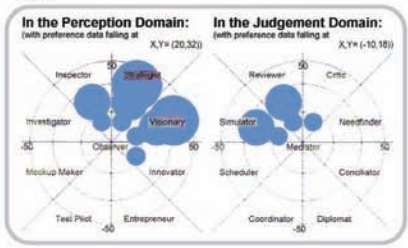
Task No.	Activity No.	Activities of students	Related Affordance		
			with Physical Feature	with Human Feature	with Belonging Feature
T-1	T1-A1	Looking for sitting place.	Look-ability, Walk-ability		
	T1-A2	Walking.	Walk-ability		
	T1-A3	Sitting.	Sit-ability		
	T1-A4	Supporting a leg.		Support-ability	
	T1-A5	Placing the magazine/book.	Place-ability	Place-ability	Place-ability
	T1-A6	Supporting the magazine/book.		Support-ability	
	T1-A7	Holding the magazine.			
	T1-A8	Placing a cup of beverage and snack.	Place-ability		Place-ability
	T1-A9	Reading the magazine/book.	Read-ability		
	T1-A10	Eating snack.	Eat-ability		
	T1-A11	Drinking a cup of baverage.	Drink-ability		
T-2	T2-A1	Looking for place to draw painting.	Look-ability, Walk-ability		
	T2-A2	Sitting to draw a painting.	Sit-ability		
	T2-A3	Leaning.	Lean-ability		
	T2-A4	Supporting a leg.		Support-ability	
	T2-A5	Placing the paper.	Place-ability		
	T2-A6	Supporting the paper.		Support-ability	Support-ability
	T2-A7	Drawing on a piece of paper.	Draw-ability		
T-3	T3-A1	Looking for place to tie.	Look-ability, Walk-ability		
	T3-A2	Sitting.	Sit-ability		
	T3-A3	Leaning.	Lean-ability	Hold-ability	
	T3-A4	Supporting a foot.	Support-ability		
	T3-A5	Tapping shoe.	Tap-ability	Tap-ability	

3.3 Personal Creativity Modes of participants

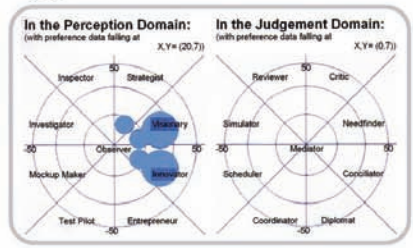
The personal creativity modes of 10 students are summarized in Table 4. For each student, the perception mode and the judgment mode are shown. In perception, the left-right axis indicates factual/intuitive preferences. In judgment, the left-right axis represents feeling/thinking preferences. The top-down axis shows introverted/extroverted nature. The stronger their preferences are, the bigger bubbles are shown. For example, student S-1 has the transforming creativity mode as shown in the upper-right quadrant of the perception domain. He also has the analyzing creativity mode as shown in the upper-left quadrant of the judgment mode. Participant S-4 also has the transforming creativity mode in the perception domain and the evaluating creativity modes in the judgment domain. But we can identify the difference between S-1 and S-4 that the level of transforming creativity of S-1 is much stronger than that of S-4 and the level of analyzing creativity of S-4 is much stronger than that of S-1 as reflected in the size of the bubbles.

