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Proceedings of the 8th International Conference on Kansei Engineering and Emotion Research

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Preface

This book contains the collection of Special Session papers accepted at the 8th International Conference on Kansei Engineering and Emotion Research (KEER 2020), organised by Japan Society of Kansei Engineering (JSKE), the Taiwan Institute of Kansei (TIK), the European Kansei Group (EKG), and Malaysia Association of Kansei Engineering (MAKE).

KEER 2020 was held in Tokyo, Japan. This series of conference has grown to become a leading point of contact between research, scientist, engineers, and practitioners in the adoption of Kansei and Emotion approach. KEER 2020 held six parallel Special Session tracks, covering conventional and emerging areas related to Kansei and Emotion, including Augmented Kansei in Senses and Interaction, Cognitive Diversity, Fashion and Design, Kansei Modelling: Theory, Methodology and Applications, Kansei Research and Emotion Design in China, and Safety and Human Factors. All tracks describe research work in diverse domain highlighting the benefits it could bring to improvements of quality of life in broad spectrum of real-world scenario. KEER 2020 provides a platform for scholars, researchers and practitioners to share their expertise, research work and innovation in related fields.

KEER 2020 received 132 paper submissions from 21 countries in five regions: Asia Pacific, Europe, Middle East, Latin America, and USA. A total of 45 papers were published and presented as Special Session papers, while other accepted papers were published in regular conference proceedings. The ratio of Special Session papers is 34%, reviewed by experts from an array of 50 reviewers from different countries, including Japan, China, Malaysia, Netherlands, Spain and United Kingdom.

We would like to thank all the KEER International Board, the sponsors and supporters, chapter contributors, the local and international committee, for all their assistance and hard work to make KEER 2020 a success. We hope that the papers included in this book will be beneficial to the audience and become a helpful

reference for all the people who have interest to address any of the research areas as introduced in this book.

September 2020   Hiroko Shoji
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Safety and Human Factors

Augmented Kansei in Senses and Interaction

Application of Ambient Scenting and High-Resolution Sound to Children with Intellectual Disabilities to Increase the Total Time for Communication Engagement

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Abstract. Snoezelen is a program conducted in the Multisensory Environment (ME) where different sensory components are designed for people with Intellectual Disabilities (IDs) in endeavor to reduce their agitation and conversely to support their ability to focus when they are involved in social activities. This research attempted to quantify the change in the total time of communication engagement while children with IDs participated the interactive programs in the Multisensory Environment where olfactory and sound stimuli were controlled. The pretest was conducted in the isolated calm-down room with controlled scent and sound stimuli, and the result indicated that the children with IDs were agitated by the fact that they were brought into the closed room alone regardless of the multisensory components in the space. In order to remove their agitation caused by the fears from isolation, this experiment was designed to a group of children in the common play room with controlled green aroma and high-resolution nature sounds. The same interactive program was instructed to the group of children and video-taped daily. A professional assessment was performed to measure the total time of communication engagement of each child during the session. The result showed that the use of green scent and also the combination of green scent and high-resolution nature sound in ME helped children with IDs to get engaged much longer in the communication with the teacher and performed less agitated and disoriented behaviors.

1 Background

1.1 Snoezelen and Multisensory Environment

The recent report indicates that approximately 7.4% of the Japanese population has some kind of disability and the estimation of prevalence of those with disabilities increased from 6.2% in 2013. The prevalence of IDs across the world is around 1% to 3% of the global population, which amounts to as many as 200 million people [1–3]. For the children with IDs, agitation and anxiety largely impact on the time they are engaged in their daily activities. Seeking the optimal environment to support the children with IDs for communication engagement is significantly important not only to increase their quality of life but also to gain more learning opportunities by communicating with others.

For several decades, a number of therapies have been introduced to people with IDs to increase their quality of life. The concept of Snoezelen was developed by Hulsegge and Verheal [4] in Holland and is widely practiced as a therapeutic method for those with IDs around the world. Snoezelen is practiced in the room with limited external stimuli, and contains a range of controlled multisensory stimulation including visual, auditory, and olfactory elements.

Snoezelen is like a tool box with different types of sensory equipment to meet the different sensory needs of the person. Several studies were conducted on those with dementia and it was reported that people showed positive changes in moods and have increased attention to their surrounding environment after spending time in ME [5–8]. These findings were also supported by Holtz et al. [9] in their research of using ME with children recovering from brain injury.

1.2 Designing Olfactory and Sound Stimuli for Multisensory Environment

Designing optimal multisensory components for Snoezelen is highly challenging especially for those with IDs. Their over or under sensitivity to sound, touch, taste, smell, and light could be greater than those without disabilities, and the optimized sensory processing would influence their ability to interact socially and communicate with others. Snoezelen provides a range of sensory stimulation that is tailored to meet the needs of people with IDs in order to manage sensory processing more appropriately. The optimal sensory processing would consequently support their interaction with people and events in society without agitation and disoriented behaviors.

A range of assessment should be undertaken per user to understand his or her sensory needs as we need to consider individual differences in sensory perceptions. Particularly, the sense of olfactory is very complex with about 10 million smell receptors which are categorized into at least 20 different types. Each type detects a different range of odorant molecules. Although humans are believed to have the ability

to identify around 10,000 types of smells, the threshold of detecting odorant molecules could be quite different depending on the individuals as the sense of smell is processed through a very sensitive and complex sensory mechanism [10].

Response to different types of smell is largely influenced by individual olfactory preferences and also their unique experience relating to the particular smells in their lives. The sense of smell goes straight to the limbic system which mainly controls emotions and memories. The particular odorant molecules could trigger certain memories with emotions when these molecules were linked to the smells at the specific past events in their lives. For these reasons, the response to the smell for people with IDs is highly unpredictable and selection of optimal olfactory stimuli in ME is extremely challenging.

A sense of sound could also impact on people's emotions. Various types of music could lure us to different mood, hence, the recent studies showed the quality of sound was also the key factor to impact on our stress condition. The sound recorded in the mountains capturing the high-pitched sound frequencies are argued to have an effect on de-stressing and relaxing people [11]. Our attempt was to design the combination of scent and the high-resolution sound together to create de-stressing and relaxing multisensory environment.

1.3 Objectives of This Study

The aim of this study was to investigate the effects of integrated space scenting and high-resolution sound on behaviors of children with IDs in the way to extend the total time they were engaged in interactive communications. It was hypothesized that the intervention would lead to measurable changes in:

- Adaptive behavior: more attentive and responsive in relation to the environment.
- Maladaptive behavior: less social behavior, apathetic behaviors, rebellious behavior, restless behavior, disoriented behavior, anxious behavior, agitation, and aggression.

By analyzing video-tapes to record the time logs of the above-mentioned behaviors, this study aimed to quantify the total time of each child for communication engagement in the interactive morning program with the teacher.

2 Research Methodology

2.1 Pretest of Olfactory and Sound Stimuli in the Calm-Down-Room

Considering the individual differences in under and over sensitivity to olfactory and sound stimuli, we conducted a pre-testing of green scent and high-resolution nature sound to evaluate the levels of children's responsiveness to ME. We built the isolated room with white partitions to remove the external visual stimuli and installed the sound system to produce high-resolution sound from the mountains and diffuse green scent at the same time. The pre-testing was conducted to three children with IDs - they were brought to the calm-down room when their maladaptive behaviors were identified,

showing profound levels of stress and agitation. We video-taped a gradual process of each child to calm down with a time sequence.

The observation of this pretest indicated that the children with IDs responded differently to the exposure of sound and scent. One child seemed to respond to the sound positively and calmed down more quickly with much lesser agitation and restless movement while others seemed to receive no impact from sound or aroma. One of the important findings from the pretest was, however, the types of sound and olfactory stimuli selected for this experiment didn't overstimulate the children to result in increasing agitated behaviors. We also learnt that bringing a child into the isolated "calm-down" room had created a certain negative psychological implication of being punished regardless of the multisensory elements in the room. With the result of the pretest, we designed ME in the common play area targeting a group of children with IDs rather than observing the change individually in the isolated room. We also confirmed the use of green scent and high-resolution nature sound as olfactory and sound stimuli for this experiment.

2.2 Behavior Assessment of Children with Ids During Morning Interactive Program

This research aimed to quantify the total time that each child was engaged in their daily interactive morning program with the teacher by analyzing video-tapes at a private support center for preschool children under 6 years old. The morning interactive program was performed for about 10 min and the teacher instructed the children a series of songs and short dialogues routinely every day. Children are expected to pay attentions to the teacher and be responsive to her instructions. The morning program was also designed for the children to focus on the activities by reducing as much disoriented and restless behaviors as possible.

Children's responsiveness during the program is also largely influenced by the skills of the teacher instructing the morning session. The data for the assessment was only collected from the program run by the same teacher to avoid different levels of responsiveness caused by the different professional skills. We also considered the fact the children with IDs would gradually become accustomed to the environment and learnt the tasks of the program towards the end of year. The adaptation and learning process was considered when the experiment was scheduled into different phases and the olfactory and sound stimulation are interchangeably implemented every day during this study.

2.3 Multisensory Environment Design for This Experiment

It is important to design each sensory stimulus in a controlled manner in the ME by understanding the influence of independent stimulus and also how they compromise and/or synergize with each other to cause the positive behavioral change on children with IDs. There are some biochemical studies indicating that specific odorant molecules from green plants have a calming down and de-stressing effect [12]. For olfactory stimuli, we used the green fragrance derived from green leaves commercially available, that is claimed to have affect on anti-stressing for this experiment. For the sound

stimuli, we installed a high-resolution sound system, "KooNe" by JVC Kenwood Victor Entertainment, which produces up to 40 kHz high-pitched nature sound in the space. We switched on scenting and sound stimuli during the morning program so that children with IDs are exposed to olfactory and sound stimuli throughout the 10-min program.

Taking the findings from our pretest into account, we installed the system to control sound and olfactory stimuli in a common play room where all children are accustomed to play together. In the common play room, we set up a video camera to film all children with IDs participating the morning program with the teacher. These children were under 6 years old and had been diagnosed with different types of IDs. The video camera was set up to film the same program every morning for 6 months between September 2018 to March 2019. During the program, we controlled the sound and olfactory stimuli in the common room and changed sensory components every day with three patterns 1) base (no sound and no scent), 2) green aroma, and 3) green aroma and high-resolution nature sound. The patterns changed daily in sequence for 6 months during the experiment.

2.4   Assessment for Communication Engagement of Children with ID

An independent observer assessed the video-tapes of all children who participated interactive program routinely instructed every morning. The observer was a professor of education and specialized in child education with IDs. Prior to the video assessment, individual assessment of each child in this program was carefully conducted with the teachers at the support center to understand their diagnosed symptoms and personalities. Unique behaviors of each child were also discussed in details to understand the indications of different behaviors that are linked to their moods.

To design the assessment criteria for quantifying the total time of each child engaging in the interactive communication, we recoded the time for communication engagement when two conditions were met per child. One criterion was when observed the adaptive behaviors when the child was looking at the teacher and responding to her instruction. Another was the reduction in maladaptive behaviors when the child doesn't didn't act disoriented and agitated movement. Only if these two conditions are both met for the child, the professional observer records the time for interactive communication engagement.

The duration of the morning session varies depending how responsive and interactive the children are daily. After recording the total time for interactive communication engagement for each child, the total time for communication was calculated as the percentage of time against the total duration of the morning session on that day. The percentage shows the portion of time each child was engaged in the interactive sessions for the total duration of the morning program.

Considering adaptation and learning process of the children for the same program conducted for 6 months, the measurements were performed in three different periods of learning stages. The 1st period is from September to October 2018, followed by the 2nd period from November to December 2018, and the final period is from January to March 2019.

3   Result

After running this experiment for 6 months, we obtained limited valid data to compare the impact of olfactory and sound stimuli on the total time of interactive communication engagement with three patterns of multisensory components. We identified 6 children with at least one measurement of each pattern as shown Fig. 1. After validating the data, only two children, #01 and #05 have a full set of comparative data for three periods for adaptation and learning stages for all three multisensory environmental patterns.
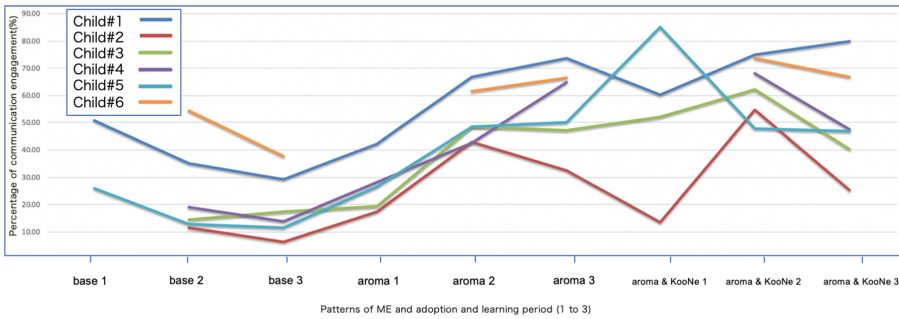
Fig. 1. Percentage of the total time for communication engagement per pattern of multisensory environment in different adaptation and learning period (1 to 3).

Although not all 6 children have sufficient data for the comparison of the different periods for adaptation and learning, the overall tendency observed was the increase in the total time for interactive communication when aroma, or a combination of aroma and KooNe were used in the multisensory environment. Comparing the values for the base, the higher percentage values were found on the vertical axis when both aroma and KooNe were implemented towards the later period of adaptation and learning stage.

3.1   Impact of Aroma and the Combination of Aroma and Sound in ME

Although we couldn't collect sufficient quantity of data for all 6 children for the comparative study of patterns of multisensory components, the average percentage of total time for communication engagement per child in three different multisensory environments was illustrated in Fig. 2. It showed the comparison in the average percentage of time of communication engagement per child for each pattern of multisensory environment, disregarding the periodic differences of adaptation and learning stages. It showed that all 6 children from this experiment resulted in longer interactive communication engagement when aroma and the sound are used in the environment.

It showed a higher percentage for total time of communication engagement when green aroma was used, and the figure goes higher when both green aroma and KooNe were used in the environment for 4 children. The result suggested that the use of aroma
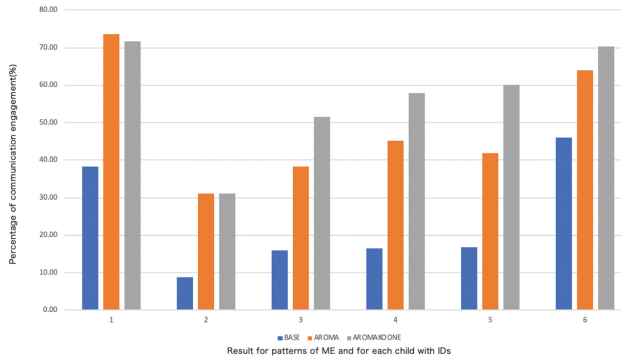
Fig. 2. Percentage of the total time of communication engagement per pattern of multisensory environment disregarding the adaptation and learning period per child.

and sound can be more effective on children with IDs to increase focus and spend more time engaged in the interactive communication activities with much lesser agitated behaviors.

Figure 3 shows the average percentages of communication engagement for each pattern of multisensory environment calculated with all data collected from the 6 children. The result illustrated that use of green aroma and KooNe achieved the longest total time of communication engagement in percentage. A degree of increase in percentage from the base, in the case with green aroma, is much greater than the increase from the green aroma to the combination of both aroma and sound. It leads to the potential argument that the green aroma provided a stronger impact on children with IDs to improve their attention to interactive activities than the effect of the sound.
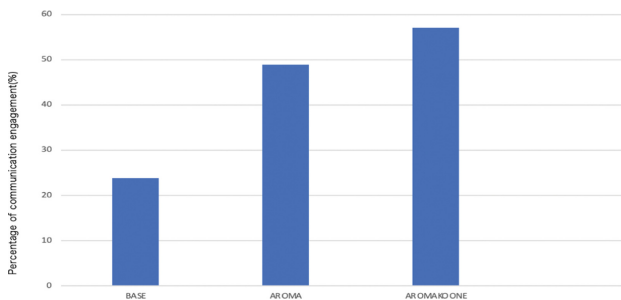
Fig. 3. Average percentage of the total time of communication engagement per pattern of multisensory components for all children.

3.2 Periodic Change of the Total Time of Communication Engagement Due to Adaptation and Learning Process

In the due course of this experiment, we need to consider the gradual process of adaptation and learning of children with the routinely instructed interactive activities.

Their adaptation to the environment at the support center and learning of the same interactive program would result in more communication engagement regardless of the multisensory environment. The periodic change of percentages of communication engagement was illustrated in Fig. 4.
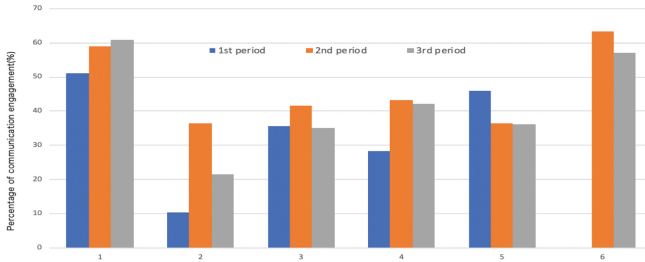
Fig. 4. Percentage of the total time of communication engagement by stages of adaptation and learning period (1 to 3) per child.

Figure 4 showed that all 6 children experienced a gradually increase of the percentage of communication engagement as the time proceeded regardless of the patterns of multisensory environment. The levels of agitation will be reduced when they were accustomed to the surrounding environment and it is often the case that children with IDs will be more stable and actively participating in interactions towards the end of the year.
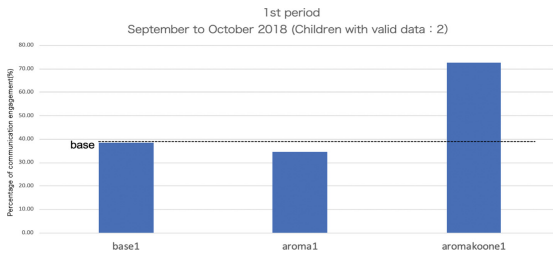
Fig. 5. 1st period (September to October 2018) average percentage of the total time for communication engagement per pattern of multisensory environment.

Considering the adaptation and learning process of children, Fig. 5, 6 and 7 shows the average percentages of total time in communication engagement per pattern of multisensory environment for the different adaptation and learning time from 1st to 3rd period in this experiment.
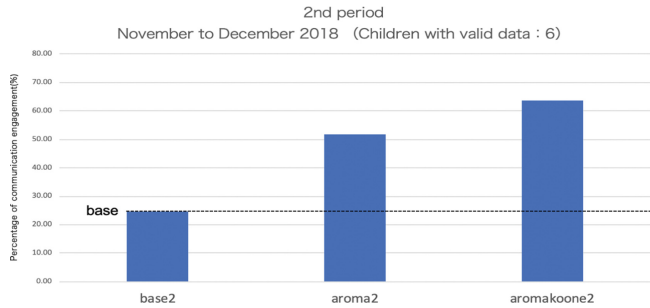
Fig. 6. 2nd period (November to December 2018) average percentage of the total time for communication engagement per pattern of Multisensory Environment.

For the 1st period, we experienced a shortage of comparative data as the data was only collected from 2 children in the experiment group. Hence, the combination of green aroma and KooNe greatly increased the total time of communication engagement compared to the base environment. For the 2nd period in Fig. 6, both green aroma and the combination of green aroma and KooNe led to a much higher percentage of total time of engagement than the base. Likewise, the 3rd period in Fig. 7 also showed a much higher percentage of total time of engagement in the case with green aroma, and also with the combination of green aroma and KooNe. The comparative analysis for different periods of adaptation and learning confirmed that green aroma and the combination of green aroma and KooNe supported children with IDs to get engaged with interactive activities longer and with less disoriented behaviors.
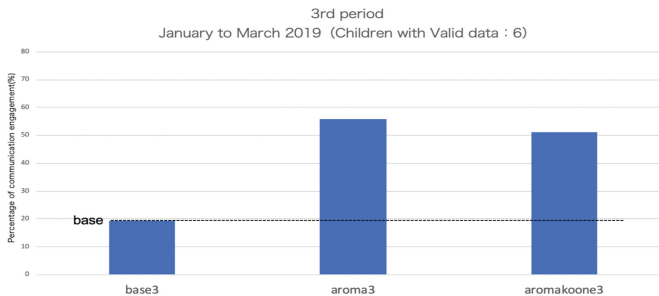
Fig. 7. 3rd period (January to March 2019) average percentage of the total time for communication engagement per pattern of Multisensory Environment.

4   Conclusion

A number of researches suggested that Multisensory Environment of Snoezelen could positively assist those with IDs and our experiment on children with IDs supported the argument that using ambient scenting of green aroma, and the combination of the green aroma and high-resolution nature sound could make a positive change in extending

total time of interactive communication engagement. Multisensory Environment with green aroma and KooNe resulted in largely increasing the total time for children with IDs to be engaged with interactive programs. They paid more attentions to the teacher and reduced restless behaviors. The result of this experiment indicated a greater potential of using green aroma and high-resolution nature sound in ME to support children with IDs for engaging with interactive communication activities, however, further investigation is required to collect larger quantity data to run the statistically comparative study of multisensory environment and its impact on extending total time of communication engagement.

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Classification of Fragrances by Mismatched Colors

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Abstract. Previous studies have examined the relationship between color and fragrance. The fragrances with similar colors have similar impressions. It suggested that colors can express other sensations. However, there has not been much on the relationship between fragrances and mismatched colors. The purpose of this study is to classify fragrances using mismatched colors, and to examine the impression tendency of the classified fragrances. Tone, hue and achromatic color in Practical Color Co-ordinate System (PCSS) were used for color stimuli. 30 fragrances were used for fragrance stimuli. These consisted of flavors and essential oils. For evaluation items, Semantic Differential method was used for impression evaluation, and Visual Analog Scale was used for brightness/vividness evaluation. Procedure for color stimuli: Subject observed the color and performed impression evaluation and brightness/vividness evaluation. Procedure for fragrance stimulation: Subjects smelled the fragrance stimulus and performed impression evaluation and selection of matched/mismatched colors for fragrance. 65 participants joined in the experiment. It was suggested that colors can express the scent through impression, even mismatched ones. In determining the color selection, we assumed that "brilliantness" is related to tone and color category along the hue circle is related to hue. In addition, it was suggested that the harmonious and inharmonic scent colors are in a trade-off relationship.

Keywords: Color · Fragrance · Mismatch color · PCSS · Tone

1 Background and Purpose

1.1 Background

Previous studies have examined the relationship between color and fragrance. The fragrances with similar colors have similar impressions [1]. A similar tendency in the music using the same color method [2]. These studies used applications to represent fragrances or music with a matched color balance. An application that runs on the Apple iPod was created, and PCCS tones, hues, and achromatic colors were used for color stimulation. These studies assert that colors can express other sensations.

Wakata and Saito [3] selected one color each for the tone and hue that matched/mismatched the presented fragrance stimulus. In total, four colors were selected for each fragrance. The results showed that fragrances with similar matched color had similar impressions. There have been a series of studies into fragrances and

matched colors. However, there has not been much on the relationship between fragrances and mismatched colors.

1.2 Purpose

The purpose of this study is to classify fragrances using mismatched colors, and to examine the impression tendency of the classified fragrances.

2 Method

2.1 Stimuli

Color Stimuli. The colors were selected from PCCS. The tone stimuli used 12 tones [vivid: v, bright: b, strong: s, deep: dp, light: lt, soft: sf, dull: d, dark: dk, pale: p, light-grayish: ltg, grayish: g, and dark-grayish: dkg]. A color wheel with 12 patches of hues (1.5 cm × 1.5 cm) was pasted onto a piece of cardboard (10 cm × 10 cm) next to each of these tones. The hue stimulus comprised the following 12 hues [2:R, 4:rO, 6:yO, 8:Y, 10:YG, 12:G, 14:BG, 16:gB, 18:B, 20:V, 22:P, 24:RP]. 12 tones (3 cm × 1.5 cm) were pasted in a belt-shape on a piece of cardboard (5 cm × 21 cm) for each hue. Items pasted onto an A3 sized cardboard (30 cm × 42 cm) were used for both tones and hues. Additionally, a gray scale of 9 neutral color shades [1.5Bk–9.5 W] was pasted in a belt-shape on a piece of cardboard (5 cm × 21 cm). There were thus a total of 25 color stimuli consisting of 12 tones, 12 hues, and 1 neutral color (Fig. 1).

Fragrance Stimuli. In all, 30 fragrances were used for stimuli (Table 1). They were selected in pilot surveys. Pilot survey 1 investigated which fragrances were used by university students in daily life and which fragrances were desired by the university
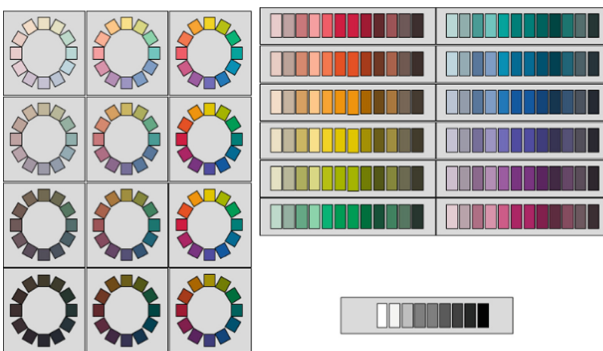
Fig. 1. Color stimuli.

Table 1. Fragrance stimuli.

Melon	(75)	Blueberry	(100)
Apple	(100)	Framboise	(100)
Pear	(200)	Strawberry	(100)
Rose	(100)	Green tea	(300)
Jasmine	(500)	Passion fruit	(100)
Peach	(100)	Pineapple	(100)
Litchi	(100)	Sandals wood	(100)
Grape	(100)	Peppermint	(100)
Orange	(200)	Lavender	(100)
Lemon	(100)	Caramel	(100)
Ginger	(200)	Chocolate	(75)
Almond	(10)	Grapefruit	(200)
Maple	(100)	Coconut	(100)
Honey	(100)	Vanilla	(50)
Banana	(100)	Cinnamon	(150)

fragrance (density:µl)

students. The instructions were as follows: "Please name the fragrances concretely. What fragrances do you use in your daily life and what fragrances do you desire? Any number of fragrances can be named." This survey reached 40 university students.

Pilot survey 2 selected fragrance stimuli from pilot survey 1. Pilot survey 1 and previous studies returned 54 fragrance names, and 23 fragrances were selected. Finally, our research group added seven fragrances from our previous studies. In total, 30 fragrances were selected (Table 1). For the fragrance stimuli, a 2 cm square piece of absorbent cotton was used that was put into a 20 mL dark brown container that had absorbed the given fragrance. The density of the fragrances was adjusted between 10–500 mL with the goal of giving people a uniform smelling experience. The densities are shown in Table 1. A coffee bean was put into the above-mentioned dark brown tinted container and used as a blank stimulus.

2.2   Evaluation Items

Three types of data-collection instruments were used, namely, the semantic differential method (SD method), the visual analog scale (VAS), and a color selection task. The SD method was used to investigate the image of the stimuli, using twenty paired opposites (loud–quiet, dynamic–static, gaudy–subdued, cheerful–gloomy, bright–dark, distinct–blurred, soft–hard, strained–loose, sweet–not sweet, manly–feminine, plain–rich, light–heavy, clear–muddy, refreshing–not refreshing, preferred–repulsive, composed–fidgety, beautiful–ugly, sharp–dull, sour–not sour, and warm–cool) and had a seven-point scale for each item. The VAS was used to measure psychological color, lightness, and saturation, and had two adjectival pair words (bright–dark and vivid–dull). The color selection task was that participants smelled a fragrance stimulus and chose the colors that matched and did not match the image of the fragrance. The color stimuli of the color selection task were general stimuli. The participants selected each color from the tones, achromatic colors, and hues. In total, four colors (matching and not matching tones or achromatic colors, matching and not matching hues) were selected for each fragrance. The instrument was presented on an iPad.

2.3   Participants and Environment of Experiment

There were 65 participants (age: 21.48 ± 1.21, gender: M26 & F39) in this experiment. It was conducted in a university classroom under fluorescent light. The participants were divided into eight groups, and each group was given the stimuli in a different order and had a different adjective pair word order.

2.4   Procedure

Color. The participants were required to look at each color and fill out the instrument (SD method first, VAS second).

Fragrance. The participants were required to smell each fragrance and fill out the instrument (SD method first, color selection task second). Between fragrances, the participants took a minute-long break while smelling a coffee bean to reduce olfactory

Table 2. Mismatched color count: the selectivity (%) of the mismatched colors of each fragrance.

	Mismatch tone and achromatic color													Mismatch hue											
	v	b	s	dp	lt	sf	d	dk	p	ltg	g	dkg	Gy	2R	4rO	6yO	8Y	10YG	12G	14bG	16BG	18B	0 V	22P	24RP
Maple	26.2%	7.7%	15.4%	1.5%	0.0%	6.2%	4.6%	0.0%	4.6%	16.9%	3.1%	0.0%	13.8%	6.2%	1.5%	1.5%	3.1%	3.1%	10.8%	10.8%	15.4%	20.0%	12.3%	7.7%	7.7%
Apple	4.6%	3.1%	1.5%	4.6%	0.0%	3.1%	13.8%	3.1%	3.1%	41.5%	4.6%	4.6%	12.3%	4.6%	4.6%	0.0%	6.2%	12.3%	7.7%	4.6%	4.6%	16.9%	24.6%	3.1%	10.8%
Orange	4.6%	0.0%	0.0%	1.5%	0.0%	0.0%	12.3%	1.5%	0.0%	56.9%	12.3%	1.5%	9.2%	7.7%	4.6%	0.0%	1.5%	1.5%	4.6%	12.3%	10.8%	16.9%	18.5%	10.8%	10.8%
Grape	7.7%	3.1%	0.0%	1.5%	1.5%	0.0%	7.7%	0.0%	1.5%	41.5%	6.2%	7.7%	21.5%	6.2%	3.1%	6.2%	7.7%	9.2%	23.1%	10.8%	3.1%	10.8%	7.7%	4.6%	7.7%
Grapefruit	3.1%	0.0%	3.1%	1.5%	0.0%	0.0%	3.1%	0.0%	1.5%	64.6%	9.2%	1.5%	12.3%	15.4%	1.5%	1.5%	0.0%	4.6%	7.7%	4.6%	1.5%	18.5%	16.9%	13.8%	13.8%
Strawberry	12.3%	1.5%	0.0%	3.1%	0.0%	3.1%	7.7%	1.5%	0.0%	35.4%	16.9%	0.0%	18.5%	7.7%	1.5%	1.5%	3.1%	3.1%	13.8%	6.2%	6.2%	30.8%	10.8%	10.8%	4.6%
Pineapple	1.5%	1.5%	0.0%	1.5%	0.0%	0.0%	12.3%	0.0%	1.5%	50.8%	10.8%	0.0%	20.0%	12.3%	1.5%	0.0%	1.5%	3.1%	6.2%	9.2%	6.2%	20.0%	26.2%	6.2%	7.7%
Banana	9.2%	0.0%	1.5%	3.1%	0.0%	1.5%	12.3%	1.5%	0.0%	30.8%	13.8%	1.5%	24.6%	4.6%	0.0%	0.0%	1.5%	6.2%	9.2%	9.2%	7.7%	30.8%	13.8%	7.7%	9.2%
Peach	3.1%	0.0%	0.0%	3.1%	0.0%	0.0%	10.8%	0.0%	0.0%	46.2%	12.3%	7.7%	16.9%	4.6%	1.5%	0.0%	0.0%	6.2%	7.7%	10.8%	15.4%	15.4%	23.1%	10.8%	4.6%
Blueberry	4.6%	6.2%	0.0%	1.5%	0.0%	0.0%	13.8%	0.0%	0.0%	41.5%	9.2%	4.6%	18.5%	4.6%	3.1%	3.1%	4.6%	9.2%	13.8%	18.5%	4.6%	18.5%	10.8%	9.2%	0.0%
Passion fruit	7.7%	0.0%	0.0%	0.0%	0.0%	3.1%	7.7%	0.0%	0.0%	55.4%	9.2%	0.0%	16.9%	9.2%	1.5%	3.1%	0.0%	1.5%	9.2%	10.8%	4.6%	21.5%	24.6%	7.7%	6.2%
Pear	13.8%	0.0%	1.5%	1.5%	0.0%	4.6%	10.8%	4.6%	1.5%	44.6%	6.2%	0.0%	10.8%	7.7%	1.5%	0.0%	4.6%	1.5%	9.2%	9.2%	9.2%	20.0%	16.9%	4.6%	15.4%
Melon	10.8%	3.1%	0.0%	1.5%	0.0%	3.1%	7.7%	0.0%	0.0%	46.2%	12.3%	1.5%	13.8%	6.2%	3.1%	0.0%	3.1%	4.6%	9.2%	6.2%	9.2%	16.9%	21.5%	7.7%	12.3%
Lemon	3.1%	0.0%	0.0%	1.5%	0.0%	0.0%	9.2%	1.5%	0.0%	46.2%	9.2%	4.6%	20.0%	15.4%	4.6%	0.0%	1.5%	6.2%	3.1%	7.7%	4.6%	16.9%	20.0%	9.2%	10.8%
Framboise	12.3%	7.7%	4.6%	3.1%	0.0%	4.6%	6.2%	1.5%	0.0%	33.8%	7.7%	4.6%	15.4%	7.7%	4.6%	6.2%	1.5%	12.3%	10.8%	10.8%	12.3%	20.0%	6.2%	4.6%	3.1%
Litchi	4.6%	1.5%	0.0%	1.5%	0.0%	0.0%	9.2%	0.0%	0.0%	55.4%	9.2%	1.5%	16.9%	0.0%	3.1%	1.5%	7.7%	4.6%	15.4%	15.4%	7.7%	27.7%	12.3%	4.6%	0.0%
Caramel	21.5%	7.7%	16.9%	3.1%	0.0%	12.3%	3.1%	0.0%	6.2%	13.8%	3.1%	1.5%	10.8%	9.2%	1.5%	0.0%	3.1%	6.2%	23.1%	10.8%	7.7%	7.7%	3.1%	10.8%	16.9%
Almond	33.8%	9.2%	10.8%	6.2%	1.5%	9.2%	1.5%	1.5%	3.1%	10.8%	4.6%	1.5%	6.2%	4.6%	3.1%	3.1%	3.1%	6.2%	13.8%	13.8%	9.2%	7.7%	12.3%	7.7%	15.4%
Coconut	15.4%	4.6%	10.8%	1.5%	0.0%	13.8%	0.0%	0.0%	4.6%	27.7%	6.2%	4.6%	10.8%	7.7%	3.1%	3.1%	3.1%	1.5%	15.4%	10.8%	12.3%	9.2%	16.9%	7.7%	9.2%
Chocolate	32.3%	6.2%	12.3%	4.6%	1.5%	13.8%	3.1%	0.0%	6.2%	3.1%	3.1%	1.5%	12.3%	3.1%	0.0%	0.0%	4.6%	3.1%	20.0%	13.8%	7.7%	13.8%	12.3%	9.2%	12.3%
Peppermint	12.3%	0.0%	6.2%	7.7%	1.5%	6.2%	4.6%	1.5%	0.0%	38.5%	10.8%	3.1%	7.7%	30.8%	9.2%	6.2%	3.1%	6.2%	1.5%	1.5%	1.5%	3.1%	4.6%	9.2%	23.1%
Rose	16.9%	0.0%	3.1%	0.0%	1.5%	4.6%	7.7%	1.5%	6.2%	32.3%	6.2%	4.6%	15.4%	13.8%	7.7%	1.5%	12.3%	6.2%	4.6%	10.8%	9.2%	9.2%	7.7%	6.2%	20.0%
Jasmine	16.9%	4.6%	6.2%	0.0%	0.0%	10.8%	4.6%	0.0%	7.7%	35.4%	6.2%	1.5%	6.2%	13.8%	4.6%	6.2%	10.8%	4.6%	4.6%	4.6%	3.1%	10.8%	13.8%	1.5%	18.5%
Cinnamon	23.1%	7.7%	13.8%	3.1%	1.5%	7.7%	3.1%	1.5%	6.2%	15.4%	4.6%	4.6%	7.7%	13.8%	3.1%	4.6%	9.2%	4.6%	13.8%	4.6%	6.2%	9.2%	10.8%	4.6%	15.4%
Ginger	30.8%	13.8%	10.8%	6.2%	0.0%	1.5%	4.6%	1.5%	0.0%	16.9%	3.1%	4.6%	6.2%	20.0%	4.6%	6.2%	9.2%	0.0%	4.6%	7.7%	1.5%	15.4%	7.7%	10.8%	12.3%
Honey	46.2%	6.2%	6.2%	0.0%	0.0%	9.2%	1.5%	0.0%	0.0%	15.4%	1.5%	1.5%	12.3%	6.2%	1.5%	0.0%	6.2%	3.1%	13.8%	15.4%	10.8%	23.1%	4.6%	6.2%	9.2%
Green tea	13.8%	3.1%	12.3%	3.1%	0.0%	10.8%	4.6%	0.0%	0.0%	30.8%	6.2%	1.5%	13.8%	20.0%	3.1%	3.1%	10.8%	1.5%	7.7%	3.1%	1.5%	16.9%	12.3%	9.2%	9.2%
Sandals wood	32.3%	10.8%	16.9%	1.5%	1.5%	4.6%	1.5%	0.0%	1.5%	12.3%	3.1%	4.6%	9.2%	27.7%	9.2%	1.5%	7.7%	3.1%	0.0%	1.5%	4.6%	6.2%	3.1%	12.3%	23.1%
Lavender	21.5%	10.8%	3.1%	4.6%	1.5%	7.7%	1.5%	0.0%	1.5%	30.8%	6.2%	0.0%	10.8%	20.0%	6.2%	7.7%	3.1%	6.2%	6.2%	3.1%	1.5%	7.7%	10.8%	7.7%	20.0%
Vanilla	16.9%	1.5%	1.5%	3.1%	0.0%	13.8%	7.7%	0.0%	4.6%	18.5%	9.2%	4.6%	18.5%	9.2%	0.0%	0.0%	6.2%	9.2%	13.8%	10.8%	10.8%	9.2%	13.8%	4.6%	12.3%

exhaustion. Additionally, because the olfactory senses can be numbed if fragrances are presented in succession, the fragrances were divided into three groups with 10 fragrances each, and an adequate break was set between the three groups.

3 Result

3.1 Color Count

Table 2 shows the selectivity (%) of the mismatched colors of each fragrance.

3.2 Cluster Analysis 1: Clustering Fragrances by Mismatched Colors

A cluster analysis was performed on the selectivity (%) of mismatch colors for each fragrance. This analysis was performed twice: "tone + achromatic color" (*tones) and "hue." The tones showed six clusters and hue nine (Fig. 2 and 3).
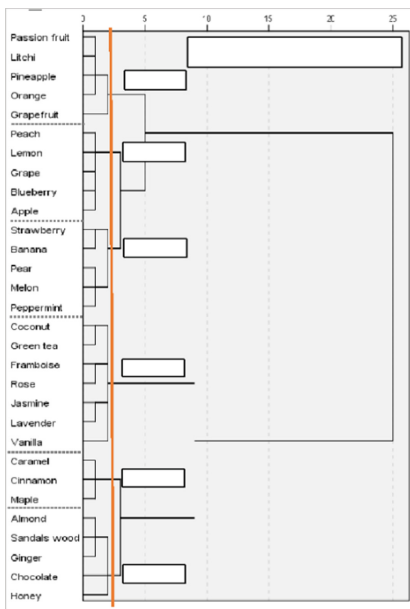
Fig. 2. Fragrance classification cluster analysis result: Dendrogram of Tone.
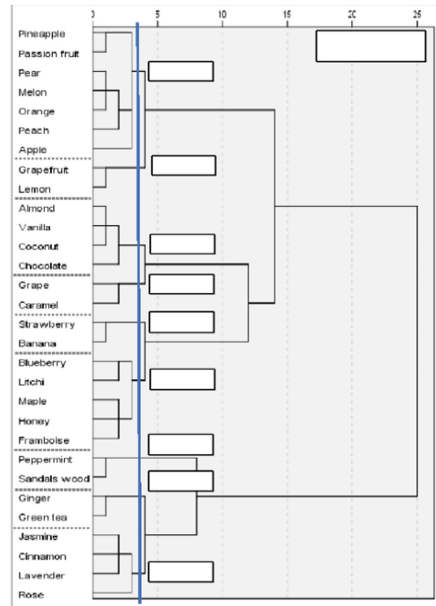
Fig. 3. Fragrance classification cluster analysis result: Dendrogram of Tone.

The results of the color impression evaluation for each cluster are shown in Fig. 4 and 5.

*Appendix 1: Evaluation item number

	-3		3
1:	not sweet	–	sweet
2:	feminine	–	manly
3:	cool	–	warm
4:	gloomy	–	cheerful
5:	hard	–	soft
6:	dark	–	bright
7:	hateful	–	preferable
8:	ugly	–	beautiful
9:	blurred	–	distinctly
10:	subdued	–	gaudy
11:	dull	–	sharp
12:	not sour	–	sour
13:	rich	–	plain
14:	not refreshed	–	refreshed
15:	fidgety	–	composured
16:	heavy	–	light
17:	muddy	–	clear
18:	quiet	–	loud
19:	static	–	dynamic
20:	loosen	–	strained
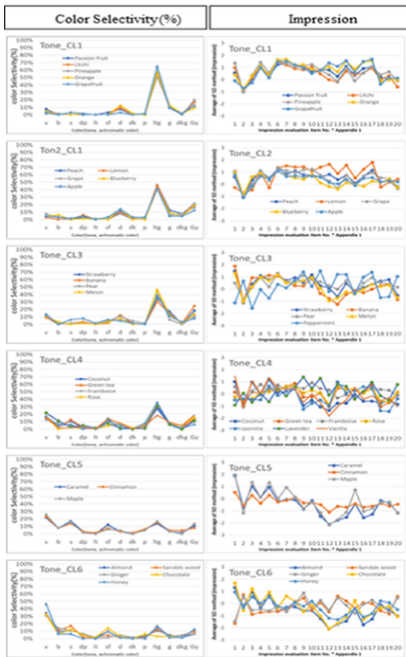
Fig. 4. Color selection and impression for each cluster (Tone).
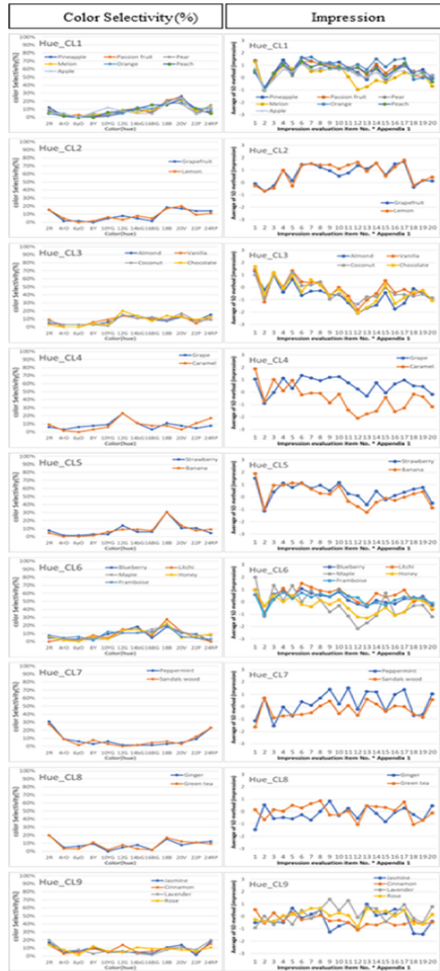
Fig. 5. Color selection and impression for each cluster (Hue).
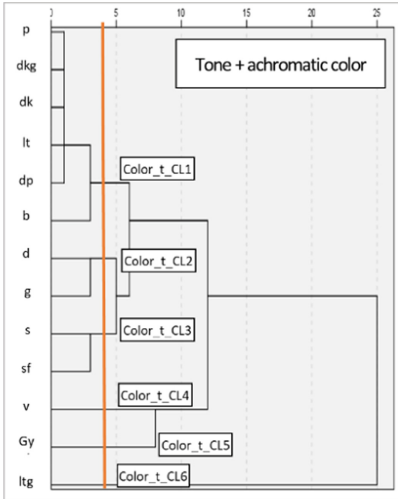
Fig. 6. Color classification cluster analysis result: Dendrogram of Tone
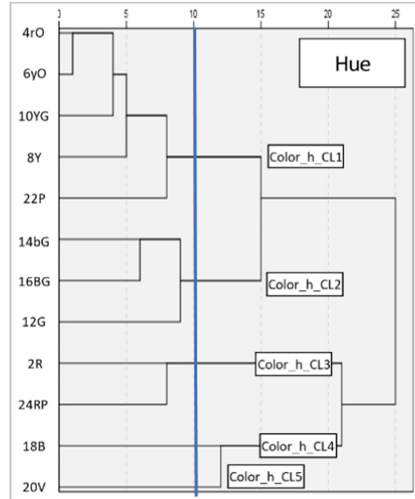
Fig. 7. Color classification cluster analysis result: Dendrogram of Tone.

3.3   Cluster Analysis 2: Clustering Color by Mismatched Color Selectivity (%) of Mismatched Colors for Each Fragrance

This involved classifying the color stimuli using the same data as cluster analysis 1 and it was performed twice too. Colors were classified by fragrance selectivity in this analysis. The tones showed six clusters and hue five (Fig. 6 and 7).

3.4   Correspondence Analysis

A correspondence analysis was performed on the selectivity of mismatched colors for fragrance. The results were showed on scatter plots (Fig. 8 and 9).
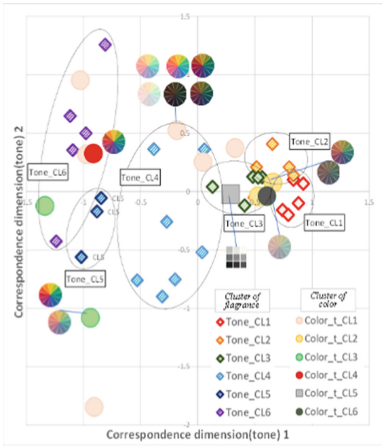
Fig. 8. Correspondence analysis scatter plot (Tone).
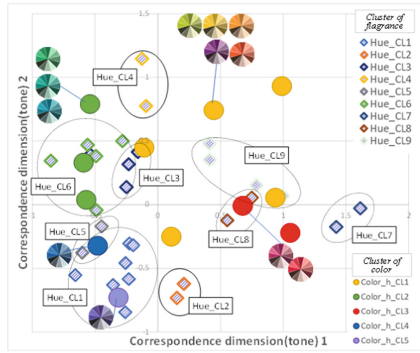
Fig. 9. Correspondence analysis scatter plot (Hue).

The purpose of this analysis was to visualize the relationship between fragrance and mismatched colors. Fragrance stimuli were plotted for each cluster obtained in cluster analysis1, while color stimuli were plotted for each cluster obtained in cluster analysis2.

3.5   Principal Component Analysis

A principal component analysis (PCA) was performed using scores from the VAS. The results of this analysis referred to the results presented in [2]. The brightness and vividness integrated by the PCA were named "brilliantness".

3.6   Correlation Coefficients Between Correspondence Analyses, VAS (Brightness and Vividness), and PCA Scores

Correlation coefficients were calculated for the correspondence analyses, VAS (brightness and vividness) and PCA scores. The coefficients were calculated for each tone and hue (Table 3 and 4).

Table 3. Correlation coefficients (Tone).

	VAS score		PCA score	Correspondence score	
	Brightness	Vividness	Tone_pca	Dimension 1	Dimension 2
Brightness	1.000	0.770	0.950	−0.776	−0.217
Vividness	0.770	1.000	0.931	−0.774	0.237
Tone_pca	0.950	0.931	1.000	−0.824	−0.007
Dimension1	−0.776	−0.774	−0.824	1.000	0.190
Dimension2	−0.217	0.237	−0.007	0.190	1.000

Table 4. Correlation coefficients (Hue).

	VAS score		PCA score	Correspondence score	
	Brightness	Vividness	hue_pca	Dimension 1	Dimension 2
Brightness	1.000	0.656	0.960	0.733	0.637
Vividness	0.656	1.000	0.842	0.427	0.175
Hue_pca	0.960	0.842	1.000	0.683	0.521
Dimensionl	0.733	0.427	0.683	1.000	0.133
Dimension2	0.637	0.175	0.521	0.133	1.000

4   Discussion

4.1   Impression of Fragrance Classified by Mismatch Colors

The results for tones and achromatic colors showed that ltg tone was selected as a mismatch color in about half of the fragrance. The dendrogram (Fig. 2 and 4) is divided into three groups: a cluster of fragrance with a large selection of ltg, a group with a low selection, and another group with a low selection. The group with a low selection of ltg was further divided into two depending on whether v tone had a selection. Focusing on impressions in each group, Tone_CL1, Tone_CL2, Tone_CL5 and Tone_CL6 showed similar impressions (Fig. 4). Tone_CL1 and Tone_2CL consist of grapefruit, orange, peach, and apple, while Tone_CL5 contains caramel and maple (Fig. 2). Although Tone_CL6 was divided into almond, chocolate, honey and sandalwood, and ginger, it was shown to have similar impression (Fig. 2 and 4).

For hue, a single color was selected specially like with tones. It was observed that 18B and 20 V were selected in Hue_CL1 and Hue_CL2, 12B was selected in Hue_CL4, 18B was selected in Hue_CL5 and Hue_CL6, and 2R and 24RP were selected in Hue_CL7 and Hue_CL8 (Fig. 3 and 5). As for the impression, it was shown that the fragrance constituting Hue_CL1, Hue_CL2, Hue_CL3, and Hue_CL5 were similar (Fig. 5).

These results suggest that citrus (orange, grapefruit etc.), peach, apple, pineapple, almonds, and chocolates are characterized by a common choice of color in tone and hue.

In addition, although no common impression was observed, the same tendency as the harmony color of Wakata et al. [4] was observed in the other clusters with fragrance classification tendencies.

4.2 Interpretation of Color

According to the results of cluster analysis 2, no tendency was observed from a brightness and vividness perspective, such as that the first cluster includes b and dkg (Fig. 6). For the individual tones, the correlation coefficient in Table 3 show that the first dimension of correspondence analysis was negatively correlated with brightness, vividness, and "brilliantness" (Fig. 8). This result indicates that "brilliantness" and brightness and vividness are related to judgment even for mismatched colors.