Table 4. Personal creativity modes of all participants

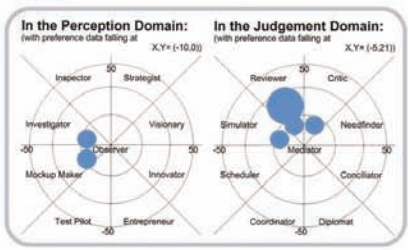
S-1



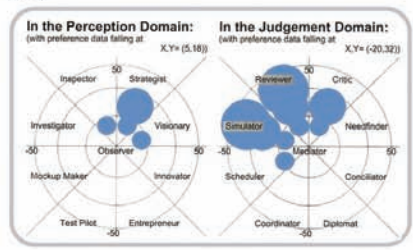
S-2



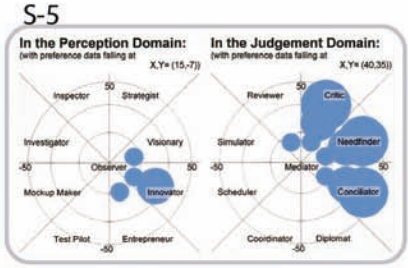
S-3



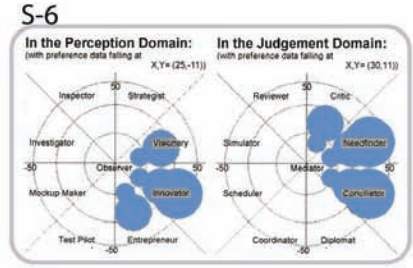
S-4



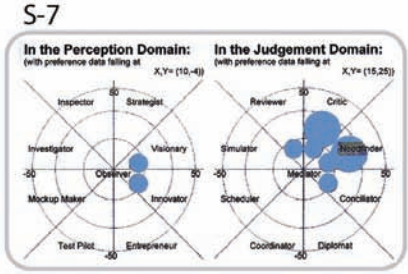
S-5



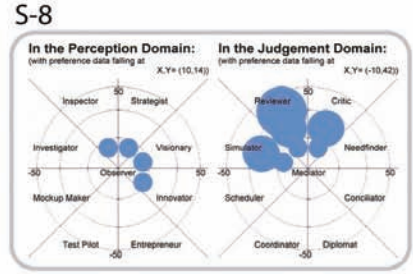
S-6



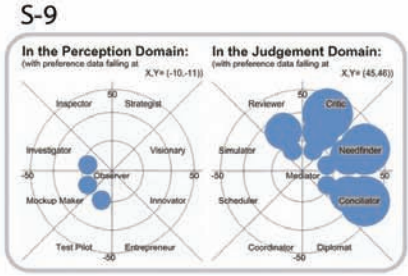
S-7



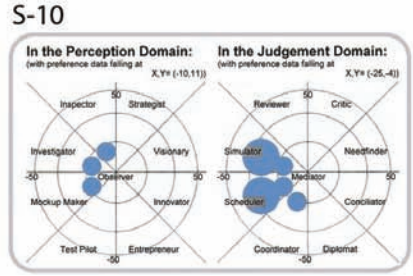
S-8



S-9



S-10



4 ANALYSIS ON PERSONAL CREATIVITY MODES AND ACTIVITIES

4.1 Task: Reading a book & Eating the snack / Drinking a cup of beverage (T-1)

Task T-1 of reading a book, eating snack, and drinking a cup of beverage was assigned to participants in Area A. This area has sofas and stools that can allow several people to sit.

The associated affordances were sit-ability, eat-ability, drink-ability, read-ability, place-ability, look-ability, walk-ability, and hold-ability. The scenes of various activities of T-1 performed by the participants are given in Figure 4 and Figure 5. All participants performed T-1 while sitting.

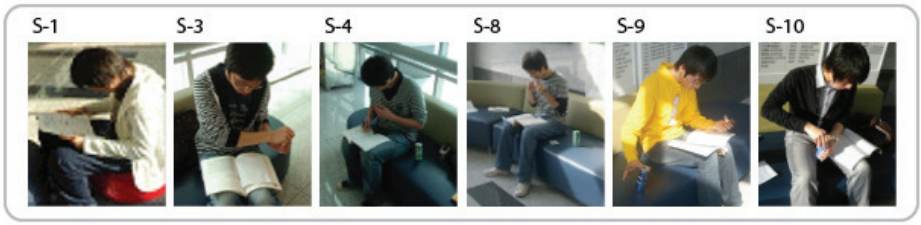


Figure 4: Activities of T-1(reading a book, eating the snack and drinking a cup of beverage): Group A