Regarding the hue, the results of cluster analysis 2 show that Color_h_CL1 contained 22P in the orange to yellowish green range, but the other groups tended to cluster close to hues in the hue circle (Fig. 7). When interpreted together with the results of the correspondence analysis in Fig. 9, it was observed that the first dimension was plotted as a red-green axis and the second dimension as a yellow-blue axis. This result suggests that color selection along the hue circle can be performed even for mismatched colors. This result was shown regardless of tone or hue.

When compared to the results of matched colors for fragrances, the classification of the fragrance with the mismatched color tended to be similar to those with matched colors. Wakata [5] on the relationship between matched colors and mismatched colors found that colors not used in the selection of the matched colors are used as mismatched colors, and the same tendency was observed in this study. In other words, it was suggested that matched colors and mismatched colors are in a trade-off relationship.

5 Conclusion

It was suggested that colors can express the scent through impression, even mismatched ones. In determining the color selection, we assumed that "brilliantness" is related to tone and color category along the hue circle is related to hue. In addition, it was suggested that the harmonious and inharmonic scent colors are in a trade-off relationship.

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Evaluating Visual Cues from Fabric Stretch Videos: A Study

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Abstract. This research aims to explain the visual information observed through videos that demonstrated fabric stretch capabilities, including factors such as the surface of the fabric being stretched and the surrounding area. As a result, the stretch conditions serving to communicate the degree of stretch of the fabric, stretch distance, and stretch speed were determined. The degree of stretch of the fabric was found to be best judged by just the stretch aspect of the fabric surface. However, visual information on stretch was not always clear, suggesting that the details involved in rating fabric stretch differs depending on the material.

Keywords: Fabric · Stretch evaluation · Visual information · Video

1 Introduction

Every year, increasingly more consumers purchase clothes through the Internet, whether directly from retailers through their e-commerce sites [1, 2] or from other individuals buying and selling clothes through marketplace apps and auction sites [3]. As these consumers assess the quality of clothes and fabric materials solely from visual information transmitted via images and videos, there is a growing need for technological ways to accurately convey the texture of clothes and fabrics through images and videos alone [4–10]. Stretchable materials are of particular interest, as they are manufactured and sold in increasing numbers in recent years due to their comfort and functionality, thus creating the need for images and videos that are capable of accurately conveying the elasticity of the material to potential consumers. Though there have been studies in the past examining how to measure the stretch of a material [11, 12] and related characteristics [13, 14], the majority of these studies were conducted via direct physical contact with the material in question, leaving unexamined the possibility of conveying texture solely through visual cues. Our research thus aims to examine evaluations of fabric elasticity through videos by varying the materials' stretch distance and stretch speed in the videos. We conducted the experiment with videos that focused on the fabric near where the fabric is being stretched (the stretch area) as well as the general surface of the fabric, with two variants of each consisting of the following: one that shows the whole fabric (with the stretch area visible) and the other a part where the stretch area is covered (eliminating the stretch area from sight). The videos were then

used for a visual evaluation, in which participants must assess the elasticity of a fabric from only visual information, and a visual and tactile evaluation in which participants assess the elasticity of the fabric from both visual and tactile information. By comparing the results of the evaluation of each set, we aim to determine the optimal stretch distance and speed at which fabric stretch is accurately demonstrated, as well as to determine the visual information associated with the evaluation of a fabric's elasticity.

2 Experiment

Figure 1 shows two experimental environments of visual evaluation (VE) and visual and tactile evaluation (VTE). In VE, Color Edge CG2420 (EIZO Company Kanazawa Japan; resolution: 1920 x 1200) was used as a display, and the display and subjective viewing distance were set to about 70 cm apart. As test fabrics, cotton and polyester with a high degree of elasticity (color: beige) were used, being cut into 20 cm × 20 cm sections. A video example of fabric (polyester) is provided in Fig. 2. Fabric videos were prepared for a total of 80 patterns; stretching speed fit 10 patterns (every 10 mm/s from 10 to 100 mm/s), stretching distances four patterns (every 10 mm from 10 mm to 40 mm), and videos were shown with and without the stretching area (2 patterns) for a fabric. These videos were captured by the animation function of D600 made by Nikon, using a fabric photo system [15]. The stretching method for fabric suppressed one side of the cloth and had stretched the other side of the cloth. A session of cloth picture presentations included 40 patterns and took five minutes. Participants took a break after each session. The fabric video and the actual fabric were presented at random. When requested, a cloth picture was repeated. Observers employed 40 students in an engineering department (20 males (21 ± 2 years old) and 20 females (21 ± 2 years old)), and the order of presentation of the fabric video with and without the stretch area was counterbalanced across participants: 20 observers (10 males and 10 females) viewed the fabric video with the stretch area then without the stretch area, and the other 20 viewed it in the reverse order. Fabric stretch was rated on a 5-point unipolar rating scale (1: *Bad*, 2: *Poor*, 3: *Fair*, 4: *Good*, 5: *Excellent*).
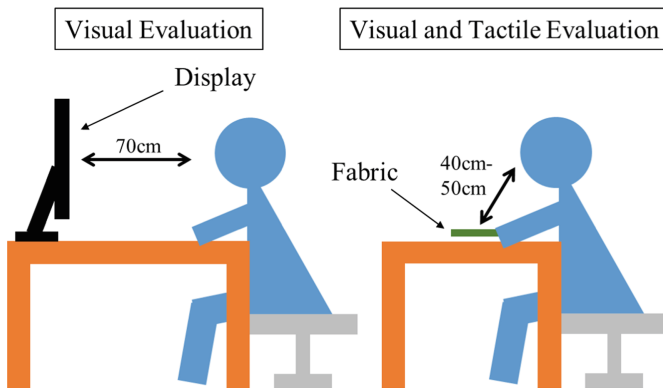
Fig. 1. Experimental set-ups of the visual evaluation (left) and visual and tactile evaluation (right).
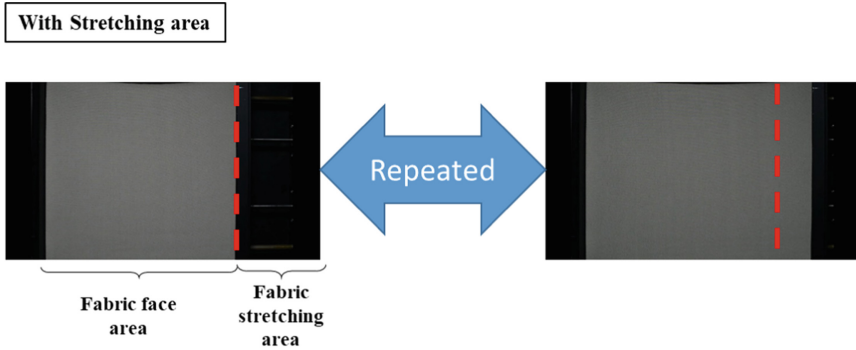
Fig. 2. Example fabric video with stretching area (ex. polyester).

3   Results and Discussion

Figure 3 shows the mean values of the evaluated elasticity for (a) cotton fabric and (b) polyester fabric, each with the stretch area visible and with the stretch area concealed. As the stretch distance increased, the assessed stretch value increased as well, demonstrating a clear link between a longer stretch distance of the fabric and the appraised elasticity of the fabric. In the case of (a) cotton, having the stretch area visible or concealed produced similar evaluations of elasticity, with no statistically significant difference. In the case of (b) polyester, however, the difference between the two variants increased along with the stretch distance, showing statistically significant differences at two data points when the fabric was stretched: 2 mm and 4 mm. It can be surmised that the general fabric surface is the key factor for the visual evaluation of the elasticity of cotton fabric, given that cotton showed no difference regardless of whether the stretch area was visible. Conversely, it is possible that the visual information for assessing polyester elasticity is concentrated mainly in the stretch area, given that the visibility of the stretch area affected the visual evaluation of elasticity for polyester. Thus, we suggest that the visual information conveyed regarding material elasticity varies depending on the material of the fabric.

Figure 4 illustrates the differences between the visual evaluation and visual and tactile evaluation of (a) cotton and (b) polyester, as well as (1) with and (2) without the stretching area. A comparison between Fig. 4a and b shows that elasticity evaluations for cotton were more accurate than for polyester under all conditions. In addition, cotton was correctly evaluated through visual cues under the following two conditions: a stretch distance of 40 mm combined with a stretch speed of under 30 mm per second, and a stretch distance of 30 mm combined with a stretch speed of over 40 mm per second. This trend holds true regardless of whether the stretch area is visible in the video, suggesting that these parameters must be the optimal conditions for conveying the elasticity of the physical material solely through visual cues. On the other hand, the data for polyester shows that the greater the stretch distance, the more closely the evaluations resemble those derived from in-person assessments of the fabric. This trend also holds true regardless of whether the stretch area is visible in the video. We surmise

(a) Cotton
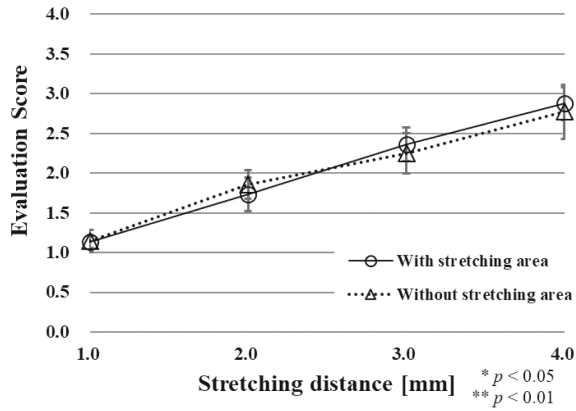
(b) Polyester
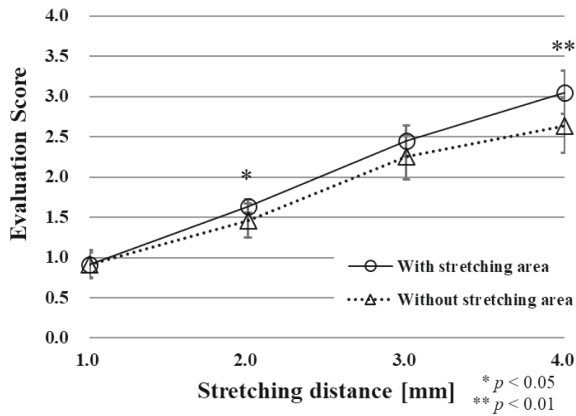
Fig. 3. Results of VE for (a) cotton; (b) polyester.

that evaluations based on visual cues alone tend to understate polyester's elasticity compared to in-person assessments.

For both cotton and polyester fabric, there appeared to be difficulty in appraising fabric elasticity with the stretch area concealed and a stretch speed less than 40 mm per second. We suggest that visual assessments of elasticity by viewing the fabric surface require the video to be filmed with stretch speed greater than a certain value.

(a-1) with stretching area   (a-2) without stretching area

Difference Scale

(b-1) with stretching area   (b-2) without stretching area
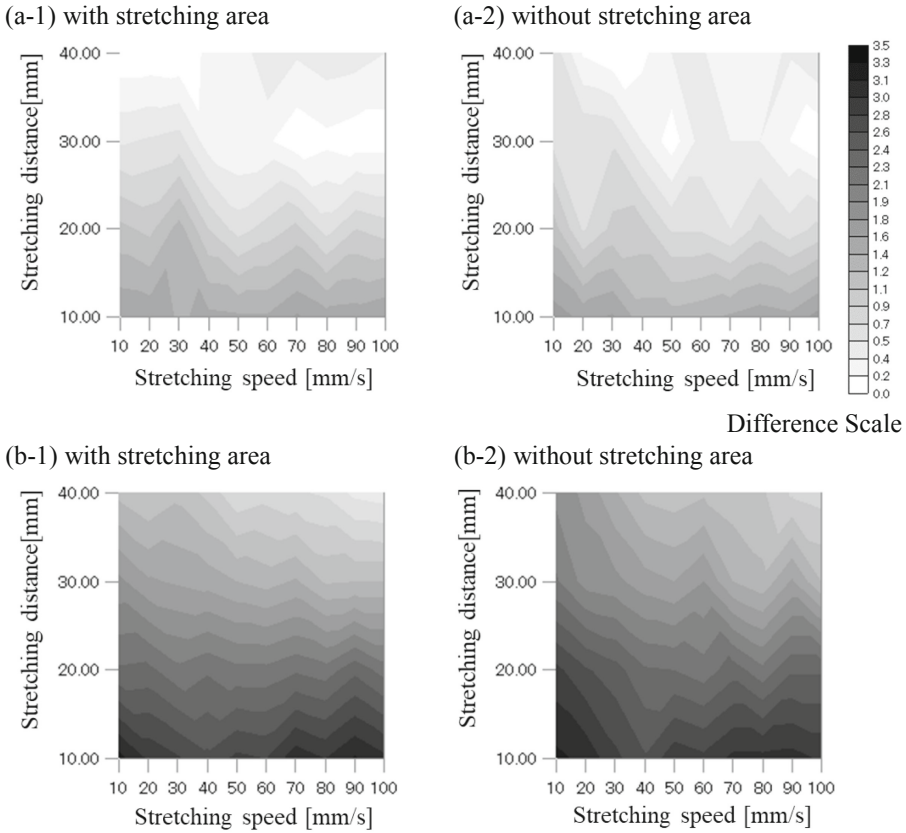
Fig. 4. Differences between VE and VTE: (a) cotton; (b) polyester.

4 Conclusion and Future Work

Through videos of fabric stretching under variable controlled conditions, we were able to determine the conditions and stretch velocity necessary to accurately convey the elasticity of a fabric solely through visual cues. In addition, we also determined that certain fabrics only require the overall fabric surface to be shown for this to be possible, while other fabrics require the visual information from the area directly near the stretched area. In both cases, a certain stretch velocity is required for such visual assessment. We aim to further define the visual cues that contribute to correct assessments of fabric elasticity in future quantitative analyses. Determining the optical flow of the fabric surface in order to clarify its associations with fabric elasticity is the way forward.

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A Research on Spatial Perception Focused on Olfactory Stimulant

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Abstract. This study aims to obtain an understanding of how olfactory stimulation influences emotional evaluation of spatial elements. For this purpose, we analyzed (1) whether there is a difference in the characteristics of the participant's evaluation tendency in the presence and absence of olfactory stimulation, and (2) how the spatial elements were perceived in the presence and absence of olfactory stimulation. Orange essential oil was selected as the olfactory element. *Ceiling height* and *wideness* elements were selected as the spatial elements. The results show a significant difference in the evaluation tendency of male and female participants. Adding on, significant interaction effects between *ceiling height* and *wideness* were also observed. The findings suggest that the spatial elements interact to affect, (1) emotions related to anxiousness such as *feeling restless* in the presence of an olfactory stimulus and, (2) emotions related to decision making such as *trusting others* and *being clear headed* in the absence of an olfactory stimulus. The results of this research clarify the relationship between multimodal perception and spatial conditions and will help establish guidelines for the development of appropriate space that offers stabilized experience.

Keywords: Spatial elements · Emotional evaluation · Multimodal perception

1 Introduction

The way we think, feel and react is affected by the environment around us. There is even a field in psychology known as environmental psychology, which examines how the behavior and experience of the users is influenced by their environment [1]. The relationship between spatial design and user preferences and their experiences is an important aspect of urban architectural design. Vartanian et al. [2] studied and reported that ceiling height influences users' aesthetic judgment and visual perception of the room [2]. Meyers-Levy & Zhu [3] reported that the variation in ceiling heights can affect how the consumers process information and respond emotionally to the given space [3]. Sakuragawa [4] reported on how the users' perception and preference were affected with the change in interior design features of a given space [4]. Research works

related to spatial perception like those mentioned above, often focus on the visual aspect of the environment to obtain an understanding of the users' behavioral and emotional response while being immersed in the environment. However, concurrent stimulation in more than one sensory modal can influence the way the surrounding condition is perceived. A sensory modal which has been reported to effectively influence visual perception is olfaction.

1.1   Olfaction in Spatial Perception

Olfaction is an active part of our daily life. It is often being used in retail spaces for improving the users' mood and impression about the product being displayed [5]. Previous research has reported that scent and fragrances provide a space with a favorable identity. Lehrner et al. [6] investigated the effect of ambient scents on mood improvement in a dental office, and the result of their study showed that ambient scents reduced anxiety and improved mood in patients waiting for their treatment [6]. Vilapana & Yamanaka [7] investigated the influence of scent on the perception and evaluation of the physical environment. They found that the presence of scent tends to affect the evaluation of the "psychological" aspects of the room. They also reported that scent triggers memories related to experiences, places and products [7]. In a preceding experimental study, Cho & Sai [8] studied the interaction effect of the spatial elements and scent on the psychological mood state. They reported that the presence of olfaction helped reduce the negative mood of the participants and improved positive mood states in deficit spatial conditions [8].

1.2   Purpose of the Study

The purpose of the study was to obtain an understanding of how spatial elements were emotionally evaluated in the presence and absence of olfactory stimulus (orange scent). For this purpose, we analyzed (1) whether there is a difference in the characteristics of the participant's evaluation tendency in the presence and absence of olfactory stimulation, and (2) how the spatial elements were perceived in the presence and absence of olfactory stimulation.

2   Methods

2.1   Participants and Stimuli

Twenty-two university students (eleven males and eleven females, average age = 20.32 and SD = 1.7), were recruited to participate in the experiment. All the participants were Japanese natives.

Orange essential oil was used as olfactory stimuli [6–8]. The olfactory stimulus was sealed in a jar with a tight lid, which was opened only during the second session of the experiment. As for the visual stimuli, nine types of Virtual Reality (VR) spaces which differed in three levels of ceiling height (lower, default, higher) and wideness (narrower, default, wider) were presented in random order to the participants during both the sessions (Fig. 1, Table 1). VR was used as a visual stimulus in this experiment as it has been reported to be an effective tool for studying emotional response to spatial conditions and has been widely applied in psychiatric treatment of space related phobia (ex: claustrophobia, acrophobia) [9–11]. The visual stimuli were presented via Head Mount Display (HMD). The stimuli used in the experiment were designed using Unity 5.5, a cross-platform game engine, and were presented via a Vive Head Mount Display (HMD).
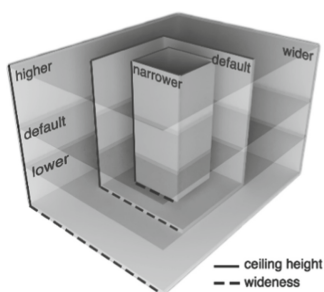
Fig. 1. Diagrammatic illustration of VR spaces.

Table 1. Nine types of VR spaces.

Ceiling height × wideness	
Visual stimulus 1	lower × narrower
Visual stimulus 2	default × narrower
Visual stimulus 3	higher × narrower
Visual stimulus 4	lower × default
Visual stimulus 5	default × default
Visual stimulus 6	higher × default
Visual stimulus 7	lower × wider
Visual stimulus 8	default × wider
Visual stimulus 9	higher × wider

The scale of measurement for *wideness* and *ceiling height* were set in Unity units (1 Unity unit = 1 m). The default *wideness* of the stimuli was set to 27.9 m^2, which is the standard floor space per person in Japan as mentioned in a report by Kanemoto [12]. The default height was set to 2.4 m, which is the average ceiling height used by house making companies in Japan [13]. The size setting for the levels other than those for the *default* levels were decided by the authors. In the case of the *ceiling height* element, the *lower* and *higher* levels were adjusted from the eye level in seated position. This was done by checking the condition in a VR environment. As for the *wideness* element, the *narrower* and *wider* levels were set two times wider and narrower than the *default* level. The level of brightness and color were maintained the same in all the VR spaces.

2.2 Evaluation Method

Evaluation of affective response was done by implementing the sixty-five evaluation phrases from the Japanese version POMS 2 (Profile of Mood States, second edition). POMS 2 is a commonly used measure for evaluating psychological mood state. The phrases are categorized into seven different moods such as, tension-anxiety [T-A], depression-dejection [D-D], anger-hostility [A-H], fatigue-inertia [F-I], confusion-

bewilderment [C-B], vigor-activity [V-A], and friendliness [F]. The items were rated on a 5-point Likert scale from 0 to 4 (0 = not at all; 1 = a little; 2 = moderately; 3 = quite a bit; 4 = extremely). The current study used the sixty-five items as questionnaire items. It does not involve the calculation of the total mood disturbance (calculation of mood states for POMS) as it is not the point of focus in this study.

2.3   Experimental Method

Prior to the experiment, the participants were given a brief introduction to the experiment, such as instructions on how to observe the stimuli and regarding the evaluation process. The stimuli were each presented to the participants for ten seconds in random order. After this, the participants evaluated the sixty-five evaluation items. This was treated as an inter-trial interval before they observed the next stimulus. The olfactory stimulus was presented while the participants were observing the VR space. The participants were not informed about the presence or absence of scent prior to the experiment to avoid biased impressions. The participants were allowed to freely turn around, look in different directions, and remained seated throughout the experiment (Fig. 2).
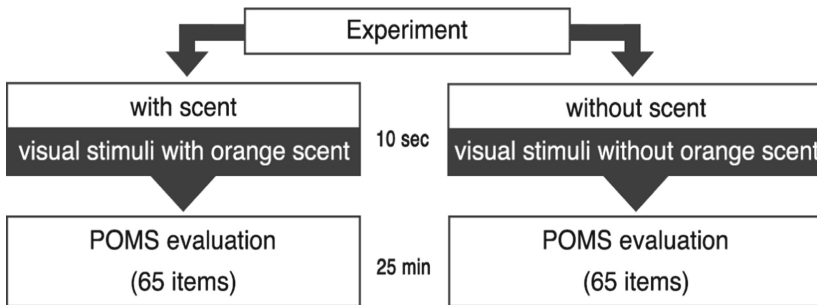
Fig. 2. Experiment procedure.

The participants participated in two sessions of the experiments. In the first session, the participants experienced the visual stimuli with no olfactory stimuli present and then evaluated their psychological mood state. In the second session, the participants experienced the visual stimuli in the presence of the olfactory stimulus after which they evaluated their psychological mood state. The ten seconds display duration was set based on a previous study on impression evaluation of spatial conditions using fMRI that set the stimulus display time to 3000 ms [2]. The duration of the experiment per subject was sixty to seventy minutes.

3 Results

One-way and two-way ANOVA were used for data analysis in the study.

3.1 Difference in Evaluation Tendency

One-way ANOVA was used to investigate whether there were any statistically significant gender-wise differences in the evaluation tendency of the participants in the presence and absence of scent element. Data is reported as statistically significant at $p < .05$ and highly statistically significant at $p < .01$. *With scent condition* presented statistically significant gender-wise difference for *"feeling intimidated", "is confused", "feel restless", "feeling optimistic", "is overwhelmed", "is not confident", "feel flustered", "feel hopeless", "is anxious", "worried about things"*, and *"be alert"*. The analysis of the above-mentioned phrases showed no significant difference in the *without scent condition*. The w*ithout scent condition* presented a statically significant gender-wise difference for *"feel clear headed"*, and "*trust in others"* (Fig. 3). The evaluation phrases which presented significant gender differences in both *with scent* and *without scent conditions* are also presented in Fig. 3.

3.2 Interaction Effect of the Spatial Elements

A two-way ANOVA was conducted to study the main effects of the spatial elements (*ceiling height, wideness*) and the interaction effects between them on the evaluation of the participants' affective response. The analysis was done on data from both, *with scent* and *without scent conditions*. Data is reported as statistically significant at $p < .05$ and highly statistically significant at $p < .01$.

With Scent Condition
Significant interaction effect between *ceiling height* and *wideness* ($p < .05$) (Fig. 4) and a main effect of *ceiling height* ($p < .01$) (Table 2) was presented for the evaluation of *"feel restless"* in the *with scent* condition.