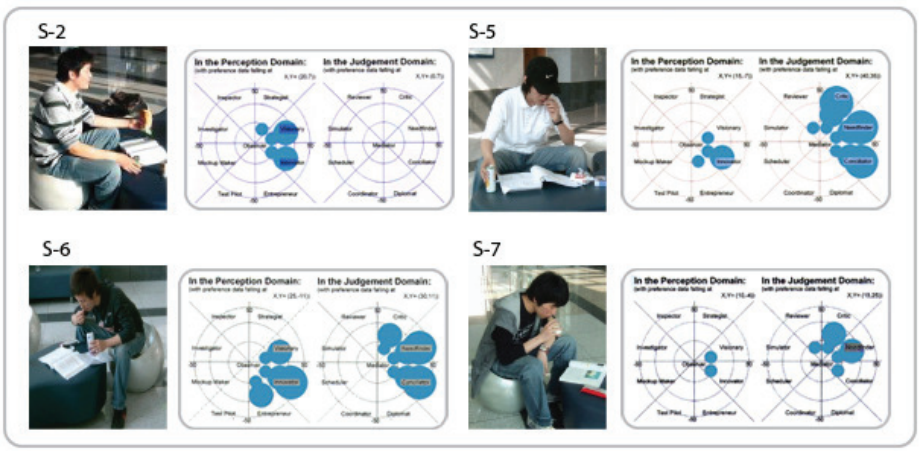


Figure 5: Activities and Personal creativity modes of T-1: Group B

As shown in the Figure 4, S-1, S-3, S-4, S-8 and S-10 who modestly sit, Group A, showed thinking oriented modes and they have introvertedness as well. S-9 was the only exception.
Unlike the above 6 participants, S-2, S-5, S-6 and P-7 of Group B performed T-1 while using the dark blue sofa as a table. The affordances associated with the sofa and stools were sit-ability, eat-ability, drink-ability, read-ability, place-ability, and hold-ability. The personal creativity modes of four participants of Group B, of T-1 also are shown in Figure 5. In this figure, three participants who spread their legs as positive attitude except S-2 showed strong feeling oriented modes in the judgement domain. On the other hand, S-2 showed similar activities to carry out the task with the cases of S-5, S-6 and S-7. However, he showed stronger inclination in perception domain than judgement domain. It is indicated that he might perceive the soft sofa as the affordance feature to support the activities by using the intuitive sensing.

4.2 Task: Sketching impressive scene on a piece of paper (T-2)

The task carried out in Area A as T-2 was to sketch any impressive scene of the lobby on a paper. This task was aimed to discover which features were used to afford the sketching activity on a flexible paper. Group A, B and C were identified by participants' behavior to draw such as standing and sitting.

Out of 10 participants who performed T-2, 7 participants, the members of the group A and C sit on a sofa and stools after looking for an object to sketch. They also used a flat surface of a physical feature to place their stuffs. The affordances they perceived were draw-ability, support-ability, place-ability and sit-ability.

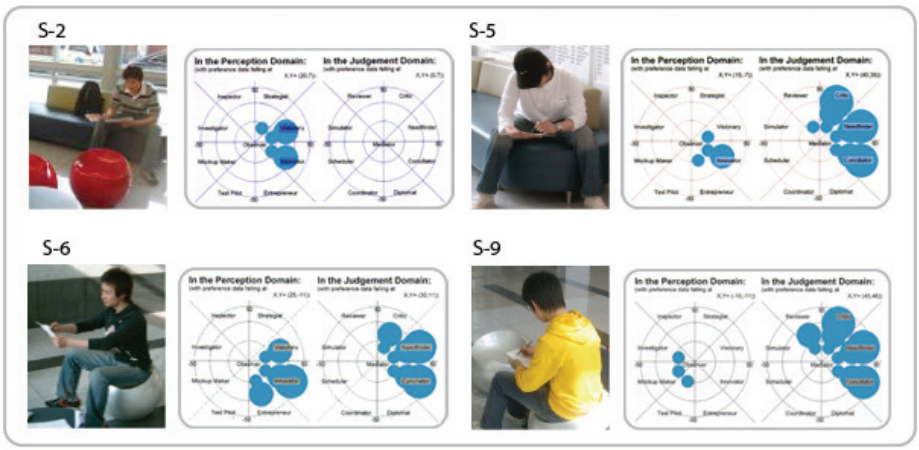


Figure 6: Activities and Personal creativity modes of T-2 (sketching impressive scene on a piece of paper): Group A