Without Scent Condition
Significant interaction effect between *ceiling height* and *wideness* ($p < .01$) (Fig. 5) and a main effect of *wideness* ($p < .01$) (Table 3) was presented for the evaluation of *"feel clear headed"* in the absence of scent. Significant interaction effect between *ceiling height* and *wideness* ($p < .01$) (Fig. 5) and main effects of both *ceiling height* and *wideness* ($p < .05$) (Table 3) was presented for the evaluation of *"trust in others"* in the absence of scent.
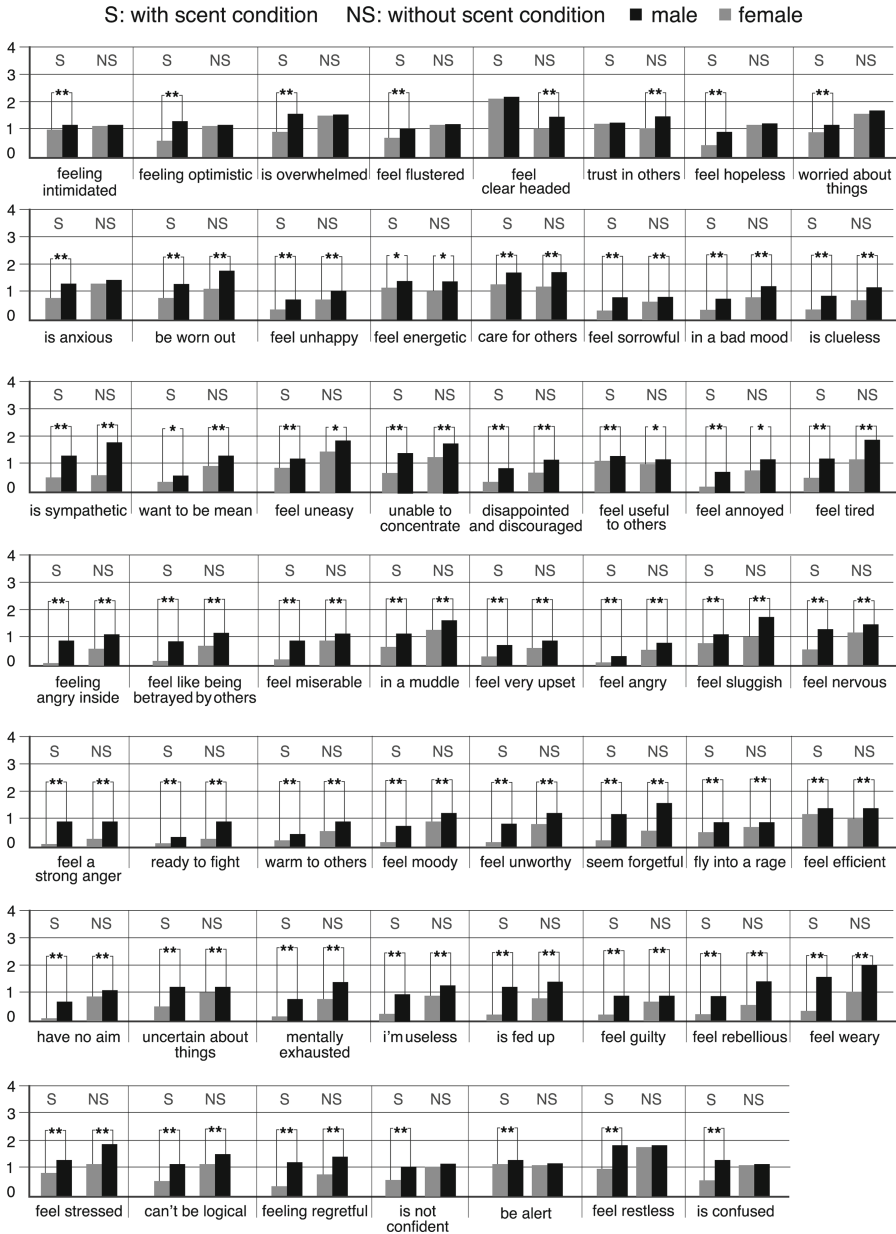
Fig. 3. One-way ANOVA results (statistically significant gender-wise difference) for the affective response to spatial conditions of the visual stimuli reported in the *with scent* and *without scent* conditions (p < .05*, p < .01**).
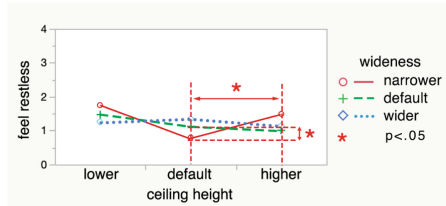
Fig. 4. Interaction between *ceiling height* and *wideness* for *"feel restless"* in the *with scent* condition (p < .05).
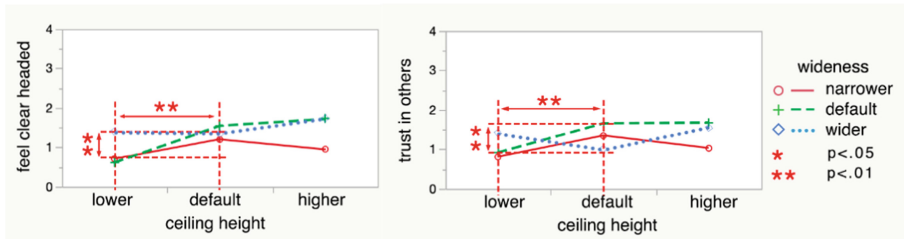
Fig. 5. Interaction between *ceiling height* and *wideness* for *"feel clear headed"* (p < .01) (left) and *"trust in others"* (p < .01) (right) in the *without scent* condition.

Table 2. Two-way ANOVA results for the interaction and main effects of *ceiling height* and *wideness* for the *with scent* conditions (p < .05*, p < .01**).

Evaluation phrase	Independent variable	p value
"feel restless"	Intercept	<.0001**
	wideness [default-narrower]	0.3254
	wideness [wider-default]	0.3894
	ceiling height [default-lower]	0.0003**
	ceiling height [higher-medium]	0.0070*
	wideness [default-narrower] * ceiling height [default-lower]	0.1099
	wideness [default-narrower] * ceiling height [higher-default]	0.0252*
	wideness [wider-default] * ceiling height [default-lower]	0.2274
	wideness [wider-default] * ceiling height [higher-default]	0.8361

4 Discussion and Conclusion

The purpose of the study was to analyze how emotional responses to spatial conditions (ceiling height, wideness) were evaluated in the presence and absence of an olfactory stimulus (orange scent).

The findings of the study presented gender-wise as one of the characteristics difference in how men and women perceived spatial conditions in the presence and absence of orange scent. The results presented a positive mood improvement in the

Table 3. Two-way ANOVA results for the interaction and main effects of *ceiling height* and *wideness* for the *without scent* conditions (p < .05*, p < .01**).

Evaluation phrase	Independent variable	p value
"feel clear headed"	Intercept	0.0001**
	wideness [default-narrower]	0.7125
	wideness [wider-default]	0.0020**
	ceiling height [default-lower]	0.0503
	ceiling height [higher-default]	0.3297
	wideness [default-narrower] * ceiling height [default-lower]	0.2120
	wideness [default-narrower] * ceiling height [higher-default]	0.2749
	wideness [wider-default] * ceiling height [default-lower]	0.0053**
	wideness [wider-default] * ceiling height [higher-default]	0.4891
"trust in others"	Intercept	<.0001**
	wideness [default-narrower]	0.6599
	wideness [wider-default]	0.0454*
	ceiling height [default-lower]	0.0340*
	ceiling height [higher-default]	0.2125
	wideness [default-narrower] * ceiling height [default-lower]	0.5712
	wideness [default-narrower] * ceiling height [higher-default]	0.3242
	wideness [wider-default] * ceiling height [default-lower]	0.0014**
	wideness [wider-default] * ceiling height [higher-default]	0.1565

with scent condition, especially a noticeably higher mood enhancement in case of female participants. This view is supported by Gérard Brand and Jean-Louis Millot's report that women tend to be superior in terms of olfactory skills than men [14]. Robinson et al. [15] presents that early visual processing is influenced by olfactory cues and that this effect is stronger in women than in men [15]. These findings provide an understanding that the presence of olfaction reduces the negative influence of the given spatial conditions and is more prominent in the case of women. Odor is often associated with memory and experiences. It is also reportedly associated with mood elevation in regards to the visual conditions. Hoenen et al. [16] reported that the mood elevation in humans are provoked by the individual perception of a particular odor, and not by the intrinsic properties of the odor [16]. It can be assumed that people's perception and experience of the given visual conditions can be based on their perception of the given olfactory stimulant. The findings of the present study also presented significant interaction effects between ceiling height and wideness in the with and without scent conditions. The present study focused on how these spatial elements were emotionally evaluated in the presence and absence of the orange scent. The findings of this study presented that (1) ceiling height tends to affect the participants' emotions of "feel

restless" in narrower spatial conditions in the presence of the orange scent and, (2) in the absence of the orange scent, both ceiling height and wideness tend to influence the participants' emotions of "trust in others" and "feel clear headed".

It has been a common research trend to study the various senses as unimodal stimuli when it comes to studying perception. The studies are mostly done by placing importance on one sensory modal and by analyzing their influence on user preferences and experiences. However, we experience and perceive things through the information obtained from more than one sensory modal such as our eyes, ears, mouth, nose and so on, i.e. a multimodal perception. Research works often study the multimodal relationship between vision and auditory, tactile or taste modals but very few works have been done to study the multimodal perception from simultaneous stimulation of vision and olfaction. What would be the effect of multimodality between vision and olfaction on our emotions? How does olfactory input influence the emotional evaluation of visual input? The present study attempted to analyze this relationship. Based on the findings, it can be suggested that, (1) emotions related to anxiousness such as restlessness are affected when visual and olfactory stimuli are presented simultaneously and, (2) emotions related to decision making such as trusting others and being clear headed were affected when visual stimuli are presented in the absence of an olfactory stimulus.

In conclusion, the findings of the present study add on to the previous evidence of effectiveness of olfactory stimulation on emotional evaluation of spatial conditions and also acts as a foundation of experimental knowledge of the relationship between multimodal perception and spatial elements. Design processes should not just focus on the aesthetic values but also on the users' emotional preferences and sensory responses. Including this affective information in designs could help provide better experiences. Further studies on the characteristics of space that are affected by multimodal stimulation will help establish guidelines on how to use them congruently to improve spatial design that offers stabilized and appropriate spatial experience for the users.

5 Future Study

As mentioned in the previous session, the effect of odorants tends to be based on the users' perception of the given scent. The current study adopted orange scent as the olfactory stimulus. The findings could be based on the perceptual effect of orange scent on the participants' response to the spatial elements. Further study needs to consider comparing the perceptual difference of different genres of scents (ex: floral scents such as lavender) on their influence on spatial perception. This can help increase the experimental understanding of the influence of olfactory input on the emotional perception of visual conditions. In a previous research work, Morrot et al. [17] studied the interaction between the vision of colors and odor determination is investigated through lexical analysis of experts' wine tasting comments. Their results suggest that their perception of the odor had been influenced by the color of the wine [17]. Visual cues can also influence how olfactory stimuli are perceived. The visual stimuli used in the current study were grey colored spaces with differing levels of ceiling height and wideness. Color has been reported to play an important role in users' experience and

spatial perception [18, 19]. Future study can include visual elements such as color to the stimuli and then study the multimodal interactions between color and odor and their effect on affective response to spatial conditions. The subject factor was limited to the region, age range and characteristics of local students from Hiroshima. The research output explains the evaluation characteristics of young people from the same region with similar ideas. Further studies could extend these ranges to get a wider spectrum to explore more of the evaluation tendency and multimodal perception of spatial conditions. This could be done by extending the regional factor, and age range of the participants.

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Cognitive Diversity

Affective Impressions Scale (AIS): The Development of a Visual Scale to Measure Affective Synchrony Among Children

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Abstract. From a young age, the affective impressions we share of others are great conditioners of our social behaviors. Affective Accuracy (AA) and Affective Synchrony (AS) are the phenomenons of accurately identifying and matching feelings with others. This paper presents the development of the Affective Impressions Scale (AIS), a dedicated tool to measure the AA and AS levels of peers in a group. The lesser the difference between evaluations, the higher the AS levels will be and the expected group integration of participants. The AIS development is discussed throughout 3 different studies, each performed with 36 to 42 participants aged between 6 and 14 y/o, grouped in teams of 3 to 4 members. In study 1, after performing a group task, participants were asked to report their dominant emotion from a list of six feelings and choose an emotion to represent each group member. Study 2 asked participants to rate their happiness levels from 1 to 5 and evaluate their group members happiness using the same scale. Finally, study 3 asked participants to rate their Happiness, Energy, and participation levels from 1 to 5. Through repeated measures, study 2 and 3 were successful in establishing significant differences in participants AA/AS levels and in partially predicting their group behaviors. Results displayed the AIS potential as a tool to evaluate children's unbiased impressions in group situations, leading to higher comprehensions of Group Kansei.

Keywords: Socio-affective development · Group Kansei · Psychometric scale

1 Introduction

The capacity to accurately identify the feelings of others, combined with the phenomenon of being emotionally connected with them, has an important role in human socio-affective development [1]. Known as empathy, this capacity allows an individual to position himself at the different viewpoints of others, which can grant a better understanding of their motivations and desires. Currently, the development of empathy is not easily achieved through existing school curriculums and indications point out that young adults may be becoming less empathic or sensitive to emotional stimuli [2]. Furthermore, most empathy assessments are diagnosed when the participant reaches adulthood, with a significant lack of tools and procedures to evaluate human empathic and affective development throughout their childhood [3]. Especially in middle childhood (around 6 to 12 y/o), an important stage for the development of sociability,

there is a lack of significant studies accompanying their empathy and affective sensitivity. Dedicated measures are needed for the development of effective interventions.

Affection, the experience of feeling and expressing emotions, is a key contributor of empathy development. Affection helps children form bridges between themselves and others through exchanges of feelings that can deepen their understanding and bonds, thus leading to higher internal motivations for social interactions [4]. According to Angerer et al. [5], individuals who have strong bonds can often share a state of synchrony where communication is facilitated and cooperation is self-motivated. Named Affective Synchrony (AS), the phenomenon of matching emotions with those of others, has been recently related to increases in cooperation level [1]. While the affective impressions of different social interactions need to be emphasized, current studies tend to limit observations on children's externalized behaviors and individualized assessments, which restricts suitable interventions [6, 7].

Assessing children's internal affective impressions of different social situations, and how aligned/synchronized these impressions are with the ones displayed by their peers, is a complex matter that may lead to novel considerations regarding children's empathy and socio-affective development. Through effective measurements of children's AS with their surrounding group, we can identify if there are high dissonances between their evaluations, investigate possible causes, and propose interventions.

This research aims to guide the development of the Affective Impressions Scale (AIS), a novel scale to measure Affective Impressions and AS levels among children. With the AIS, participants are compelled to report their past emotional states after performing a group task and use that same criteria to evaluate the emotional states of their peers. The AIS then calculates the difference between the reported and evaluated emotion to determine each participant's Affective Accuracy (AA), or how accurate they were when evaluating the emotions of peers. In that sense, a group in which all participants displayed high levels of AA would be considered Affectively Synchronized (AS). This paper summarizes the finding of three studies that tested three different versions of the AIS.

Empathy measurements were applied as an initial control of the AIS evaluations together with observed cooperative behavior and additional individual conditions. In each study, the efficiency of AIS evaluation is measured according to how well it was able to establish differences between groups, and how well it aligned with their pre-evaluated empathy-levels. The following question was asked: Is it possible to establish different levels of Affective Accuracy (AA) and Synchrony (AS) among groups of children through a Visual Report Scale?

2   Study/Version 1: Emotion Matching Scale

Individualized measurements of empathy levels acted as the main base for initiating the development of the AIS ver. 1. For this research, it would be ideal to find child-dedicated scales focused on the affective dimension of empathy. From Neumann, et al. [3] empathic measurements review, the Kids Empathy Development Scale – KEDS [8] was found to be suitable for evaluating affective empathy in middle childhood.

KEDS is an interview tool designed to assess empathy in children aged 7 to 11 y/o. In this scale, empathy is examined using emotion recognition, picture-based scenarios, and aligned with behavioral self-report techniques. An emotion guide composed of six different emotions (Happy, Surprised, Relaxed, Sad, Angry, and Scared) was designed as a support for emotion identification in 13 different designed pictures. In each picture, the interviewee must identify the dominant emotion of the characters. The KEDS scale was initially utilized to pre-evaluate the empathy disposition of participants according to its pre-established scenarios. The Version 1 of the AIS, named Emotion Matching Scale, was developed based on KEDS Six-emotions chart and tested in a second stage. An experiment was conducted in which participants, after performing a group work task, were asked to report their feelings and evaluate the feelings of their group members utilizing the six emotions chart. The group work tasks were, in alternate sessions, a building block game session and a design idea generation task. Additional information is available in Fernandes and Yamanaka [9].

2.1 Study 1 Participants and Ethical Considerations

36 students aged 6 to 14 y/o (M = 9.58, SD = 2.53), from second to ninth grade joined this study. Within participants, 12 were female while 24 were male, 13 were Japanese while 23 were from different countries. Prior to the experiment, individual interviews were conducted to pre-evaluate the empathy level of each student and their relationships with peers. After this step, 12 same-gender multi-aged teams were organized with four children each.

Before starting this project, the research received approval from the Ethics committee of the University of Tsukuba Art & Design Graduate school, as well as requested authorization from school headmasters and the parents of the involved children. A letter explaining the general purpose of the research was given to the parents, where they had to sign a consent form to give their child the permission to participate (opt-in). In each experimental session, participation was voluntary for children, and they were constantly reassured that, if feeling unwell or with any discomfort, they could interrupt at any time.

2.2 Study 1 Affective Accuracy and Synchrony Evaluation

Named the Emotion matching Scale, the version 1 of the AIS required participants to, after performing a group task, report their dominant emotion and evaluate/estimate the dominant emotion of each of their 3 group members. The scale can be seen in Fig. 1.

The main challenge of this study was to observe if distinctions between AA and AS levels could be established throughout participants. Then, we evaluated if high empathy scores in the pre-established scenarios interviews would correlate to high AA in the designed real-time group situations.
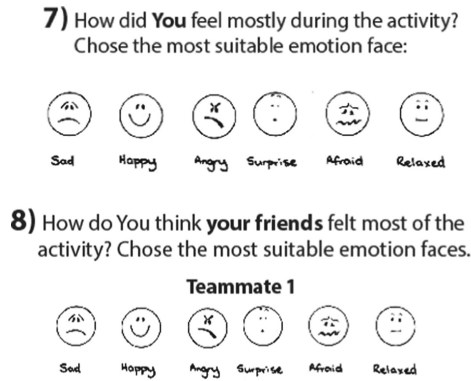
Fig. 1. AIS design ver.1. Scale compared the reported self-emotions and peer's evaluations.

2.3   Study 1 Results

After performing a group task, participants were asked to report their dominant emotions. As seen in Table 1, most of the reported emotions were positive, and most participants (22 out of the 36) reported to be feeling 'happy'. This situation has made it particularly easy for participants to accurately predict the emotions of their group members, limiting the efficacy of the AIS scale in establishing group differences.

Table 1. Count of reported emotions and evaluated emotions of group members (only 100 of the expected 108 peers' evaluations was retrieved due to participants' errors in filling the scale).

Reported emotion	Self-report	Peers evaluations
Happy	22	37
Relaxed	8	30
Surprised	4	22
Sad/Scared/Angry	2	11
Total	36	100

Like the task impressions, the study also considered if age and empathy levels would influence children's affective impressions and accuracy levels. Overall, no matter how old or empathic participants were, significant differences were not observed on the participants' AA levels.

2.4   Considerations Study/AIS ver. 1

In study 1, the results of the AIS scale were non-conclusive, mostly due to the participants often selecting 'happy' as their dominant emotion. Since this was a usual or even biased feeling to have in positive group situations, we determined that the six-

emotion range was insufficiently strong to detect differences in children's AS levels. Reconsiderations and redesigns were made for the following studies.

3   Study/Version 2: Happiness Impression Scale

Study 1 displayed that, in group situations, children tended to display positive response bias and describe their dominant emotions as "happy". This led to the second version of the AIS tool. Hall et al. [10] produced an extensive research based on children's positive response bias. Based on their research, the authors developed the Smiley Face Likert Scale, an emotion-based Likert scale tool with only positive expressions. Version 2 of the AIS was highly influenced on the Smiley face Likert scale and named "Happiness Impression Scale". In this version, instead of selecting between six different emotions, participants had to rate their happiness and evaluate each group member's happiness level with a five-point visual Likert scale.

Study 2 tested the Happiness Impression scale with participants of a one-week group design workshop. The workshop was composed of three design sessions which were, in order, an idea sketching session, followed by a 3D modelling task, and a group idea presentation. The AIS was applied after the performance of each task and then averaged. Additional information can be seen in Fernandes and Yamanaka [11].

3.1   Study 2 Participants

36 students (18 male and 18 female) aged between 7 and 14 y/o joined the design workshop. Following the workshop procedures, Participants were divided into same-grade and same-gender groups of three members (two, in the case of members shortage). In total, 13 groups were established. Except for the final open group presentations, all the workshop sessions were applied individually inside the classrooms of each grade. The same ethical guidelines of Study 1 were applied.

3.2   Study 2 Affective Accuracy and Synchrony Evaluation

Based on Hall et al., the second version of the AIS evaluated the difference between how participants perceived the happiness level of their group members and the reported happiness level of these members. The lesser the difference between evaluations and reports, the more Affectively Accurate participants were considered.

For example, if Participant A rated participant's B Happiness to be 4 points, and Participant B reported his own happiness to also be 4 points, the difference between impression and report would be 0, indicating that participant A evaluation of B's Happiness was highly accurate. This evaluation was applied for every member of the groups, which were composed of 3 members. If the accuracy rates of all group members were close to 0, the group would be considered emotionally synchronized. Figure 2 illustrates the AIS ver. 2.
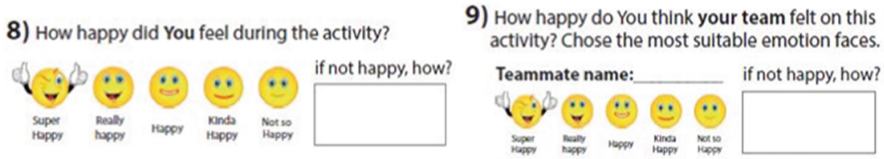
Fig. 2. AIS design ver. 2. Happiness impression scale.

The main objective of this study was to observe if differences in AS levels could be established following these criteria. Then, we wanted to observe if these would correlate with positive group performance and with individual conditions such as empathy, and age. Group performance was coded by a separate jury composed of five school-staff members after observing the final presentations of each group. Jury members were unaware of the AIS Affective Synchrony evaluations.

3.3   Study 2 Results

When the Happiness accuracy levels were evaluated separately in each session, we were unsuccessful in establishing significant differences between groups and participants. In many cases, a participant could accurately predict the happiness level of their group members by reporting 5 out 5 points. However, this type of error was drastically reduced when we averaged the Happiness Accuracy levels of the three design sessions, making the establishment of different AA levels a successful matter in this study. A significant regression was established between group performance and AA [F (1, 17) = 10.82, p = .003]. With a R_2 effect of 0.35, children who were more accurate when evaluating how happy their group members were feeling had more chances of receiving higher design evaluations. A strong effect was also observed on AS levels on group performance [F (1, 8) = 9.89, p = .011]. With a R_2 effect of 0.55, groups in which all the participants were evaluating each other's levels of happiness more accurately also received higher group scores by the jury.

While AS levels were theorized to correlate to empathic skills, a direct correlation with age and with the pre-evaluated empathy score was not established. This indicates that, more than the inherent capability of being able to detect people's feelings, children's affective evaluations could be influenced by other factors, such as their levels of friendship or task familiarity. Finally, a multiple regression with Happiness Accuracy and Empathy levels was able to highly predict the group performance of participants (F (3, 11) = 12.15, p = .0008. R_2 = .76). These results suggest that AS and empathy could be complementary factors in group work situations.

3.4   Considerations Study/AIS ver. 2

Among the results of Study 2, the happiness impression scale appeared to be highly related to children's group performance according to the jury evaluations. However, the obtained results were not directly related to the previously assessed empathy or expected social level of older children. This indicated the possibility of external influences, such as friendship level or facility with design tasks. Moreover, this AIS

version was not precise enough to detect differences between groups within a single session, needing multiple assessments throughout a one-week period to achieve reliable scores. Redesigns of the tool were applied to reach more in-depth assessments of affective impressions.

4 Study/Version 3: HEP Scale

While the average scores of the AIS Ver 2. were successful in establishing different AS levels and in predicting group performance, this same result was not observed when isolating the Happiness Impression Accuracy of each session. Study 3 investigated if we would be able to establish differences in children's AS levels and group performance after performing a single group session. For that matter, we have opted to not only rely on "happiness levels" but to expand the number of evaluated affective dimensions. To provide a more comprehensive assessment, the evaluation of affective impressions was based on the three PAD dimensions: Pleasure, Arousal, and Dominance present in the Self-Assessment Manikin (SAM) visual Scale [12]. Although SAM has been successfully applied with infant participants in the past [13], one of the main points of criticism comes from the design of its figures and from its word choice. Furthermore, adaptations were needed in order to evaluate AS levels among infant participants.

Based on the SAM scale, The AIS HEP version was designed for children to rate their emotions and evaluate the emotions of their group members in three 9-point dimensions: Happiness; Energy; and Participation. Like the happiness impression scale, AA was measured in the three dimensions by subtracting participant's reported affective levels from the evaluations group members had of their feelings. In the performed study, we have observed if different levels of AS could be established between participants after performing different group tasks. The group tasks were, in order, a group dancing game session and a reward-sharing task. Additional information is available in Fernandes [14].

4.1 Study 3 Participants

Study 3 worked with 42 students aged between 6 and 14 y/o (m = 9.63, SD = 2.18), grades 2 to 8, 24 females and 15 males. With 15 participants having their empathy pre-measured, all participants were divided into three-member same-age, same-gender groups. 14 sessions were applied. Five participants were excluded from the analysis for either not understanding the task or not filling the report properly. The same ethical guidelines of study 1 and 2 were applied on this study.

4.2 Study 3 Affective Accuracy and Synchrony Evaluation

Study 3 retained the happiness impression evaluation presented in Study 2 and related it to the SAM pleasure/valence dimension. The study expanded the affective assessments with that of the Energy Dimension, which ranged from relaxed to energetic figures to evaluate the participants' levels of excitement, and the Dominance

Dimension, which ranged from a small to a big figure to evaluate their self-impressions of participation. The developed HEP Affective Impression Scale can be seen in Fig. 3. All visual icons and words were redesigned to be more child-friendly than the traditional SAM and to enable the assessment of AA levels. In study 3, we have observed if differences in affective impressions could be established according to different group conditions, with participants who performed dance group games being hypothesized to display higher AS levels. Then, we observed if, according to higher AS levels, participants would display higher cooperative behavior in a reward sharing task.

Fig. 3. AIS design ver. 3. Happiness, energy, & participation (HEP) scale.

4.3 Study 3 Results

When observing the accuracy of children's impressions of their group members' feelings, the closer to 0 was the figure, the more accurate were children's evaluation. Regarding Happiness and Participation Impression Accuracy, significant differences were observed between groups at the $p < .05$ level for the three group conditions $[H_{Happiness} (2, 33) = 7.06 \ p = .029] \ [H_{Participation} (2, 33) = 10.41 \ p = .005]$. For Energy Accuracy, no significant differences were observed between group conditions. These findings suggest that the accuracy of Energy Impressions were not significantly affected. Group level effects also pointed to these same trends. Results can be better seen in Fig. 4.
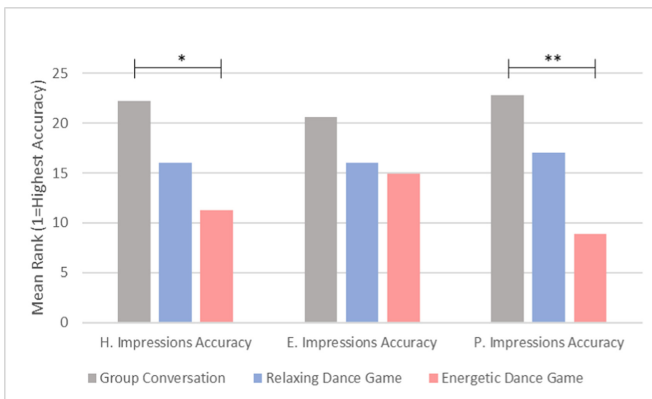
Fig. 4. Rank of participants' HEP impressions accuracy by three group conditions. (H = Happiness, E = Energy, P = Participation) *$p < .05$, **$p < .005$.

Additional generalized simple linear regressions displayed close to significant effects of empathy in participant's Happiness Accuracy [F (1, 10) = 3.929, p = .075], and in their Participation Accuracy [F (1, 10) = 4.175, p = .068], but not in the Energy Impression Accuracy [F (1, 10) = 0.024, p = .87]. This indicated that the participants with higher levels of empathy could more accurately evaluate how happy, and how confident/participative their group members were. Higher empathy was not influential in detecting if a group member was more relaxed or energetic. A significant regression was also established when evaluating the averaged accuracy levels of Happiness and Participation Impression. When observing cooperative behavior, higher AS levels did not indicate to directly affect participants' trust with their group members nor their disposition to cooperate.

5   Considerations HEP Affective Impressions Scale

Throughout redesigns, the AIS Ver. 3 proved to be efficient in gathering reliable data about participants AA and group AS levels. Within the scale, clear differences could be observed between group conditions and affective dimensions. Additionally, the AIS successfully managed to establish significant differences between the AS levels of children's groups in study 2 and 3. In study 3, the accuracy of happiness and Participation impressions were significantly related to participants' pre-evaluated empathy levels. In other words, in two of three affective dimensions, the scale successfully evaluated aspects related to empathic dispositions and AS in real-life contextual situations; a finding that has not been previously observed in the literature.

Although HEP Happiness and Participation Evaluations were indicated to be reliable, the studies also revealed a few inconsistencies within the dimension of Energy. In the latter, there was a dissonance between the impression children had of their members' energy levels and their energy self-reports. This might have happened due participant's perception of being "energetic" being somewhat worse than being "relaxed", or because participants felt more relaxed than how they had acted in front of their group members. In either case, this high difference between group and self-impressions can greatly aid on understanding children's perception in group situations. It is possible that children's affective evaluations of peers might, in fact, display several of their self-impressions which are not usually expressed through conventional report scales. Further studies should investigate this potential factor.

Also, although AS was identified as a significant factor for cooperation in Study 2, this relationship was not observed in Study 3. Among the differences between studies, Study 2 was performed more longitudinally throughout three sessions, whereas Study 3 only observed the immediate effects of a single group session. It is hypothesized that AS effects can only manifest on group cooperation throughout more extensive group interactions. Further studies are also needed to completely investigate this hypothesis.

Provided with improvements, the AIS displays great potential. The tool contains a way to evaluate children's affective states in contextual situations considering their own points of view. Furthermore, it actively encourages children to consider how others are feeling in different contextual situations, possibly contributing to their development of awareness and empathy. It is expected that the AIS will be continuously improved as

an assessment measure of children's feelings and internal motivations throughout different group situations. This will bring us closer to understanding the internal desires of children alongside with the Kansei of group Interactions.

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Digital Map Design Elements for Local Tourism: Comparing User Cognition Between Age of 20s and Above 60

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Abstract. This study investigates the influence of nationality, ages, and address systems on the use of digital maps in wayfinding. Examining how user— whether they are merely browsing maps or actively trying to find a destination— perceive and interact with their environments. Also, assessing the current problems is regarded digital maps, comparing user experiences of participants from different nationalities, age groups, and genders through a questionnaire. The subjects are Taiwanese and Japanese, and either in their 20s or above the age of 60. The crucial result is focusing on results of determined and undetermined destination how the users operate digital maps. In principal component analysis, age of 20s user have four factors influence digital map functions: (1) Orientation; (2) Advice Tip; (3) Decision Making, and (4) Atmosphere. But for user who are above 60s, they are categorized three factors: (1) Tourism Tip; (2) Orientation; and (3) Surrounding. When 20s go for traveling the orientation will be essential information, nevertheless user who is above 60 sees Tourism Tip as priority.

Keywords: Digital tourism map · Map design element · User basic consciousness · Age comparison

1 Introduction

According to the 2018 Newzoo Global Mobile Marketing Report (2018.09), approximately 70 million people (55.3%) in Japan and 14.2 million people (60%) in Taiwan use smartphones. These portable devices have become part of people's daily lives, and digital maps are now being used more often than paper maps. Digital maps do, however, still present usability difficulties; they target a small range of user, and there is little scope for usage among local people (Newzoo 2018).

As same as belonging east Asia countries, more and more Japanese and Taiwanese go traveling to each other's country. Especially in this decade, twice Japanese people traveled to Taiwan, and 4.5 times Taiwanese people traveled to Japan. It shows the tourism map becoming more important than before. Even though we have smartphone and digital map, somehow these tools only can provide large scale. Even though Google Maps, Apple Maps or other digital map apps can point the large scale for the daily life or do some roughly research for traveling, for not a famous tourism spot or

small town is not enough or even no data. Therefore, this research is focusing on design the local tourism area to develop or design a digital map and have some distinctions with these exist map apps to provide a better tourism and map using experience. For local tours, there are some functions still deficient. The aim of research is supplying local tourists more fluently and deeper experience the place they visit. In this study, want to connect how user make decision and the order of they are operating digital map whether they have decided destination or not.

Modern map design relies on two sets of tools and methods; one is thematic cartography, which has regional characteristics, and the other is geo-visualization. However, there are some disadvantages to thematic cartography, such as foreigners find it difficult to comprehend the map legend, the scale is not accurate, locations are not precise, and there is too much information that confuses the user, or they are unable to find what they need. Conversely, geo-visualization, relies on technology to detect user's position by Global Positioning System (GPS) and the Geographic Information System (GIS) and updates the data accordingly and instantly. Since the 1950s, technological advances like these have changed how people read maps (Tsao and Chang 2010). Nowadays, people tend to use the maps application on their phones or electronic devices rather than paper maps. Also, most of digital maps can provide information instantly.

2 Literature Review

2.1 Wayfinding and Environment Cognitive

A city is composed of five elements: paths, edges, districts, nodes, and landmarks, which are also used in wayfinding and cognitive mapping (Lynch 1960). Lawton and Kallai believe that there are two kinds of wayfinding processes: (1) orientation/survey strategy and (2) route strategy (Lawton and Kallai 2002). The orientation/survey strategy can obtain information from different resources (i.e., integrating the information between different nodes) and create a more flexible cognitive map. Moreover, route strategy refers to a series of instructions, such as landmarks being the main reference in a wayfinding strategy when subjects move from one location to another (Lawton 1994, 1996; Prestopnik and Roskos-Ewoldsen 2000; Colucciaa et al. 2007).

Nori and Giusberti indicate the wayfinding have three types of group which are (1) landmark task, this type of people mainly rely on photo and figure; (2) route task, they more use sequence, map description, right–left discrimination, and 2D rotation to make sure the destination or orientation; and (3) survey task, in this group, they use path, 3D rotation, and sum and straighten which more likes bird's-eye viewpoint of an object-centered reference system (Nori and Giusberti 2006). And these studies show that women may use route strategy/task more, but in Nori and Giusberti's study shows other two tasks still have around 20% of people in each. Therefore, it may relate to other socio-demographic not only just gender (Schmitz 1997). Even though, there are few studies that shows whether age have a significant effect on wayfinding strategies (Hund and Minarik 2006; Kato and Takeuchi 2003). But there are no study indicating which factors will affect people. The analysis about what kind of factors affect differences of age is the focal point.

These two strategies exhibit two kinds of map user: one needs some additional information between the nodes along the route, and the other needs a landmark to create a route plan. The first strategy is primarily used by men, and the second one is used primarily by woman. However, there is no study that shows whether culture or nationality have a significant effect on wayfinding strategies. When creating a cognitive map, people interact with their environment, using all five senses to absorb all kinds of information. They then combine their knowledge and memory to form a unique mind map (Lynch 1960; Nori and Giusberti 2006).

One theory says that responsiveness to site-specific features, such as a arrangement of landmarks, coupled with the mediating effects that verbalizations contribute, begin to play a role in spatial cognition once language appears around two years of age (Hermer-Vazquez et al. 1999). This point could explain the cultural influences to make them to create their own mark, not entirely transforming from core processes as by supplementing them (Heft 2013).

2.2   Digital Map Design

The origin of maps can be traced back to around B.C. 500, when people used these maps to indicate to locate food or water. Thus, to read maps, people should have an understanding of space and semiotics. Humans have developed language and semiotics to help place information in maps and develop cartography to make user easy to understand the information form in map. The map revolution started with the 1950s' quantitative revolution, followed by the 1960s' communication model, the 1970s' cognition theory, and then the 1990s' geo-visualization, which improved map design and legibility. Wakabayashi Yoshiki has elaborated on the difference between paper and digital maps (Wakabayashi 2008).

According to Mentello et al. (1999), the performance of a map depends not only on its visual appeal but also on its words and graphic (Montello et al. 1999, 2014). Meanwhile, the digital map has changed the performance differs from each one and the way how map interacts with user. User choose their own accuracy to clarify the information and make the difference of their recognition for each user. The interface will influence usability and impact on wayfinding. Digital maps, such as Google map and Apple map, has changed peoples' behaviors. These maps try to combine a user's previous information and the interactive functions to make it more real time.

Digital maps can show and output any scale and range. They can also easily connect with satellite images, aerial photos, or other information from databases to enhance user's recognition of geographic information. Moreover, processes involved in map design should be integrated with GIS, remote sensing (RS), and GPS as databases (Lin and Wang 2010).

2.3   User Experience

User experience research seeks to understand a user's need, expectations, and operating error (Doherty and Sorenson 2015; Nakevska et al. 2017). People use paper or digital maps to identify a map's most and least important functions. They then combine these functions with their experiences in the wayfinding process. Some external stimuli, such

as haptic and visual material, provide information that helps the brain realize space (Miller 1997; Guccione 2000; Herssens and Heylighen 2008). The color which are around us will become the daily experience, which will help us understand and move through space (Steinfeld and Maisel 2012; Doherty and Sorenson 2015).

Some theories explain how user experience is applied in the design and construction of spaces. These theories are related to people's behaviors and how they are guided by a building's features. Fogg's model believes that people are coercive, but this concept is only applicable in specific situations (Fogg 2009). Moreover, Rahimi's model tends to believe that a user is influenced by his or her own sociocultural experience (Rahimi 2014; Rahimi et al. 2018). Lastly, Kuntson et al.'s model includes the following seven factors: orderly, benefit, accessibility, convenience, utility, incentive, trust, and environment. This model also divides user experience into different levels to analyze how people participate in common activities (Kunston et al. 2007). Based on these theories, this study tries to find the important elements of map usage that help user to have a pleasant wayfinding experience. Enthought there are 3 models approaching spatial experience, but still can't explain the differences between people have decided or undecided destination. By the differences, even the same functions show different meaning for user's operation. It may show when people use the same tools, but the meanings can be variable.

3   Case Study

For this study, five digital maps were analyzed to identify their various functions and elements: Google Maps, Apple Maps, Taipei Historical Maps, what3words, and Drink Store TW. The results of this case study were then used to design the questionnaire. The aim was to determine which of these functions' participants used.

Google and Apple have created the most extensive digital maps, and the other three maps are based on these designs because they allow user to pinpoint their position and access information. Google Maps, for example, uses instant GIS to update the traffic status (e.g., show peak traffic sections or suggest an alternative route) based on a user's position. Apple Maps does not give instant updates. The case study shows that Google covers more functions than the other four maps, but many of these—such as Shop and Spot or Street View—need to be updated. Furthermore, Google's maps of smaller, tourist-oriented areas can update very slowly or not at all.

Taipei Historical Maps collects 10 maps from different eras and integrates them into present-day Taipei. Tourists can use these maps to find ancient monuments or use Street View to experience what streets or places might have looked like in earlier times. Conversely, the what3words map does not rely on traditional coordinate reference systems; instead, the design team divides all areas into a grid of 3 m × 3 m squares and assigns a unique three-word address to each, e.g., "reform.goals.reaction." The application Drink Store TW helps user in Taiwan to find their nearest drinks store. The app also allows them to access the stores' menus or telephone numbers. The table below gives an overview of the functions these five maps have to offer (Table 1).

After analyzed these apps, the Google map and Apple map will be the best imagination and most user in all the countries, in the questionnaire will be under their

Table 1. Figures of map (organized by this study, last accessed 2020.05)

Function	Application				
	Google Maps	Apple Maps	Taipei Historical Maps	what3words	Drink Store TW
Main target	Wayfinding	Wayfinding	Education & tourism	Wayfinding	Shop indicated
Base map	–	–	Google Maps	Google & Apple Maps	Google & Apple Maps
GPS	○	○	○	○	○
Navigation system	○	○	✕	○	✕
Number of layers	3	1	10	1/1	1/1
Layer switch	Changeable	✕	Changeable	✕	✕
Direction indicator	○	○	✕	○	✕
Street View	○	✕	✕	✕	✕
Provided information	Shop & Spot	Shop & Spot	✕	✕	Shop
External linkage	User or Google	Uber or other taxi apps	✕	Uber	Official website

frame of these two digital maps to set up or provide the example for subjects to understand the whole situation when they use digital map.

4   Questionnaire and Method

To determine the usability and user experience of paper and digital maps, the questionnaire was divided into three categories: background, experience, and perception. The background category included questions on nationality, age, gender, career, and education. This information includes some significant disparities to set up principle. The second part of the questionnaire focused on user experience: how frequently they used their maps (5-Point Likert scale), how they evaluated their experience, and what wayfinding aids they used. There are lots of wayfinding abilities and strategies with demographic such as gender, culture, age and so on (Rahimi 2014; Rahimi et al. 2018; Lawton 1994, 1996; Lawton and Kallai 2002; Nori and Giusberti 2006; Zomer et al. 2019), and some researches of age related are more focus on learn environmental layout, real vs. virtual test, and big scale map using (Kirasic 2000; Taillade et al. 2013; Taillade et al. 2016). Hence, this study focuses on the age distinction with map information.

A total of 183 people (93 Taiwanese and 90 Japanese) participated in this research project. Of these, 113 people were in their 20s, and 70 were above the age of 60. To reveal what the dissimilarities are, this study uses principal components analysis to categorize the functions of digital map (such as google map or apple map, some apps are more used in daily life and understood). When the users are in two situations: 1. Decided destination, and 2. Undecided destination. How these functions (Direction, Navigation, Multilayer, Information, Outward Appearance and Street View) are important to them (5-Point Likert scale) in the final part of questionnaire.

5   Analysis and Results

This study uses principal component analysis to categorize the function in tourism digital map between 20s and above 60, when designer design the functions or the process of operation what the priority and order are. In total, 12 map functions—of which six were decided (D) and six undecided (U)—were analyzed in this part of the study.

In the result of all participants, KMO is 0.685, Bartlett's Test of Sphericity is 815.946, and cumulative 68.02% of variance. The analysis points to four factors that influence map function: (1) Orientation; (2) Tourist information (switching layers about type of place and searching for information to shop or spot); (3) Atmosphere (attracting a user who does not have a destination yet, and offering the senses about environment and which they may not feel in the daily life); and (4) Checking information (helping a user to confirm a destination) (Table 2).

Table 2. Four factors of map functions

	Orientation	Tourism Information	Atmosphere	Checking Information
Direction (U)	0.83229	0.06188	-0.1776	0.00137
Direction (D)	0.76949	-0.05771	-0.23523	0.0779
Navigation (D)	0.76895	0.0681	-0.05988	0.17601
Navigation (U)	0.75842	0.21872	0.04277	0.10144
Multilayer (D)	-0.01212	0.7687	-0.02213	0.1739
Information (D)	0.03954	0.69532	-0.46008	-0.05891
Multilayer (U)	0.12953	0.69435	-0.47055	-0.11316
Information (U)	0.16745	0.64124	0.07543	0.28692
Outward Appearance (U)	0.11959	0.30191	-0.75948	0.11526
Street View (U)	0.25684	-0.06272	-0.73971	0.36887
Street View (D)	0.0798	0.03398	-0.27009	0.84782
Outward Appearance (D)	0.23145	0.41674	-0.03416	0.67328

Orientation guides the user and is the most important factor, because all user (whether they have a place in mind or not) need to confirm their destination. Tourist information is unique to digital maps. This kind of information is also provided regardless of whether a tourist has decided on a destination or not. Regarding 3rd and 4th factor, the results show that the outward appearance and street view of a building or place are used as wayfinding aids if the user has decided on a destination; when the destination is unclear, these two factors can attract tourists to a particular place.

For understanding the meaning of functions in decided/undecided situation for different ages of users. The Table 3 is 20s and 4 is above 60 users. When they are using digital map, the functions are also representing different roles in the process.

Table 3. 20s user's factors of map functions

	Orientation	Advice Tip	Decision Making	Atmosphere
Navigation (D)	0.78315	0.12851	0.0326	0.09714
Navigation (U)	0.78241	0.05099	0.03315	0.31249
Direction (U)	0.77399	0.0145	0.08316	0.16726
Direction (D)	0.70629	0.12099	0.26523	0.24211
Multilayer (D)	0.01373	0.73056	0.21572	0.06465
Outward Appearance (D)	0.15155	0.72697	0.1347	0.21342
Information (D)	0.09866	0.66873	0.13995	0.04983
Information (U)	0.08321	0.19855	0.86808	0.04075
Multilayer (U)	0.15916	0.26303	0.74912	0.10501
Outward Appearance (U)	0.10386	0.03924	0.62025	0.53797
Street View (U)	0.20986	0.06639	0.15619	0.84985
Street View (D)	0.07131	0.54726	0.10688	0.62578

The KMO in 20s is 0.651, Bartlett's Test of Sphericity is 441.068 ($p < 0.000$), and cumulative 66.38% of variance. The analysis points to four factors that influence map function: for the age of 20s user have four factors influence digital map functions: (1) Orientation (giving direction where a user wants to go); (2) Advice Tip (the users have decided destination, these functions only providing some detail to them), (3) Decision Making, and (4) Atmosphere (attracting a user who does not have a destination in mind, but in 20s they may see Outward appearance (U) as Decision Making to help them decide to go where). For Orientation guides the user and is the most important factor for 20s, because all user (whether they have a place in mind or not) need to confirm their destination. Tourism information, they think multilayer, outward appearance, street view, and information when they decided the destination, as confirming or getting the information before they arrive. Decision making, they have not decided the destination yet, therefore they use these functions to help them to decide the

next spot they are going to. The final factor only contains Street Views no matter users decided the destination yet, there to go which is named as atmosphere.

The KMO of above 60 is 0.708, Bartlett's Test of Sphericity is 445.867 ($p < 0.000$), and cumulative 68.02% of variance. The user who are above 60s, there are only three factors: (1) Tourism Tip (No matter they have decided the destination or not, these functions play the same meaning is giving them tips; the Outward Appearance is only in undecided situation, they may use is to get some more detail for decision); (2) Orientation (same as 20s); and (3) Surrounding Situation (feeling through these information from the environment they can understand where they are). For people above 60, they regard Information (U&D) and Multilayer (U&D) as the function providing them about local tourism information. Information can provide detail about store (e.g. open time, phone number, address, recommendation rank *et al.*). Multilayer can filter types of spot. Outward Appearance (U) can show how the spot looks like (Table 4).

Table 4. Above 60 user's factors of map functions

	Tourism Tip	Orientation	Surrounding Situation
Multilayer (U)	-0.8843	-0.08722	-0.02369
Multilayer (D)	-0.83008	0.01025	0.04506
Information (U)	-0.79735	0.0494	0.24222
Information (D)	-0.66418	-0.27392	0.15365
Outward Appearance (U)	-0.61945	-0.11883	0.37461
Direction (U)	-0.14267	-0.89882	0.03707
Direction (D)	-0.05141	-0.83395	0.21249
Navigation (U)	-0.05	-0.83265	0.11042
Navigation (D)	-0.04415	-0.73063	0.27762
Street View (D)	-0.03538	-0.08638	0.90298
Outward Appearance (D)	-0.2543	-0.34371	0.62522
Street View (U)	-0.37957	-0.33725	0.59769

In conclusion, even though the age seems a big gap, the orientation is the same factor for user. But the shop related information and spatial data represent the distinct meaning to different age of users. Are these functions can convey the distinct meaning to the different types of wayfinding strategy or task user? The order of functions can be customized to fit the user's wayfinding process or the preference for giving them more freedom when they are proceeding digital maps.

6   Conclusion

The aim is identifying the types of maps, map functions, and information of local tourist areas that are acceptable for most user. The findings from the case study emphasize the preciseness and accuracy of digital maps such as Google Maps and Apple Maps. Therefore, designers or engineers with limited budget would profit from using these two maps as bases to create smaller local maps for tourism. Instead of updating every 2–3 years like world maps, local tourism maps are designed with specific areas and people in mind; therefore, they have unique features. Orientation for 20s is priority and second for above 60. This result shows then 20s using digital map, they want to know where they are? Which direction they are facing? Also, how long they do need to move? It shows that not only gender can influents wayfinding strategy/task, and age also influent how people have wayfinding process (Zomer et al. 2019).

Orientation is the only one factor has the same function in all three results which means no matter all ages of people see digital map orientation related function is important. If we make user answer some questionnaire before using digital maps. The designer can make variable interfaces which may alter user's basic consciousness about wayfinding. Furthermore, the results show that the purpose of a function determines how much importance a user attaches to it. For example, participants in this study valued a map's orientation function (whether they had decided on their destination or not).

However, the data also shows that Street View and Outward Appearance of a destination impact on different factors. When user have decided on their destination, they use these two functions as check information, i.e., to confirm their position. Nonetheless, when the destination is undecided, the atmosphere factor comes into play to attract tourists. Combining with the results in wayfinding strategies/tasks, demographic and decided/undecided destination. The map can be designed into a better map using process to fit variable groups through a preceding test and following by the demographic to setting three types mainly wayfinding aids to make sure they can have an easier and comfortable local tourism map operating experience (Prestopnik and Roskos-Ewoldsen 2000; Nori and Giusberti 2006; Rahimi 2014; Rahimi et al. 2018; Zomer et al. 2019).

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Kansei Engineering Implementation in Web-Based Systems: A Review Study

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Abstract. In recent years, website interface design based on emotional aspects are getting more attention. When designing an interface, the focus should not only be on the aspect of usability, but also stress on providing usefulness and functionality, and emotional usability. Therefore, designing a more persuasive interface for users is a critical matter. This paper reports a review study on Kansei Engineering (KE) implementation in web-based systems focusing on e-Learning, mobile learning, and website interface design in order to help beginners to gain better knowledge and understanding of the emotional elements of a website. The findings show the success in using KE and the emotional approach in previous studies, and how it is important in the design and development of web-based systems. Further works involving KE adoption and approach in a wider scope of investigation within Web Systems design is recommended.

Keywords: Kansei engineering · E-Learning · M-Learning · Web-based systems

1 Introduction

The design of a product is very important because it needs to meet all the users' criteria and expectations. A poorly designed product may lead to unwanted results and bad user interaction, and may lead to an inconvenient and unpleasant user experience. Well-designed products that suit user expectation are easier to sell. As stated by [1], developing products that meet users' needs and expectations as well their psychological needs will benefit the developer as the products will become easier to market and get a more profitable return. KE which was pioneered by Professor Mitsuo Nagamachi of Hiroshima University is a method to design and develop products that can fulfil consumers' feelings and desires to sustain business [2]. Emotions and feelings are vital to be considered in product design as they play an important role in the user's decision-making process. In addition to buying items on the required list, users also make purchases based on their feelings for the products. This statement was supported by [1] saying that products produced that fulfil the users' or consumers' needs, as well their emotional needs will reap benefits.