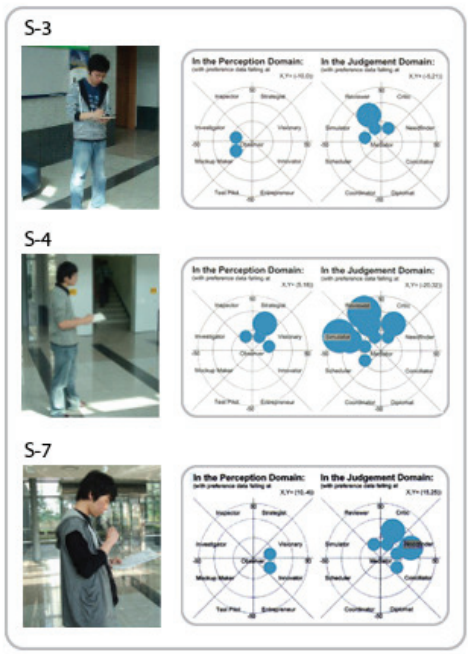


Figure 7: Activities and Personal creativity modes of T-2: Group B

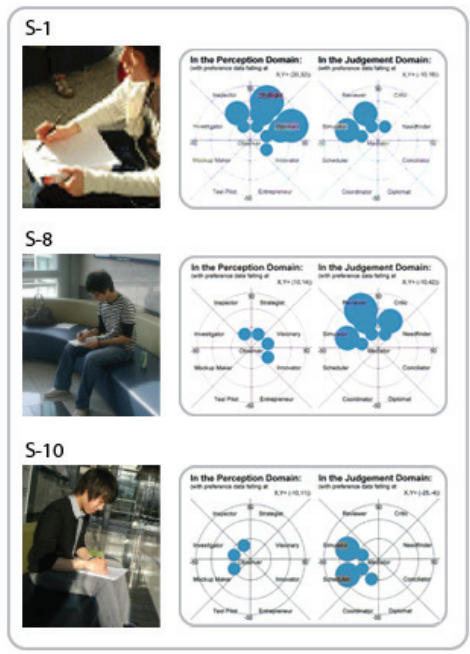


Figure 8: Activities and Personal creativity modes of T-2: Group C

As shown in Figure 7, S-3, S-4 and S-8 of the group B did not sit for convenient. Additionally, they did not find any features to place their belongings but they used their own human body features to support the flexible paper during sketching. The associated affordances were draw-ability, walk-ability, and support-ability. In particular, there were three participants, S-1, S-8, and S-10 of the Group C, who used their thighs to carry out the T-2. They perceived the affordance of support-ability of human feature to fix the paper with hands and to sketch a scene as shown in Figure 8. In this case, the affordances they perceived were draw-ability, support-ability and sit-ability. The personal creativity modes of S-5, S-6, and S-9 among the Group A, who used their palms to support the paper while sitting, showed extremely strong subjective inclinations in the judgement domain. On the other hand, as shown Figure 8, S-1, S-8, and S-10 of the Group C indicated objective inclinations.

The dominant characteristics of S-3, S-4 and S-7 in the personal creativity modes are given in Figure 7. They showed stronger inclination in judgment domain than perception domain, and they were introvert in both domains. They rather passively performed T-2 without actively searching for affordance features in the area. They might have not perceived affordance features from the environment, but made their own judgment. The activities of S-4 and S-8 were different to carry out T-2. Nevertheless, we noticed that both of them are very similar characteristic in the personal creativity modes and they have no distinction to find affordance feature for T-1.

Comparing P-10, Figure 9, of participant of previous research [4] with S-3, although they carried out T-2 at totally different place and environment, their behaviors are extremely similar. They had more introvertedness in their personal characteristics. This characteristic may let them do the same activities for find affordance feature.

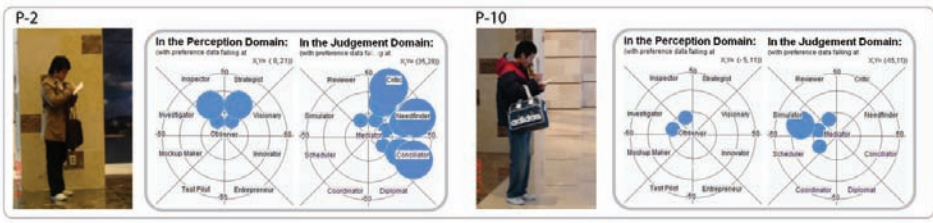


Figure 9: Activities and Personal creativity modes of T-2 [4]

4.3 Task: Shaking sand out from the shoes (T-3)

Task T-3 was shaking sand out in Area B and Area C. As shown in Figure 11 three participants of group A were shaking sand out while they leaned on physical features such as a column wall and a street light with their backs bent over. The affordances they perceived were tap-ability, support-ability and lean-ability. Group B shake their shoes by raising one leg and putting it on other leg with their backs bent over as well. In contrast, only one of 6 participants performed T-3 while he was sitting on a stair as shown in Figure 12. The affordances he perceived were sit-ability, and tap-ability.

The personal creativity modes of Group B, of T-3 are shown in Figure 11. Group B shake their shoes by raising one leg and putting it on other leg with their backs bent over as well. In this figure, two participants who use their one leg without any supporting feature showed strong feeling oriented modes in the judgement domain. Both of them had exceptionally similar attributes and personal characteristics showed similar activities to carry out all the three tasks using similar affordance features.