Therefore, designing products that meet user's desires tangibly and emotionally is very compulsory for product designers [3]. The same principle is applied for designing user interface for web-based systems. According to Turumugon and Baharum [4],

designing a user interface that satisfies the emotional needs of the user is essential as the user interface plays a crucial role in generating notable user experiences for the user interface in a web-based system. Thus, the KE methods have aided in this process by using an analysis of human emotions. KE is a discipline that systematically explores a human's feelings toward a product and turns it into a product design parameter [5]. Nagamachi [2] defined Kansei as the harmonized mental state of knowledge, emotion, and sentiment. The process of Kansei is described as a higher function of the brain whereby the psychological cognition concerned with perception, judgment, and memory interprets human basic senses [6, 7]. In short, applying KE helps with the creation of products that represent the emotions of customers and customers' self-confidence in using the products.

User interface design should also focus on the usefulness and functional usability instead of only focusing on the user experience [8]. As dictated by Prihati et al. [9], usability is one of the most important aspects in interface design. Yet, as stated in Lokman et al. [10], interface design should also focus on providing functional usability and effectiveness instead of solely focusing on the aspect of usability. Previous study and literature have increasingly emphasized the importance of understanding people's emotional responses toward the characteristics of everything that has points of interactions with people [11]. Therefore, knowledge in designing a more persuasive interface for the users is a critical matter [12]. Previous study by Noor et al. [13] also reported that IT designers have begun to address affective or emotional elements in their products and a significant amount of work is put into the design of mobile phones. In short, past studies have concluded the importance of designing a user interface for a web-based system that focuses on the emotional effects toward the users. Reviews on existing studies in KE on web-based systems show that most studies are context specific where the studies were conducted specifically and thoroughly discussed in this paper.

The review study was performed by following the below methods:

1. Formulating review question - What are the studies that can be found in KE web-based implementation?
2. Searching for relevant literature.
3. Conducting data abstraction; and reviewing and writing the discussion.

This paper reports a review study on KE implementation in web-based systems, particularly in e-Learning, mobile learning (m-Learning), and website interface design. It will provide stakeholders with better knowledge and understanding of KE implementation in these web-based systems, especially for beginners.

2   Methodology

This part shows the steps to write the review of the study by performing the literature identification to answer the review questions. The process of literature identification involves a comprehensive and extensive search for studies to be included in the review. Search strategies and processes are usually iterative and benefit from:

1. Primary searches (to identify existing review and volume of studies);
2. The primary search process involved the use of 9 online databases: ACM Digital library, IEEEXplore, ISI Web of Science, Emerald Insight, ISI Proceedings, Sage Full Text Collections, Science-Direct, SpringerLink, and Scopus;
3. Trial searches (combination of terms from RQ);
4. Check the search results against list of known studies;
5. Consult the experts in the field.

The following steps were conducted to construct search strings:

1. List the keywords mentioned in articles found in preliminary searches;
2. Derive major terms used in the review question (i.e., KE, Kansei designs, Kansei learning);
3. List the keywords related to the major terms (i.e., Kansei, robotic, UX study);
4. Search for synonyms and alternative words (i.e., Emotion, Affect, Affective, Emotive).

The selection of online databases was based on the researcher's knowledge of databases that index KE related studies and the list of available online databases that have been subscribed to by UiTM's library for all categories found in the preliminary search. The following are base literature selection for 3 main topics discussed:

1. E-Learning: 11 papers were chosen – 9 were selected while 2 were rejected due to the lack of study contribution.
2. m-Learning: 8 papers were chosen - 7 were selected while 1 was rejected due to the lack of study contribution.
3. Website interface design related to Kansei web-based papers (excluding e-learning and mobile learning): 9 papers were chosen - 7 were selected while 2 were rejected due to the lack of study contribution.

The initial literature papers were selected based on the search criteria, however the rejected papers need to be excluded due to contents discussed and not mainly focused on the 3 main topics. The searching criteria is limited to:

1. Inclusion criteria:

    • Includes studies that involve KE implementation in web-based systems (e-Learning, mobile learning and website interface design).

2. Exclusion criteria:

    • Papers presenting unsubstantiated claims made by the author(s), for which no evidence was available.
    • Papers not written in English or *Bahasa Malaysia*.

To avoid bias, the study has also extended the search by:

1. Searching the Google scholar database using similar keywords;
2. Reviewing reference lists of retrieved articles to extend the search;
3. Reviewing publications of corresponding or first authors of published studies found;

4. Manual searching of related journals, conference proceedings, and books related to KE implementations;
5. Using personal references, and emails, and referring to experts in the field.

3   KE Implementation and Discussion (Analysis and Findings)

The Internet and the World Wide Web has grown in its ubiquity, popularity, and extent of use and is continuing to grow at an exponential rate, surpassing all other technological developments in history over the decades [14]. Nielson [15] posited that a well-developed website will help with attentive user-web interaction. According to Bidin and Lokman [16], a good website should provide good usability and be able to capture users' feelings at once. The comfortability of the website should meet with the real world experience in order to capture user attention with the service or product offered. As a result, the same focus should be emphasized on all web-based systems. A web-based system is a system in which client-side application components communicate with application components in a web server to process data [17]. There are a few research discussing the implementation of KE in designing web-based system applications. This paper focuses on reviewing the implementation of KE in web-based systems including e-Learning, mobile learning, and website interface design.

3.1   E-Learning

E-Learning is a method of education that uses different kinds of technologies focusing on the internet or is computer-based [18, 19]. The Internet has become an important medium for accessing available resources for research and for learning for both teachers and students to share and acquire information [20]. Technology-based e-learning encompasses the use of the internet and other important technologies to produce materials for learning, teach learners, and regulate courses in an organization [21, 22]. According to Arkorful and Abaidoo [22], e-Learning is defined as the use of information and communication technologies to enable access to online learning and teaching resources.

Studies by [8] focused on web-based e-Learning system which aimed to complete the concept of Human-Computer Interaction (HCI), and involves the factor of psychological feelings in designing systems by introducing KE to overcome the issue of how to persuade the learner to use the system at first sight and psychological feeling. This study involved 20 high school students as respondents and used the KE Type 1 and multivariate analysis such as Principle Component analysis (PCA) and Factor Analysis (FA) to analyse the data. The result shows that the emotion of "Enthusiastic" has the greatest value, thus becoming the most critical emotion to be considered in designing the interface of web-based e-Learning systems. This concluded that the PCA is similar to FA, where two concepts of emotion are generated, which are "Attractiveness" and "Cuteness", and FA is used to sharpen the results of the PCA by breaking down the concept of emotion to the specific emotion coefficient score. Thus, this study has come out with the output of designing the web-based systems based on user

psychological feelings. Other than that, Hadiana and Lokman [12] conducted a research regarding the use of Kansei evaluation in open source e-Learning systems. The objective was to analyse and choose the desired open source e-Learning systems based on students' implicit needs. The issue confirmed that only a few guides exist to support them in choosing systems that meet the implicit needs of students, thus the adoption of e-Learning system is unsustainable. Thus, to overcome this issue, 100 respondents participated in the study and the KE analysis (Kansei checklist) and multivariate analysis consisting of the PCA and FA were used to analyse the data collected. The outcomes showed that the emotion 'harmony' has the highest influence on the selection of open source e-Learning system, followed by the emotions 'unique' and 'dynamic'. Hadiana [23] extended the study on e-learning systems to Kansei based interface design analysis for open source e-Learning systems with the goal to analyse the desired open source e-Learning systems based on students' implicit needs. Since higher education institutions such as universities must implement e-Learning systems to support their learning process, such systems are believed to be suited to the needs and characteristics of students and can be sustainable for a long time. This study used 5 open source e-Learning systems as specimens and adopted the KE Method Type I (KE Pack) to analyse users' psychological needs and desires in a system. Results show that factors represented by Kansei Words had impacts on choosing a desired open source e-Learning system. Therefore, the results have proven that the design of the interface plays an important role for students to choose such open source e-Learning systems.

The above studies have achieved their aim on implementation of KE in e-Learning system accordingly. The existing methods used before were improved with the KE approach to obtain better results and diversity in designing the desired interfaces based on emotions. The domain of study focused on the users' emotional and psychological feelings other than the usability aspect or user experience. This was supported by Hadiana [8], stating the importance of usefulness and functional usability in interface design. A well-designed interface for e-Learning or web-based systems plays an important role in attracting users and students having good interactions with them as well as providing better communication with users. Nielsen [24] in his study detailed the importance of the design interface to attract and retain each user. The interface of the website itself will be the primary thing that people see once they connect to any web-based system. Redzuan and Lokman [25] in their study stated that not many have considered the emotional aspect in the design of the courses in the e-Learning environment. The importance lies in their purpose of visiting which makes them stay, thus providing an affective e-Learning environment which helps students to happily access the system. However, Arkorful and Abaidoo [22] stated that e-Learning has some disadvantages in that it makes the learners feel contemplation, remoteness, as well as a lack of interaction or relation. Therefore, an emotional e-Learning system can help provide an affective approach and emotive learning environment.

According to Al-Rahmi et al. [19], students were required to go online and access the system as part of their university's requirement, as in the last decade, the development and implementation of e-Learning have become a requirement for academic institutions. As it is compulsory for students to access the e-Learning web-based systems, a design interface that can catch their attention is essential to have. If the design fails to catch their interests, students would be more comfortable opting for the

conventional way of learning rather than choosing the e-Learning system. Hadiana [23] in her study stated that open source e-Learning system is an alternative learning environment in higher education that complements conventional learning to make learning more efficient. Therefore, it strengthens the point of having an attractive yet efficient e-Learning system, to persuade users to prolong their stay during their visit while maintaining comfort and have proper interactions with the system. Thus far, research on emotional design using KE implementation is widely used in design interfaces for educational purposes.

3.2 Mobile Learning

Mobile learning (m-Learning) can be defined as the learning that takes place via small portable devices or small portable computing devices to achieve flexibility and inter-activity [26–28]. Nail and Ammar [28] also added the importance of m-Learning to enhance the learning process. M-Learning helps with the learning process and delivers educational experiences and materials that fulfil the requirements of each learner and circumstances. Thus, having an affective interface design for the m-Learning environment will help with the process of learning.

Other than studying the designs used in the e-Learning system, Hadiana [29] also wrote a paper concerning m-Learning interface using KE and Analytical Hierarchy Process (AHP). The purpose was to study about the m-Learning system. The objective was to analyse and select one of the desired m-Learning systems based on students' psychological feelings, as without consideration of students' needs, the implementation of a learning system would be unsustainable. This is to overcome the difficulty of selecting a learning system that meets the students' implicit needs such as psychological feeling. This study involved 100 students as respondents and used the AHP, FA, and Partial Least Square (PLS) analysis to analyse the data by selecting Kansei Words, and constructed them into a checklist using five points (from 1 to 5) Semantic Differential scale. The method has shown that KE has been successfully adopted in this research to analyse students' psychological feelings related to the m-Learning system. This research result has shown that there are two significant students' psychological feelings and enabled the selection of an m-Learning system that has a suitable interface. The result has also proven that the implementation of KE in web-based system development has come out with the most desirable interface for the m-Learning system. Nevertheless, a study regarding emotion on web-based systems is further developed by Hadiana and Ginanjar [30] in designing the interface of a mobile parenting information system based on users' perception using KE. The study's aim was to explore the relationships between users' emotional factors (psychological feeling) with the interface of a mobile parenting information system. This study was designed to overcome the issue of the lack of attention to what children and parents feel, and take that into consideration when designing a website. This study involved 30 respondents to choose the most desired design interface using the KE Type I, FA, and PLS to analyse the data. The results produced a guide on how developers can enhance a selected m-Learning system by having a suitable interface which considers the students' psychological feeling.

Thus, it can be concluded that m-Learning is able to provide flexibility and suitability in learning. This study has proved the theory of designing an m-Learning system that puts focus on its emotional effects towards the users instead of only emphasizing on the usability and user experience. According to Zubir and Redzuan [31], m-Learning is able to provide flexibility and conduciveness in learning, as learning materials are accessible anywhere and anytime using mobile devices. Apart from using mobile devices for daily use, users are also provided with the feeling of comfort when using mobile devices for learning purposes. The Kansei approach in learning has given them the feeling that they are interacting with a real life learning environment compared to digital learning. Hence, having a well-developed and emotionally affective user interface for m-Learning is important to make sure users are happy when accessing the learning environment and are provided with good interaction for m-Learning. The attractive yet conducive design for user interface is inevitably important as it gradually affects user interest while accessing m-Learning. This was supported by Noori et al. [32] who indicated that the user interface is the connecting bridge that connects users to a particular web environment or an application, and therefore, it is an interaction platform for users and machines.

3.3   Website Interface Design

Turumugon and Baharum [4] wrote a paper to identify a user interface web design standard for higher learning institutions using KE. The objective of this paper is to identify a standard HLI's web design by exploring the needs and emotions of the users through KE. This study was triggered by the desire to improve the poorly-designed user interfaces that currently exists, which is the cause of bad user interaction and unpleasant user experience when browsing a website, and elicits the dissatisfaction emotion and consequently results in avoidance and prevents users from revisiting the website. There were 125 respondents involved in the study consisting of 74 female and 51 male students in Malaysia. KE analysis was used to analyse the data and developed user interface web design guidelines for the development of the higher learning institutions' website. The guide can be used for future studies that focuses on design interface. Thus, showing that the implementation of KE in a web-based development system is expanding to a broader scope. A previous study by Lokman [33] discussed the affective website design and focused on the website's affective evaluation. The study was performed to identify differences in Kansei structure by gender and educational background. The purpose was influenced by the issue as it is only natural for social, cognitive, semantic, and affective issues to be addressed in the designing and building of websites. 120 undergraduate students participated in this study and PCA is solely used to analyse the collected data. The outcomes showed that Kansei structure from both gender backgrounds is similar, and a majority of subjects with an educational background produced similar Kansei structure. Whereas, a recent study by Bidin and Lokman [16] discussed the topic of elderly to enrich the comfortability emotion in website interface design using KE. Bidin and Lokman [16] has written about the website as a virtual medium for everyone including corporate companies or organizations and are used for many purposes such as electronic commerce and business marketing. This has inspired numerous research on exploring the meaning of web

usability as well as enhancing website capability. However, the findings of web usability studies were more towards website efficiency which focused more on functionality and could not measure user satisfaction. To overcome this issue, this study mainly aims to create an evaluation of website design from a perspective of online user comfortability by using KE approach. 40 respondents participated and the collected data were quantitatively analysed by using PCA and PLS analysis. The outcome was expected to provide design guidelines for any web designer to design any website that can meet user's comfortability emotion expectations. Lokman [34] has discussed emotional usability in e-commerce websites. The paper wrote about the approach of applying Kansei in the development of e-Commerce websites since only a few studies exist focusing on the emotions applied on the websites and the lack of a systematic guideline on how to produce websites that are embedded with emotional aspects. KE approach was used to analyse the collected data and produce the resulting concept emotion and the relationships between user's feeling and impression with website designers, and help the designers embed user's emotional feelings or Kansei into desired website design to produce a Kansei e-Commerce website.

Nowadays, with the increasing demands and needs for product variation and product technology, users continuously demand for services that fully cater to their needs, tastes, and lifestyles. Lokman [35] wrote a book saying that users prefer to choose products or goods that have affective or interesting elements that are close to their hearts. As mentioned by Nielsen in the 1990s, the importance of designing a good user interface relies on the practicality and the feasibility of the elements to create a good website design [13]. To be certain, when implementing technologies to secure customer loyalty, the key is to include the elements of emotion into the user experience. Thus, emotional engineering is an important part to be considered in the research conducted. This theory is supported by Lokman [34] who mentioned that emotional aspects play a significant role when designing products in order to produce desirable products. Hadiana and Ginanjar [30] also supported the theory that users' psychological emotion plays an important role in web-based interface design as well as the application of information systems. The fact that KE has been successfully used to incorporate an affective appeal into the product designs are undeniable. Qualities of usefulness, usability, and desirability play a central role in the good design of all digital products and digital environments such as websites, and have become researchers' main focus [34]. According to Hussin [36], recent developments in the literature have shown that users are very concerned with their emotional experience when they are browsing websites. Providing an affective interface design for websites has become a crucial attribute to be considered when designing websites in order to offer emotional connectivity from websites to deliver a positive experience for users. The affective approach provides reliable references and guidelines for Kansei website designers in designing successful Kansei websites for present day and future works.

4   Conclusion

This research has achieved the aim to review previous studies on the implementation of KE in web-based systems. The paper focused on the KE implementation in the web-based system particularly on the e-Learning, m-Learning, and website interface design to help beginners to gain better knowledge and understanding in KE studies. The review process has been briefly discussed and the selected research papers according to the topics have been revised thoroughly to aid future researchers to know where to start from when conducting research in related topics. In short, the implementation of KE in e-Learning has provided an attractive and efficient e-Learning environment, and persuades users to happily use them. This also worked for m-Learning with the KE approach whereby it provided the users with feelings as if they were interacting in a real life learning environment, compared to digital learning using electronic devices for learning purposes. Website interface design with KE approach helps users maintain positive perspectives when using the website. Users feel more secure when interacting with the website that can provide them comfort and portray positive user experiences. Thus, it can be concluded that past studies on this topic has highlighted the implicit details of emotion studies in web-based systems.

Overall, the findings from the past literature show the success of using KE and emotional approach in their study and how it is important for the design and development of web-based systems. Issues such as people's perspective and acceptance must be well-measured to make sure future research is thorough and comprehensive. Future works are recommended with a wider scope of KE adoption to avoid bias, and conduct in-depth research with an approach to understand the concept of KE implementations in web-based systems.

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Viewer's Emotion and It's Associated Design Elements in Political Video-Based Medium Using Thematic Analysis

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Abstract. YouTube has their own "communication power" via its broadcasted videos. Nowadays, this video-based medium has been used in many official campaigns by political parties and citizens to win the hearts and minds of people by portraying many social reality issues related to politics, which in turn could affect unity amongst the people. Henceforth, to understand how people's emotional responses towards the political agenda videos posted on YouTube could influence unity, specifically for the Malays, this study conducted interviews with experts from three different backgrounds, i.e. politics, psychology and cinematography. These experts have examined the contents of the videos for the purposes of confirming their suitability in conveying their messages. Upon analysis and confirmation of the videos by the experts, this study proceeded with a Thematic Analysis. The objectives of this analysis are; i) to identify the Kansei Words (KWs) and their perceived affect, and ii) to classify the positive and negative emotions and items and categories of the selected videos – based on the expert's justifications and perspectives. This study therefore used a seven-phase procedure in conducting the thematic analysis, which was adapted from a six-phase guide of the procedure framework provided by Braun and Clark (2006). After the thorough process of identifying and classifying the themes, eventually, this study successfully identified and classified 61 items of emotions and a total of 10 items and 88 categories of design elements over all 17 videos. The resulting set of emotions provide dimension that contributes access to emotional experience viewers would feel when viewing political YouTube videos. Thus, the results from this study are proposed to be utilised as a basis of understanding for future investigation into emotions, especially in political awareness, as well as the design elements of videos, which could influence unity.

Keywords: Thematic analysis · Emotion · Malay unity · Politics · YouTube

1   Introduction

Malaysia consists of the Malays, Chinese, Indians and indigenous communities living together, and they have distinct histories, languages, cultures and religions. However, according to [1], political institutions in Malaysia have been designed to keep them apart. Furthermore, it would prove to be more difficult if racial problems actually persist amongst a race's own ethnicity, which has been known as a mono-ethnic problem [1, 2]. For example, the Malay unity, and the issue regarding this ethnic is still debated. As the majority race in this country, it could be considered as a major issue if the Malays are not united, resulting in difficulties for Malaysians in general to achieve national unity as well [2, 3].

The Malay unity issue could become more complicated when it involves the new media as a third party. This is because the information disseminated by the third party could result in political prejudice [2, 4]. Therefore, in this study, the researchers' emphasis of concerns lies in social reality issues in relation to politics, which are being played by the new media, such as being posted on YouTube. As a key international platform of media diffusion, YouTube is the most popular social media that could be a powerful media channel for manipulating issues.

Therefore, this study attempts to i) identify the KWs and the perceived affect; ii) classify the positive and negative emotions and items and categories (design elements) – of political agenda videos posted on YouTube based on social reality issues, related to Malaysian politics, which in turn could affect Malay unity. This study used the Thematic Analysis to identify and classify the aforesaid emotions and design elements of the selected videos. Henceforth, this study used a seven-phase procedure in conducting the thematic analysis that has been adapted from a six-phase guide of the procedure framework provided by [5]. The extract of the transcripts has been taken from the interview answers by the experts – based on their justifications/comments towards the selected videos. Thereafter, the result of the KWs or emotions and items and categories or design elements derived from the Thematic Analysis, will be explained at the end of the study, demonstrating the significance and conclusion of the study as well.

2   Literature Review

2.1   Social Reality Issues Related to Malaysian Politics

The new media, complemented by the emergence of technology, are now becoming popular platforms for the people, especially in Malaysia – to spread ideas and issues, which could contribute to the rise of society to advocate their political ideologies and interests. For instance, many of the social reality issues that have been well played by the new media could affect the general elections, especially influencing the majority votes of the ruling parties.

Moreover, when the issues are well articulated from certain parties and well disseminated using the new media platforms, it will also affect people's emotion and perceptions towards certain issues, which in turn could affect unity. In fact, in the 2013

General Election, the opposition parties have articulated well the social reality issues. e.g. the unfairness of the electoral system, economics, lack of transparency, corruption, crimes, leadership issues, national security concerns, health, as well as playing on local issues, all of which had affected the results of the general elections and people's perceptions towards the leadership of the ruling government [2, 6].

In this case, this study selects several prominent issues related to politics in Malaysia. The period of selected issues for this study is the period between pre and post the 2013 General Election, i.e. from 2012 until 2016.

2.2   YouTube: A Popular New Media Video-Based Channel

In this digital era, anyone can produce and receive quick information. Therefore, to understand the potential of social media video-based platforms, [7] suggested the four concepts of communicative functions, such as informing, interacting, engaging and mobilising. For example, YouTube – a video-based social media and a video-sharing website, which consequently could contain all four concepts of communicative functions.

YouTube started to be used in political communication during the electoral campaign in the 2006 United States election. According to [8], YouTube has their own "communication power", which has been used in official campaigns by political parties, as well as by the citizens. The political parties have uploaded their speeches through this medium and represented their candidates' capabilities either in positive or negative ways. Moreover, YouTube could have an impact when it comes to several areas of campaign, e.g. it could create access to voters, advertising campaign, fund-raising, and the uploaded videos could certainly target their dissemination on the network [8].

Consequently, this study scrutinised that YouTube videos are persuasive video-based mediums for people to propagate their ideologies and agendas that in turn could influence unity. Therefore, this study will use social reality issues' videos posted on YouTube as a unit of analysis to investigate people's emotions that could affect unity.

2.3   Thematic Analysis: Accessible and Flexible Approach

Thematic analysis is a "method for systematically identifying, organising and offering insight into, patterns of meaning or themes across a dataset" [9]. The thematic analysis teaches the researchers about the coding's mechanics and to analyse the qualitative data that could then be linked to broader theoretical or conceptual issues. Therefore, [5] stated that any researcher that will apply the thematic analysis needs to understand and explain why they are applying this particular method. In this situation, [5] have provided a clear guideline to other researchers to start the thematic analysis and conduct the study in a more deliberate and rigorous way. There is a six-phase approach to thematic analysis i.e. 'Phase 1: Familiarising yourself with the data', 'Phase 2: Generating initial codes', 'Phase 3: Searching for themes', 'Phase 4: Reviewing themes', 'Phase 5: Defining and naming themes' and 'Phase 6: Producing the report'. According to [9], the outline of the six-phases provided by them is an approach to the thematic analysis and to learn the process of thematic analysis.

Henceforth, this study scrutinised that thematic analysis is an accessible and flexible approach, which could be used across a range of epistemologies and research objectives, research questions and research aims. In this case, this study will use the thematic analysis to identify and investigate people's emotional response towards political agenda videos posted on YouTube. Also, this study will classify the design element of the videos using the thematic analysis as one of the important aims that will be determined in the study.

3 Methodology

3.1 Participants and Specimens

Before the researcher could proceed with the Thematic Analysis and other experiments in this study, the interview sessions were conducted with three participants – the experts from three different backgrounds such as politics, psychology and cinematography. The experts have examined the contents of the videos for the purpose of confirming their suitability in conveying the message that could affect people's emotion, which in turn could affect unity. The identification and selection of the videos were important processes that had to be conducted so as to avoid any biases.

The initial video specimens that were selected for this study were based on various prominent social reality issues related to the political sphere in Malaysia, starting from pre and post 13th General Election i.e. between 2012 to 2016. The various social reality issues related to politics, which became amongst the prominent issues discussed between the timeline followed in this study are the "1MDB Scandal", "BERSIH Movement", "Malaysia People's Aid – BR1M", "Goods and Services Tax – GST", "Corruption", "Phantom Voters", "National Security" and "*Kalimah Allah*".

Moreover, the video specimens were selected based on popularity as shown in "View Count", "Likes" and "Dislikes" on YouTube. Additionally, this study followed the control conditions and criterions in identifying and selecting the initial video specimens i.e. i) Video website – YouTube; ii) Focus content – various social reality issues – prominent issues; iii) Length - < 3.00 min; and iv) Language – Malay and English. The total videos reviewed by the experts in the interview sessions were 22 videos, whilst the total of selected is 17 videos.

3.2 The Method of Thematic Analysis

After the experts have analysed and confirmed the video specimens, this study proceeded with the next method of analysis – Thematic Analysis. The main objective of this analysis is i) to identify the KWs and the perceived affect; and ii) to classify the positive and negative emotions and items and categories of the selected video specimens – based on the expert's justifications and perspectives.

This study adapted a six-phase guide of procedure framework in conducting the thematic analysis provided by [5]. In Braun and Clark's [5], the six-phase framework for doing a thematic analysis involved six steps of procedure, i.e. Step 1: Familiarising with the Data; Step 2: Generating Initial Codes: Step 3: Searching for Themes: Step 4:

Reviewing Potential Themes; Step 5: Defining Themes; and Step 6: Producing the Report. Therefore, in order to fit the research objective of this study, the researcher added one additional step (after Step 5), which is 'Step 6: Classifying Themes', and moves the initial 'Step 6: Producing the Report' to become the last step of the procedure. Henceforth, the study extracted the transcript that has been taken from the interviewees' answers, based on the selected video specimens and justifications towards the social reality issues related to Malaysian politics posted on YouTube. The procedure of each step will be explained in the following subtopic.

The Procedure of Thematic Analysis

Step 1: Familiarising with the Data. In this step, the study had to read and re-read the interview transcripts of the expert's justifications and perspectives towards the videos. The study needs to identify the KWs and the perceived affect elements in order to classify the positive and negative emotions, as well as items and its categories.

Step 2: Generating Initial Codes. In this step, the study coded the data based on social reality issues used in this study as a subtopic or segment of the data, which could capture something interesting about the study. Then, the study referred to the interview questions – to obtain more systematic ways to generate the codes throughout the coding process. Afterwards, during the coding process, this study started to develop the codes based on the research perspectives and research objectives of the study. This study coded the data associated with feelings, emotions and perceptions with green colour coding. Meanwhile, for data associated with visual features, contents and messages have been coded with orange colour coding. This step of the procedure ended when the data has been fully coded and the data relevant to each code has been collated.

Step 3: Searching for Themes. In this step, the study must take shape as the researcher needs to shift from codes to themes. To identify the similarity areas and overlap between codes, this study reviewed the coded data. This step involved the basic process of generating themes and subthemes that are the subcomponents of a theme. Afterwards, the study examined the generated codes and had set them together into themes. Also, the important elements that the study started to explore in this step are the relationship between themes and to consider how those themes work together in telling an overall story about the data. This step will end with a table outlining the themes which collate all the data extracts relevant to each theme.

Step 4: Reviewing Potential Themes. This step involved a repeated process, in which the developing themes were reviewed in relation to the coded data, as well as the entire data set. This study checked the themes against the organised extracts of the data set and explored whether the theme associates to the data. Therefore, in this step, the study reviewed the themes in relation to the entire data set that involved a final re-read of all the data to determine whether the developed themes meaningfully capture the whole data set, or just an aspect thereof. Alternatively, the researcher also generated subthemes, so as to support the research objective of the study.

Step 5: Defining Themes. Basically, this step is the semi-final refinement of the themes. Moreover, this step also involved the selection of data extracts to be analysed, thus, setting out the outline or purpose of each theme. For instance, the aims or objectives of

this study is to identify the KWs and the perceived affect; and to classify themes of the positive and negative emotions, as well as items and categories of selected videos, which have been analysed and justified by experts. Therefore, the data extracts that have been selected to quote and analyse will provide the structure for the analysis – the data narrative will inform others of the interpretation of the data and their meanings.

Step 6: Classifying Themes. Under this step, the study classified the themes – the positive and negative emotions, as well as items and categories. Firstly, the study reviewed all the identified emotions from each video viewed by the experts, as determined in the previous step. Then, this study read and re-read all the data to understand and analyse the entire code that will be fitted under the theme and sub-theme. Henceforth, in a way to understand and analyse the codes, this study also referred to 30-items emotional descriptors or Positive Affective and Negative Affective Scale-Expanded (PANAS-X) as a guideline. After completing the step of classifying the emotions, this study reviewed all the identified perceived affect elements from each video – to classify the items and categories (design elements). The classification of items and categories has been conducted in the same manner as the classification of emotions. However, as a way to classify the design elements of the videos, this study referred to the Six-Element of Film Features Element (Racial Unity) as a guideline.

Step 7: Producing the Reports. The final step of the analysis is the production of a report, to summarise all the results obtained from the analysis of thematic. The purpose of the report is to provide a compelling of the data on the study, based on the analysis. Therefore, in this step, the study will illustrate the Final Thematic Map, to show the flow of the analysis and the full results that will be obtained from all the steps mentioned above.

4   Results and Discussion

4.1   Final Thematic Map: The Experts' Perspectives About Political Agenda Videos Posted on YouTube

This study used a seven-phase procedure in conducting the thematic analysis and extracted the transcripts from the interview answers from three experts of different backgrounds i.e. politics, psychology and cinematography. The final thematic map illustrates the compelling flow of the data on the study, based on the analysis.

Henceforth, the final thematic in Fig. 1 shows that the experts were required to analyse, confirm and select the videos based on their expertise. For example; to explain the contents, messages, emotions, feelings, visual features and state their justifications or comments towards the issues in the selected videos. Then, this study had to get familiar with all the data received, generate the initial codes of the data, search for the specific themes, review, define and classify the themes, to identify and develop the KWs – the positive and negative emotions, as well as design elements – items and categories of the selected videos.

This study examined the generated codes and fitted them together into themes. Several coded sentences that relate to perceptions, sentiments and emotions were
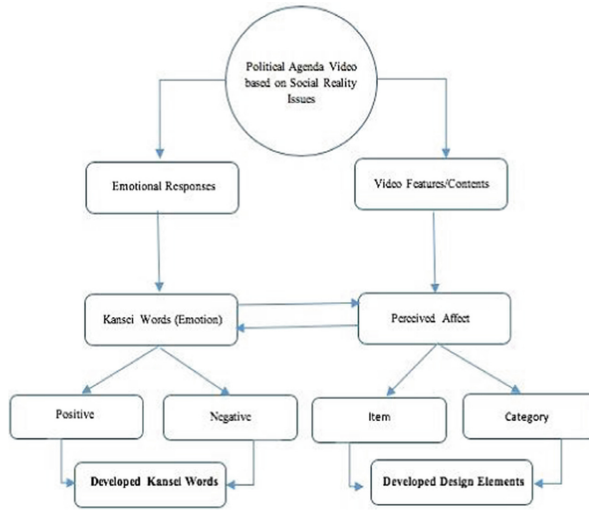
Fig. 1. The final thematic map based on political agenda videos posted on YouTube.

collated into an initial theme called The Emotional Responses. For example, for Video 1: 1MDB Scandal's Issue – this study identified that certain sentences or codes justified from the Cinematography Expert could be fitted together into the theme of The Emotional Responses. The codes mentioned that:

> *"...because the graphic and motion that the video maker used can make people understand about the issue (1MDB), ..." [L5]*
> *"...as well as affecting people's feelings – negative emotion i.e. **angry, surprised,** etc. about the issue..." [L6]*

Whilst, for several coded sentences from data that relate to content, message, visual features i.e. background colours/sounds/music were collated into an initial theme called The Video Features/Content. For instance, the codes stated that:

> *"... the **motion of the graphic was very informative**..." [L3]*
> *"...So far, the video is informative (in a negative way for certain people), ... [L4]*
> *"...because the **graphic and motion** that the video maker used can make **people understand** about the issue (1MDB), ..." [L5]*
> *"...It is also a **straightforward-info** video which **includes facts about the issue**..." [L7]*
> *"...a **nice motion for the graphic** such as **pop-up, good colours, sound**, etc., [L8]*
> *"...just to make sure the audiences' eyes and ears will look at the video and **hear the sound very clear**..." [L9]*

Therefore, this study identified that the coded sentences which were fitted under The Emotional Responses and The Video Features/Contents were inextricably linked as the expert felt that Video 1: 1MDB Scandal's Issue, would have a negative impact for certain people, which in turn could affect Malay unity. To support the research objective of this study, the researcher has generated one subtheme on each of the themes, which could capture something of importance in the research objective. For the theme The Emotional Responses – the subtheme that had been generated was The

Kansei Words (Emotion), whilst for the theme The Video Features/Contents, the subtheme that had been generated was The Perceived Affect.

For example, according to the justifications mentioned by the Cinematography Expert for Video 1: 1MDB Scandal's Issues, the identified emotions that fitted into the subtheme The Kansei Words (Emotion) were i) Understand (Understanding); ii) Angry; and iii) Surprised. Meanwhile, the identified visual features/contents, which fitted into the subtheme The Perceived Affect were i) Very informative; ii) Motion of the graphic – very informative; iii) The graphic and motion – make people understand; iv) Straightforward info – includes facts; v) Nice motion for the graphic, such as pop-up vi) Good colours; and vii) Good sound – to hear sound very clearly.

To classify the positive and negative emotions, this study had to read and re-read the codes that fitted under the themes The Emotional Responses, and the subtheme The Kansei Words (Emotion), to understand the codes and analyse the entire codes, which fitted under those themes. Besides, in order to understand and analyse the codes, this study referred to the PANAS-X as a guideline. After the thorough process of classifying the themes, eventually, as a result, after gathering all the positive and negative emotions, this study identified 61-items of emotions mentioned by the experts in the political agenda videos posted on YouTube which could affect Malay unity, and shown in Table 1 as follows;

Table 1. List of positive and negative emotions.

Positive emotion			Negative emotion		
Understanding	Uniting	Harmonious	Irritating	Fanatic	Sensitive
Calm	Safe	Peaceful	Surprised	Annoying	Confusing
Protecting	Thankful	Supportive	Violent	Boring	
Humorous	Catchy	Simple	Disuniting	Stupid	
Convincing	Promising	Satisfying	Worsening	Sad	
Responsible	Secure	Cute	Wondering	Doubtful	
Happy	Interesting	Funny	Burdensome	Angry	
Joyful	Intelligent	Confident	Upsetting	Disappointing	
Agreeing	Energetic	Exciting	Sarcastic	Bad emotion	
Strong	Reuniting	Grateful	Intriguing	Dramatic	
Rational	Patriotic	Desired	Hateful	Dissatisfied	
Delightful	Creative		Messy	Terrifying	

To classify the items and categories, this study also had to read and re-read the codes several times, as well as evaluating the entire codes that had been fitted under the theme The Video Features/Content and the subtheme The Perceived Affect. This study also referred to the guideline from the design criterion, six-elements of Film Features Element (Racial Unity), to classify the items and categories of the selected videos. In the context of features and contents of the video, each video may comprise all or part of the elements. As a result, this study identified a total of 10 items and 88 categories

(design elements) over all of the 17 videos. A sample list of the items and categories is shown in Table 2 as follows;

Table 2. A sample of list of items and categories.

Specimens ID	Items	Categories
1MDB Scandal Video 1	Background Colour	Good colours
	Character/Actor	Leadership and moral issues
	Content	Suitable
		Very informative
		Factual and straight forward
	Graphic/Animation	Nice pop-up
		Informative and understandable graphic/motion
	Sound	Good and very clear
	Storyline	Convey their own message
Phantom voters video 1	Background Environment	Good visual, background
	Content	Very informative
		Suitable
		Attractive and clear
		Cleary understood
		Funny message delivery
		High desire – to get more information
		Interesting message conveyed
		Has their own way (to delivery message) and not boring
	Sound	Good sounds
	Storyline	Has a sense of humour element
		Has a sense of interest
		Interesting
		Creative and convincing
…	…	…

5   Conclusion

The purpose of this study is i) to identify the KWs or emotions and the perceived affect; and ii) to classify the positive and negative emotions and items and categories of political agenda videos posted on YouTube, using the Thematic Analysis. Before this study could proceed with the Thematic Analysis, the researcher conducted interviews sessions with the participants – the experts from three different backgrounds such as politics, psychology and cinematography. The experts have examined the contents of the videos for the purpose of confirming their suitability in conveying the message that

could affect people's emotion, which in turn could affect the unity, specifically for the Malays.

To identify and classify the aforesaid objectives, this study used a seven-phase procedure in conducting the thematic analysis, which has been adapted from a six-phase guide of the procedure framework provided by Braun and Clark (2006). The process involved in the analysis was Step 1: Familiarising with the Data; Step 2: Generating Initial Codes: Step 3: Searching for Themes: Step 4: Reviewing Potential Themes; Step 5: Defining Themes; Step 6: Classifying Themes; and Step 7: Producing the Report.

After the thorough process of identifying and classifying the themes, eventually, this study successfully identified and classified the positive and negative emotions, as well as items and categories obtained from the analysis. As a result, upon gathering all the positive and negative emotions, this study identified 61-items of emotions and a total of 10 items and 88 categories of design elements over all the 17 political agenda videos posted on YouTube that have been used as specimens. The resulting set of emotions provides dimensions that contribute access to emotions experienced viewers would feel when viewing political YouTube videos. Thus, the results from this study are proposed to be utilised as a basis of understanding for future investigation into emotions, especially in political awareness, as well as the design elements of videos, which could influence unity.

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The Impact of Quality Attribute on Purchase Intention Take Unboxing Video as an Example

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Abstract. The unboxing video has become the most popular video online. Companies cooperated with video creators such as YouTubers to broadcast product advertising, which has achieved significant results. The goal of the cooperation video is trying to enhance the purchase intention of the audience just like traditional advertising. However, it is hard to understand how the unboxing video is so attractive to the audience. This study aims to explore the quality attribute that can enhance purchase intention from the unboxing video and understand the hidden attribute behind it. Through the Kano quality model, we can classify the quality attribute to understand the factors hidden behind the videos. The result shows that in order to enhance the purchase intention, first-hand product information must be concluded and allow the audience to fasten understanding of the product information. The further generation of several emotions such as surprise, avoiding regrets, and granting stress relief could have a positive impact on the video. This research hopes to provide not only to the company, but also YouTubers, advertisement directors, marketing strategy departments or the related industries a reference in the future.

Keywords: Unboxing video · Rational and emotional cognition · Kano model · Video design · Purchase intention

1 Introduction

The booming of social media and electronic consumption has changed the pattern of consumer behavior in the past ten years, especially with the launch of YouTube back in 2005, which has changed the way people receive product information and is replacing regular advertisements. Nowadays, social media is playing an important role in marketing [1]. Previous research has shown that advertising through print ads and TV ads can enhance consumers' purchase intention [2–5]. However, with the maturance of packaging, many consumers might be disappointed when they receive the product that is as good as expected or lacking in detail information. Therefore, unboxing videos have become a new type of advertisement on the internet. According to the World Federation of Advertisers' report in 2018, 65% of international brands increased the budget for internet promotion to enhance brand awareness (86%). Since Yahoo Tech uploaded the first unboxing video through YouTube, which was unboxing the Nokia E64 [6], it has become one of the most important themes on network video streams. There are multiple unboxing videos on YouTube, such as products, beauty care,

apparel, home appliances, and even travel and service experiences, etc. The unboxing videos have been defined as videos of unboxing experience through an Out-Of-Box Experience [7], which means the consumer takes the product out from the package, prepares it for use and experiences it.

Walter Isaacson, the author of Steve Jobs, quoted Jonathan Ive's words describing that package is like a theater that can create a story [8]. It is similar to storytelling which allows the audience to understand the process of unpacking an unexpected content, which is a useful tool for stakeholders such as advertisement, communication branding, and management [9]. The unboxing videos can not only create a strong impression of the product, but also arouse a strong emotional feeling [10], and can induce the positive emotions through different packaging aesthetic perception [11]. Compared to the information released from the company, unboxing videos and evaluation can enhance the credibility and appeal because the information is from a third party's self-experience [12]. The videos on YouTube have a significant impact on consumer's purchase intention [13, 14].

Currently, most of the quantitative research is focusing on consumer satisfaction, and purchase intention is seen as a one-diminution structure, which represents the higher quality receives higher satisfaction, but not vice versa [15, 16]. However, at some point, satisfaction rarely enhances even though the service performance has dramatically improved [17]. Therefore, in order to understand the consumer's cognition, not only the rational but also emotional quality attributes need to be studied, and there is no similar research has been done in the past. This study aims to discover the potential factors and quality attributes that affect consumers' purchase intention of unboxing videos through applying the Kano model.

2 Research Method

2.1 Kano Model

Professor Noriaki Kano and Fumio Takahashi proposed a two-dimensional Kano model which aims to improve the defect of linear assumptions based on the idea of psychological quality [18]. Through the two-dimensional model explain the relationship between the quality and dependent variable, such as satisfaction. The horizontal axis represents the adequacy of "Quality," and the vertical axis represents "Purchase Intention," shown as Fig. 1. Three major attribute categories are classified as the following:

1. Attractive (A): The quality can enhance satisfaction even though the quality has a negative trend, it can be seen as latent requirements. Take optional car configuration as an example, for some consumers, the manual window is all right for the driver, and the power window would enhance the satisfaction.
2. One-dimensional (O): The satisfaction would go along with the quality; it can be seen as the expected requirements. For example, the higher quality of car performance would increase satisfaction but vice versa.
3. Must be (M): The higher quality would not enhance the satisfaction, but the lower quality would decrease the satisfaction, it can be seen as a basic requirement. For
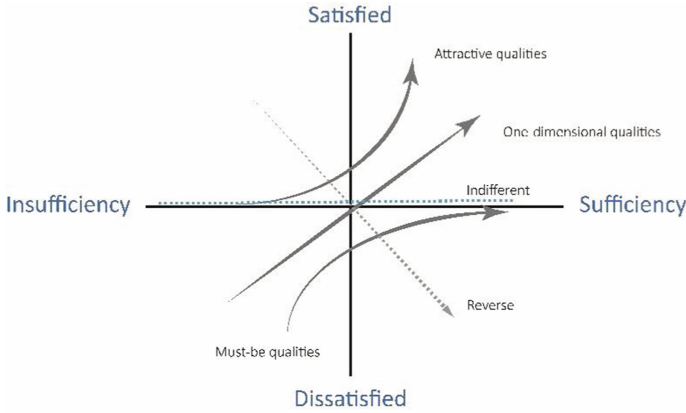
Fig. 1. Kano model [18].

example, a car with an airbag is a basic configuration that would not enhance satisfaction, but a car with less or no airbag would significantly decrease satisfaction.

There are two attribute categories which are Indifferent (I) and Reversal (R), Indifferent quality represent the quality performance would not affect the satisfaction; and the Reversal represents that the quality performance and satisfaction in inverse proportion.

The questionnaire conducts the Kano model to divide the quality factor into positive and negative qualities, then applied regression analysis with a dependent variable such as satisfaction or purchase intention. Based on the coefficient of regression analysis to determine the quality attribute, the attribute is determined to have been explained as Table 1. Therefore, this research will explore the quality attribute of purchase intention on unboxing videos, distinguishing the quality positioning through the Kano model.

Table 1. Relationship between significance of regression coefficient and quality attribute.

Quality attribute	$\beta1$ $(-)$ Sig.	$\beta2$ $(+)$ Sig.	Note
Attractive (A)	n.s.	*	$\beta1 = 0$; $\beta2 > 0$
One-Dimensional (O)	*	*	$\beta1 < 0$; $\beta2 > 0$
Must Be (M)	*	n.s.	$\beta1 < 0$; $\beta2 = 0$
Indifferent (I)	n.s.	n.s.	$\beta1 = 0$; $\beta2 = 0$
Reversal (R)	*	*	$\beta1 > 0$; $\beta2 < 0$

Note: n.s. = no significant; * = significant

2.2 Questionnaire Design and Participants

The questionnaire is based on the previous scholar research [19–21] combined with interview results of experienced participants. The interview conducts the semi-

structured interview method based on exploring the reasoning and feeling while watching the unboxing videos. The process of the interviews follows the interview outline, which is designed before the action. However, there will be no restrictions on the participants' response and this allows further in-depth exploration based on the participants' responses. The type of product is not included because this study focuses on general cognition. Next, the KJ method was conducted to classify the overall factors to reduce and organize the dimension, which was divided into two-parts, being rational cognition and emotional aspect. It was finally concluded of 20 overall quality attributes by applying Likert five-point scale, and adds the question of purchase intention.

Smartphones and computers are the primary equipment for sociality nowadays, and people rely on the equipment to receive information. Google Trends data shows that it is generation Z, a young adult born after 1995 [22, 23], who dominate the amount of online information search more than other generations [24], and generation Z and late generation Y are proficient in operating smartphones and computers [23]. Therefore, the participants of the questionnaire were set at the age of 18 to 30, whom are all students of National Cheng Kung University. A total of 123 valid questionnaires were collected, with 44 males and 79 females consisting of 80% of undergraduate and 20% of graduate school students.

3 Discussion

In order to verify the reliability and validity of the questionnaire, the reliability analysis was conducted on the questionnaire. The value of Cronbach's α is 0.885, which explains that the questionnaire has high reliability. Further conducting Bartlett's test of Sphericity with varimax rotation, and the KMO (Kaiser-Meyer-Olkin) coefficient value came out as 0.815 with all factors loading higher than 0.5, explains that the questionnaire is valid for further experiment. The following will discuss the "attractive", "must-be", and "one-dimensional" quality attribute, and the indifference will be discussed.

3.1 Attractive Attribute of Unboxing Video

There are seven attractive attributes classified, which are "Unboxing videos can save me the time to physical store," "Unboxing videos can make up my expectations of products I want to purchase," "The professionalism of the host is important," "Unboxing videos can avoid regrets," "Unboxing videos is stress relieved," "Unboxing videos give me the feeling of surprise," and "Unboxing videos give me the sense of satisfaction through product information," and the detail is shown in Table 2 below. The quality attribute has positive performance and would enhance the audience's purchase intention, but when it has negative performance, it would not significantly influence the purchase intention. From Table 2, it can be generalized that the condition of the attractive attribute is information performance. A quality of a video depends on the professionalism of the host, and the provided information indirectly affects the audience's emotion and expectation. The information presented from the host in the video allows the audience to understand the product, further satisfying the expectation.

From Table 2, it can be explained that all the quality attributes require the professional knowledge of the product and is the reason for the audience to watch the unboxing videos. Rationally, the consumer could receive the product information through the official website or visit the physical store. However, in the current internet era, many things can be done through the internet, as time has become valuable. If the unboxing video provided enough and unique information, it would be an attractive attribute to enhance purchase intention. The sufficient product information can generate the feeling of surprise and satisfaction, and stress is relieved because an unfamiliar product drives the audience watching the video to have their gap of knowledge to be filled which would enhance the purchase intention.

Table 2. The attractive quality attribute of unboxing video.

Evaluation item	n.	β1	Sig.	β2	Sig.	Q
Unboxing video can save me the time to physical store	3.77	−.136	n.s	.393	*	A
Unboxing video can make up my expectations of products I want to purchase	**4.02**	−.181	n.s	.333	*	A
The professionalism of the host is important	**4.04**	−.192	n.s	.099	*	A
Unboxing videos can avoid regrets	2.80	.029	n.s	.287	*	A
Unboxing video is stress relieved	3.47	.005	n.s	.230	*	A
Unboxing video give me the feeling of surprise	3.74	−.056	n.s	.303	*	A
Unboxing video give me the sense of satisfaction through product information	3.28	−.045	n.s	.401	*	A

3.2   Must-Be Attribute of Unboxing Video

Must-be is an important attribute in the cognition quality; two factors are classified as the must-be attribute, which is "Unboxing videos can make me understand the fashion trend," and "Unboxing video allows me to discover the new product," as shown in Table 3 below. The must-be quality performance can be read as a requirement, which means the video must contain the factors or decrease the purchase intention. From Table 3 we can generalize the quality performance as a trend connection. As stated earlier in the article, the internet has become one of the most important channels to receive information, and most unboxing videos are performing the newest product or what is news in the society. Therefore, the unboxing videos do not contain the popular or newest trend that would decrease the purchase intention. There is an interesting phenomenon that there is no factor classified as the must-be attribute. Emotional feeling is the interaction stimulating from the situation [25]. The emotional factors in this study are focusing on positive emotion, and the must-be attribute shows no positive purchase intention. Therefore, there is no emotional aspect to show in the must-be attribute.

Table 3. The must-be quality attribute of unboxing video.

Evaluation item	n.	β1	Sig.	β2	Sig.	Q
Unboxing videos can make me understand the fashion trend	**4.12**	−.250	*	.132	n.s	M
Unboxing video allows me to discover the new product	3.52	−.215	*	.147	n.s	M

3.3 One-Dimensional Attribute on Unboxing Video

The one-dimensional attribute is a common result of the statistical analysis. Three factors show a one-dimensional attribute that may influence the purchase intention, which is "unboxing videos can help me for purchase decision making," "unboxing video can make me feel excited," and "unboxing videos can make me feel secure." The results are shown in Table 3. The influence level would show the purchase intention along with the attribute performance. The result from Table 4 can be generalized as decision making. The feeling of excitement and securely generated from the video. If the video makes the audience feel excited, secure, or is helpful, it would enhance the purchase intention, but not vice versa. From here we can understand that the purchase intention would follow the degree of helpfulness, the feeling of excitement, and security. The feeling of security mainly describes the safety feeling when the consumer understands the product's function, feature, or even certification.

Table 4. The one-dimensional quality attribute of unboxing video.