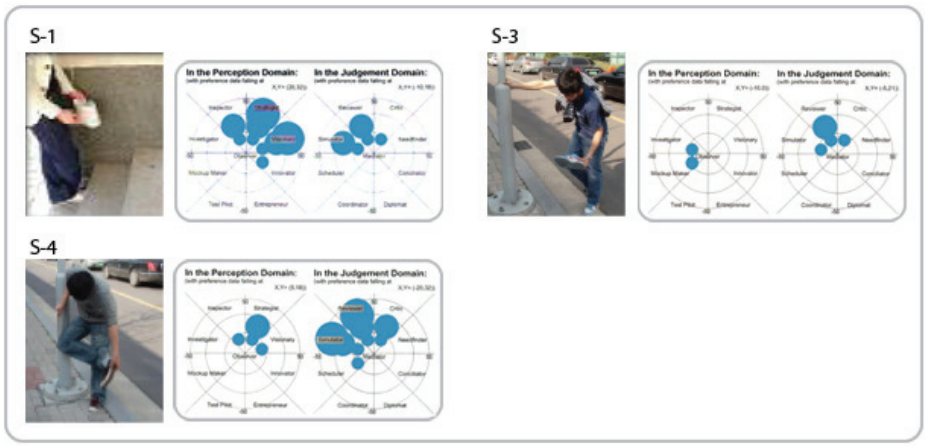


Figure 10: Activities and Personal creativity modes of T-3(shaking sand out from the shoes): Group A

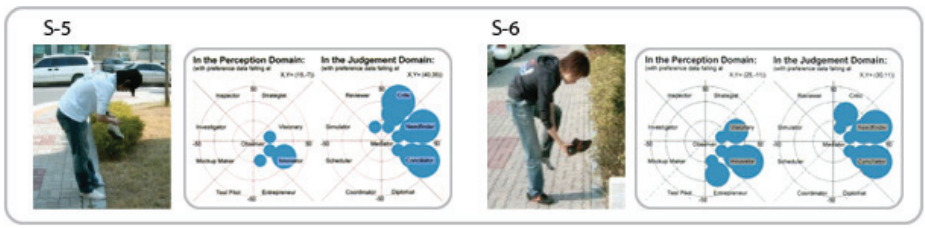


Figure 11: Activities and Personal creativity modes of T-3: Group B

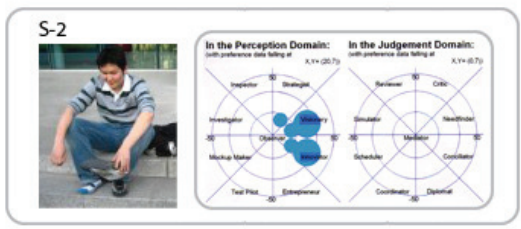


Figure 12: Activities and Personal creativity modes of T-3: Group C

4.4 Discussions

As discussed in the previous sections, humans perceive diverse features in different ways based on the personal characteristics. In other words, humans do not think and act equally although they look at same features. In addition, humans perceive different emotional affordances based on their personal characteristics, resulting in different activities for the same tasks done in the same environment.

In this research, affordances were extracted by observing the participants' actual activities. Those affordances could or could not be perceived according to the participants' personal characteristics. User of the lobby space could perceive the affordances which the designers may not originally consider. In particular, when participants perceived different affordances, their activities and behaviors varied. Those participants who behaved similarly, but in less common manners compared with the majority of the participants, had similar personal creativity modes.
Therefore, it may be necessary for designers to consider various users' activities. For example, when designers are to provide the affordance of sit-ability for the lobby space, they may have to provide

various features to afford the sit-ability considering diverse users. In addition, they also need to expect the users to perceive unintended affordances.

5 CONCLUSIONS

An analysis on user activities and perceived affordances reflecting personal characteristics was conducted through the case study in the public space – a building lobby. The user activities and behaviors were monitored and analyzed under several tasks. The user activities in performing the tasks were classified and then related with their personal creativity modes. It was observed that the personal cognitive characteristics could be related to diverse ways of perceiving affordances. This fact certainly was found out again in this case study. These findings may lead to further studies of how to apply our understandings of affordance in the field of designing products and spaces, where affordance plays vital role, as well as in developing educational tools for people of different emotional and personal characteristics. Diverse users with different emotional and personal characteristics perceive affordances differently.

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