Evaluation item	n.	β1	Sig.	β2	Sig.	Q
Unboxing video can help me for purchase decision making	**3.59**	−.287	*	.185	*	O
Unboxing video can make me feel exciting	3.54	−.398	*	.250	*	O
Unboxing video can make me feel secure	3.44	−.268	*	.251	*	O

4 Conclusion

The internet is a very important generational product in the 21st century, and radically changes consumers' behavior. Unboxing videos can not only be seen as a product advertisement but also as entertainment. From this study, it can be found out that the factors affecting consumer's purchase intention might have multiple qualities, not only one-dimensional. An attractive attribute represents information performance. The attribute factors share a common characteristic that if the video does not reach enough quality performance, the audience has other choices to find out the information from, and it would not decrease the purchase intention. Those attractive attributes are like a switch as it would not affect the purchase intention until the video stimulates the audience, not only the rational stimulation such as to satisfy their expectation, but also emotional stimulation such as feeling surprised. However, must-be quality attributes,

which are classified as trend performance, become an essential attribute standing in the promotional aspect. A product needed to be promoted usually is a new release product, which means if the producer is filming a video for an old generation product, it would reduce the purchase intention because the video is about a product that everyone already knows. Interestingly, there is no positive emotional performance in the must-be attribute. Emotional feeling is the interaction stimulating from the situation [25], which means if the video does not provide the stimulation, it might generate emotion but in the negative direction, and it would not enhance purchase intention anyhow. Finally, the one-dimensional attribute, which is classified as decision making performance in order to enhance the purchase intention, needs to provide the audience with the decision and arouse the feeling of excitement and security. Often unboxing video contains the evaluation of the product, which sometimes makes the comparison with a similar product or a different version. This clearly and visibly allows the audience to make the comparison and understand the advantage through personal understanding or experience, and all of those become critical factors of decision making.

The unboxing video is an interesting performance style on YouTube because it contains unlimited opportunities in a different position such as YouTube, company, and government, which binds all the social ecology together. The company sponsors YouTubers to promote the product through YouTubers exposing the product on the internet. From the business perspective, it is a new style of advertising which walks into the lives of the consumer through YouTubers and YouTube. The goal of the company is to enhance the purchase intention. This research understands what is important for the unboxing video contents and strongly recommends to have the must-be attribute to be contained in the video no matter what product is unboxed, encourage to include the attractive attribute factors, and look to generate the attractive emotion so that it is possible to enhance the purchase intention for the product. Furthermore, this research can enhance the product or service promotion to the consumer to stimulate or arouse the satisfaction of consumer needs, not only from the rational aspect but also emotionally. It is hoped this research can provide not only to the company, but also YouTubers, advertisement directors, marketing strategy departments or related industries a reference in the future.

5   Recommendation for Future Research

This study is generally discussing the quality attribute of the unboxing videos. Follow-up studies can further explore the variables such as gender, age, background, or even the types of product video. Moreover, we can assume that the quality attributes might have a sequence between each other, which can provide a more specific and accurate analysis of unboxing video.

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Evaluation of Learning Recommendations for Autonomous English Study

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Abstract. In this study, we proposed recommendation phrases to promote autonomous English learning according to motivation types by employing self-determination theory to study groups of learners. Participants were classified according to their relationship to motivation stage and human needs. A positive correlation between human psychological needs and motivation stage was found. In addition, the recommendation phrases based on that model were confirmed to increase English learning motivation values.

Keywords: Self-determination theory · SDT · Motivation · Foreign language education · Recommender system

1 Introduction

In recent years, there has been a wide-ranging advancement of informatization, spreading information of various sorts to the population, making knowledge readily available. In this scenario, autonomous learning has become indispensable. In particular, it is not very easy for someone to study on their own in places other than environments such as a cram school or similar schools, thus autonomous learning is not easy. In order to facilitate this process, researchers have begun investigating how to promote learning through the autonomous method [1–3]. In this field, there are several theories such as self-determination theory [4, 5], two-factor model [6, 7], and achievement goal theory [8, 9]. The self- determination theory suggested that human motivation is continuously expressed using human psychological needs. These have been studied to partially capture the transformation of human motivation in daily life.

In these studies, Hiromori et al. examined what factors enhance the English learning motivation of the high school students using the self-determination theory [10]. Tanaka et al. also suggested that the satisfaction of human psychological needs in self-determination theory was correlated with intrinsic motivation in the English class [11]. Okada et al. [12] suggested that the interest in the task and anxiety during the task are different depending on the motivation state. These researches focused on classroom-based learning not for individual learners. In addition, these researches also suggested that having an individualized recommendation phrase is important as a

motivating method for each learner. Self-determination theory states that there are six states of human motivation, thus the purpose of this study is to classify the learners based on the self-determination theory and to find the most efficient way to motivate different groups.

2 Method

Motivation for learners is roughly divided into two types: extrinsic and intrinsic motivation. In intrinsic motivation, students are less affected by external stimuli such as shame, punishment, and reward. In general, intrinsic motivation states have been considered better motivation states, but it is unclear how one transitions from the external motivation states to the intrinsic ones.

These two motivation states were determined by using three human psychological needs (autonomy, competence, and relatedness) described by self-determination theory (SDT). SDT proposed six consecutive regulatory styles (non-regulation, external, introjected, identified, integrated, and intrinsic) between extrinsic motivation and intrinsic motivation. Figure 1 illustrates the taxonomy of motivation types, arranging them from left to right in a continuum from non- regulation to intrinsic regulation.
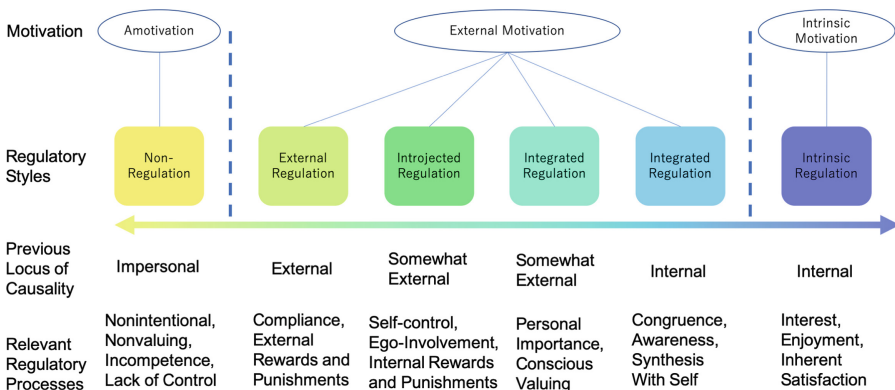
Fig. 1. The self-determination continuum showing types of motivation with regulatory styles, loci of causality, and corresponding processes.

2.1 Procedure of the Model Creation

We did structural equation modeling (SEM) to reveal the relationship between human psychological needs and human motivation stage, then prepared the result of factor analysis to find the elements of the SDT model from the questionnaire based on previous studies and to confirm whether the elements revealed by previous studies are much or not for college students.

Questionnaire. In preparing the questionnaire scale, with reference to previous studies conducted based on the SDT, we prepared a total of 26 items (15 items for motivation

status and 11 items for psychological human needs, including two inversion questions about competence) that uses a 5-points scale ranging from strongly disagree to strongly agree [13] and the questionnaire was answered using Google Form.

Factor Extraction. Based on the questionnaire, we performed a factor analysis and extracted factors for modeling motivation state.

Model Creation and Evaluation. We reconstructed models from previous studies based on the results of factor analysis.

2.2 Procedure of Recommendations

Based on the model, we found supposedly effective recommendation phrases for each motivation state. The effective recommendation phrases considered in this study evaluates whether the continuous rate of English learning has increased or not. According to SDT, the closer to the intrinsic motivation state someone is, the higher the possibility of autonomous learning, thus we considered a recommendation phrase that promotes the learner to shift towards the intrinsic motivation state.

We recommended to the learners some indications to promote their studies through messages with the LINE [14] application or e-mails for users to check immediately. We investigated the increase or decrease in continuous English learning before and after the recommended indications, and in the human needs scale scores that was previously defined with the questionnaire and Duolingo (a platform that includes a language-learning web site, mobile app, and a digital language proficiency assessment exam). In order to measure the human desire scores, four questionnaires about human psychological needs were added. The subject responded to a total of 30 items. Their English learning duration was extracted using Duolingo's features.

3 Results

3.1 Model Creation

Factor Extraction. In this experiment, the questionnaire was given to 137 students (male: 67, female: 70) in their 20s. We have used varimax rotation for analysis, then we ultimately adopted four factors for the previously assumed motivation state and three factors for psychological human needs, based on the cumulative contribution rate and ease of interpretation (refer Table 1 and 2). Factor naming was done with reference to previous studies.

Model Creation and Evaluation. We performed a structural equation modeling focusing on the relationship between human needs and motivation stages. Then Amos26 (statistical software package) was used for analysis, and the maximum likelihood method was used as a parameter estimation method based on previous studies [10]. It was assumed that each type of motivation state was affected by three psychological desires. The results of the analysis were indicated by an evaluation index

Table 1. Factor scores for human needs and factor contribution ratio.

	Factor1 (Non-Regulation)	Factor2 (External Regulation)	Factor3 (Integrated Regulation)	Factor4 (Intrinsic Regulation)
The reason you study English is that English is fun	−0.007	−0.066	−0.031	0.942
The reason you study English is that English is interesting	−0.055	−0.05	0.033	0.901
The reason you study English is that studying English is your hobby	0.03	0.04	0.028	0.646
The reason you study English is that it is useful for your growth	−0.091	0.031	0.777	0.073
The reason you study is that you want to speak foreign language	−0.054	−0.044	0.817	0.042
The reason you study English is that it is useful in another situation	−0.062	0.039	0.859	−0.087
The reason you study English is that studying English is custom	0.015	0.788	−0.037	−0.01
The reason you study English is that it is decided	−0.089	1.043	0.036	−0.083
The reason you study English is that you are decided by your parents	0.23	0.328	−0.239	0.125
You don't know what you are learning English	0.613	−0.023	0.065	−0.125
You feel that you are wasting time to learn English	0.636	−0.077	−0.279	0.001
The reason you study English is that if you don't study English, we feel awkward	0.762	−0.081	−0.206	−0.043
The reason you study English is that it is uncomfortable unless you study English	0.654	0.019	−0.037	0.039
The reason you study English is that you are worry unless you study English	0.603	−0.15	0.191	−0.006
The reason you study English is that you want others to think you can do it	0.512	0.21	0.29	0.067
Factor contribution ratio	0.166	0.155	0.145	0.127
Cumulative contribution ratio	0.166	0.321	0.466	0.593

Table 2. Factor scores for motivation stage and factor contribution ratio.

	Factor1 (Relationship)	Factor2 (Autonomy)	Factor3 (Competence)
Do you feel that you can't get good English grades?	−0.002	−0.084	0.798
You don't feel that you can get good English grades?	0.015	−0.042	0.982
Do you feel that you get good English grades?	0.135	−0.145	−0.419
Do you feel that the way of studying is decided?	0.091	−0.088	0.103
Do you feel that your opinion is valued on your English learning environment?	0.189	0.468	−0.002
Do you feel that you can say how to study English?	−0.317	1.157	−0.068
Do you feel that you have decided how to study?	0.194	0.394	0.192
Do you feel that your friends are care of you?	0.354	0.245	−0.083
Do you feel that you have a good relationship with your friends during classroom?	0.524	0.17	−0.087
Do you feel that your friends who always together are real friends?	1.096	−0.333	0.004
Do you feel that friends around you are very kind?	0.679	−0.047	0.087
Factor contribution ratio	0.206	0.177	0.168
Cumulative contribution ratio	0.206	0.383	0.552

(Goodness of Index = 0.82, Adjusted Goodness of Index = 0.77, Root Mean Square Error of Approximation = 0.07).

The result confirmed that the fit between the model and the data was positive. Figure 2 shows the relationship between human needs and motivation level obtained from structural modeling.

Working Considerations. Effective ways of working in each motivation state was considered from the results of equation structural modeling. A positive correlation was found between the intrinsic state and psychological human needs, except for autonomy. The reason might be that learners with intrinsic motivation are able to learn on their own, therefore there is negative correlation between them. This would also be expected by the cognitive evaluation theory within SDT. Since the goal of this study is to enable learners to study autonomously, learners within the intrinsic motivation states were not targeted, and in order to shift learners in other states towards the intrinsic motivation state, we considered learning recommendation phrases that increased the score of items with low factor scores.
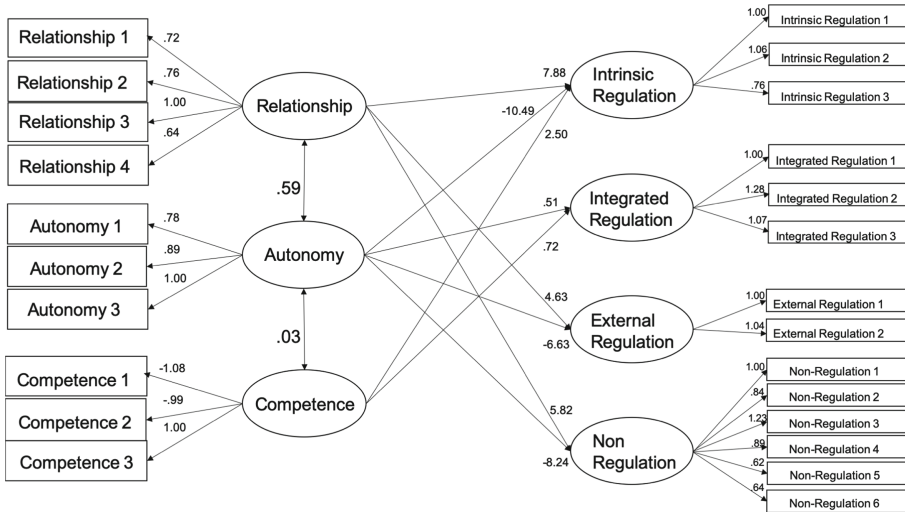
Fig. 2. Causal model of human needs and motivation by structural modeling.

For instance, if the relatedness scores are low, the learners and their friends can make a learning recommendation phrase by learning together. Figure 3 shows examples of recommendation phrases in English and Japanese respectively.

Fig. 3. Examples of recommendation phrases in English and Japanese.

Evaluation of Learning Recommendation Phrases. The recommendation phrase evaluation was conducted by 10 students in their 20s. After studying English for 30 min, each with and without these recommendation phrases, although the continuation rate did not increase, the subjective evaluation confirmed that those scores increased after these recommendation phrases. However, no significance was found in the difference between means (Fig. 4).
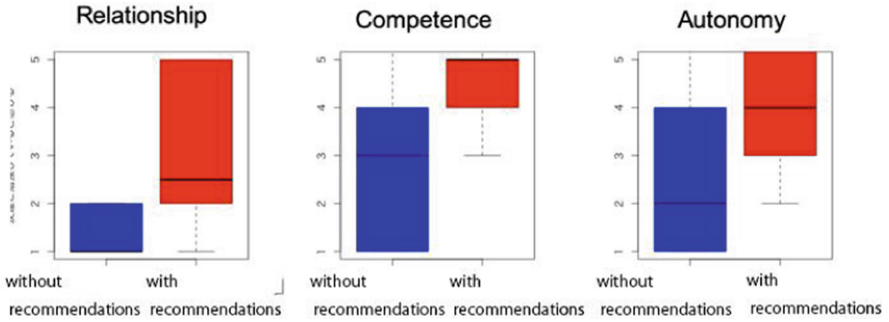
Fig. 4. Variation of scores on human needs with and without recommendation.

4 Discussion

4.1 Factor Analysis Results

The items of human needs used in previous studies in factor analysis could be similarly divided in this experiment. From this, we suppose that this questionnaire can also be used for university students. In addition, regarding the item on motivation state, more question items were related to the unadjusted state than in the previous study. This is presumably because of the differences in English learning environments between high school students and university students. High school students are required to take English learning courses to graduate high school.

4.2 Creating Model

The models show that competence is considered to be one of the key factors in shifting to a more intrinsic motivation state. This has also been suggested in previous studies [10]. As for autonomy, a positive correlation was confirmed only with the integrated regulation stage. This indicates that autonomy is also necessary to transition to a certain intrinsic motivation state, and that learners with intrinsic motivation do not need motivation for autonomous learning. It is probable that a negative correlation was observed because learning can be performed independently.

4.3 Evaluating Recommendation Phrases

It was confirmed that the learning recommendation phrases based on the model increased the average of the scores with learners, but no significance was found in the difference between the means. This may be due to the fact that the number of experimental collaborators was small, and the experimental period was short, which may have had an effect. It is considered necessary to increase the number of experimenters and experimental periods in the future.

5   Conclusion

In this study, a model to estimate motivation state based on the SDT was developed to generate recommendation phrases to help students study English. In recommendation evaluations, the increases in the score of psychological human needs were confirmed to have no significant differences between the means. These results show a high possibility of shifting motivation state through recommendation phrases that increase the score of low score items of human psychological needs, especially competence. Results indicate that this topic is sensitive to individual differences, each learner needs different recommendations to change their motivation state. Therefore, the objective indicator is fundamental to estimate motivation states.

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The Adoption of Learning Management System: A Case Study of Schoology and Edmodo

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Abstract. E-learning focuses on education transformation in terms of teaching and learning process using electronic means to create innovation and value to the institution. This study focuses on e-learning methods in teaching delivery using tools called Edmodo and Schoology. Edmodo and Schoology courses have been conducted among community college instructors to provide an alternative for teaching delivery and improve the process of course delivery. However, the adoption and acceptance of e-learning among instructors and students on Edmodo and Schoology are still lacking. This study is conducted to identify factors that contribute to the adoption of e-learning as a teaching and learning tool. The research model adopts the Structural Model for determining the factors of adoption tools in teaching and learning. A survey was conducted with an IT student at Kuala Langat Community College (KKKL). The findings reveal that perceived usefulness, social influence, facilitating condition, and community identification significantly contribute to the e-learning adoption. This study also determines the limitation and challenges of adopting e-learning which can be improved for future recommendations in the adoption of e-learning at a technical institution such as Kuala Langat Community College.

Keywords: E-learning · Edmodo · Schoology · Learning Management System

1 Introduction

Learning can be thought of as either a product or a process [1]. E-Learning is a well-established idea of promoting Information Systems and Technology for open, remote, and flexible forms of learning and teaching [2]. The new trend of developing the technologies facilitated collaboration, communication, and access to content ubiquitously [3–5]. E-learning occurs within a blended learning environment where experiential learning, research, and community engagement is combined with traditional face-to-face teaching and learning. According to Al-Qahtani & Higgins [6], e-learning provides better output compared to traditional face-to-face (F2F) education when

learning the same topic. As some studies have shown, the e-learning strategy is superior to the traditional learning methods concerning students' motivation [7]. It is facilitated by electronic means involving networks, channels, and computers Alkharang & Ghinea [8]. Furthermore, education through technology benefits students and instructors by providing accessibility, flexibility, and an active teaching style according to the appropriate desired time, space, and approach [9].

As for our case study, KKKL was chosen as a case study to identify the factors of adoption of e-learning tools in their Information Technology program. Currently, e-learning tools that are used in KKKL for learning are Edmodo and Schoology. Due to the usage of e-learning in the global and local environment, the Ministry of Higher Education (MOHE) under the Department of Community College Education has conducted a course on Innovation in Teaching. That course is one of the initiatives from the ministry to encourage digital learning on technical institutions and improve the teaching and learning process as well. At the KKKL, there are still many classes of IT programs not having or using e-learning tools in teaching and learning. However, the students agreed that their self-motivation is affected, and the quality of learning is improved by practicing digital learning in class. Therefore, this research will attempt to identify which e-learning tools students prefer to use in the learning environment. Hence, the main factors that contribute towards the adoption of e-learning and the preference tool will be identified.

2   Research Work

The online learning framework provides a platform that allows instructors and students to access and engage with content, interaction, and assessment tools for academic purposes within institutions. This section discusses two types of online learning frameworks which are Learning Management System (LMS) and Virtual Learning Environment (VLE).

2.1   Online Learning Framework

Learning Management System (LMS) is a software-based platform that provides infrastructure, framework, and tools to facilitate online learning. LMS serves as an online portal that connects lecturers and students to provide easy sharing of class activities and materials [10]. However, LMS is also known in various universities as Virtual Learning Environment (VLE) or Course Management System (CMS) [11]. A Virtual Learning Environment (VLE) is a system for delivering learning materials to students via the web including assessment, student tracking, collaboration, and communication tools. VLE is considered as a subpart of the LMS, which allows entities within educational systems especially instructors and students to go beyond the limits of place and time in communication and interaction [12]. Besides, VLEs are designed for supporting and improving the individual study process by offering a repository for course documents, discussion forums, chat boxes, and mass communication options.

2.2 Students' Engagement via E-Learning

Student engagement in an online learning environment can be seen through emotion, cognition, and actions by students [13]. Three dimensions can be measured in emotional student engagement, behavioral engagement, and cognitive engagement [14]. Although the emerging technologies in the learning process are evolving, it can be improved with a better user experience for the teacher [15]. According to [15], interaction in e-learning will provide a joyful environment for teaching and learning besides improving students' confidence.

2.3 E-Learning Technology

Learning Management System (LMS) embeds all course materials and learning activities into one platform. It is used to plan lessons and navigate progressively to achieve the desired learning outcome [16]. Modular Object-oriented Dynamic Learning Environment (Moodle) and Blackboard are among popular web-based learning management systems which are widely used in education.

- *Edmodo* - Edmodo is a platform for social networking [17]. Edmodo is a free and secure learning platform similar to Facebook. Edmodo allows interaction with students by creating a group of classes. The parents can also take part in their children's learning using the platform as they can check the works and progress of their children [18]. The collaboration in Edmodo enabled students to improve their online work quality [19]. Edmodo promotes the connection between instructors and students regardless of time and place.
- *Schoology* - Schoology, collaboration, and learning tool is a web-based K-12 learning environment that will give students, parents, and teachers 24/7 access to class materials and information via the internet. It offers the possibility of collaboration between students and teachers and allows customized learning for each student [20]. Schoology is an online learning, classroom management, and social networking platform that attempts to improve learning through better communication, collaboration, and increased access to the curriculum and supplemental content [21].

2.4 Comparison Features Between Edmodo and Schoology

Both Edmodo and Schoology are Learning Management Systems (LMS). It became very popular as a tool and technology in teaching and learning. According to [22], Table 1 shows the comparison between the common features of Edmodo and Schoology, such as a familiar interface, and comprehensive products such as discussion panels, announcements, schedules, and grading.

Table 1. Edmodo and Schoology features.

Features	Edmodo	Schoology
Mobile application	Yes	Yes
Teacher collaboration tools	Yes	Yes
Google Docs syncing	Yes	Yes
Student self-enrolment	Yes	Yes
No messenger for students	No	No
Gradebook	Yes	Yes
Automated quizzes	Yes	Yes
Online assignment submission collection	Yes	Yes
Granular group segmentation	Yes	No

3 Research Model

The research model provides guidelines for conducting the research, and displays the variables involved and the illustration of how the variables relate to one another. The model adopts the Structural Model by [11]. The research model is shown in Fig. 1 below.
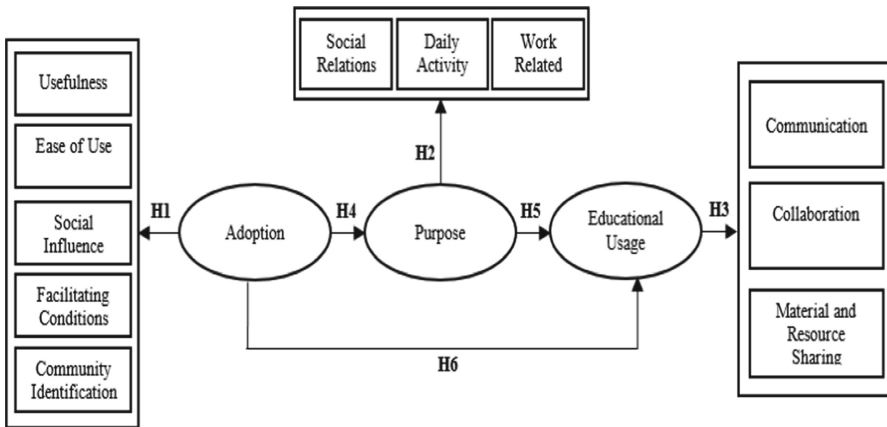
Fig. 1. Structural Model [11].

The hypotheses are created as a guide to a prediction on the relationship between variables. The hypotheses to be tested are explained as shown in Table 2 below.

Table 2. Research hypothesis.

Hypotheses	Explanations
H1	There is a significant relationship between Edmodo and Schoology adoption for usefulness, ease of use, social influence, facilitating conditions, and community identification
H2	There is a significant relationship between Edmodo and Schoology on purposes of e-learning usage for social relations, daily activity, and work-related
H3	There is a significant relationship between Edmodo and Schoology on educational usage for communication, collaboration, and material and resource sharing
H4	There is a significant relationship between adoption and purpose of Edmodo and Schoology usage
H5	There is a significant relationship between the purpose and educational usage of Edmodo and Schoology
H6	There is a significant relationship between Edmodo and Schoology adoption and the purpose of Edmodo and Schoology for educational usage

The research instruments consist of two main parts which are Section A (demographic) and Section B (variables). Section A incorporates a nominal scale to identify respondents' demographic information and Section B consists of several variables which are adoption, purpose, and educational usage. Section B uses the 5-point Likert scale where 1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, and 5: Strongly agree. Likert scale is used in surveying because it is a universal method used for collecting data and allows respondents to express an either-or-opinion without force and they are allowed to be neutral if they choose to do so. The summary of items in the research instrument is shown in Table 3.

Table 3. Description of research instrument.

No.	Variables	No. of items	References
1	Demographics	6	–
2	Adoption	26	Mazman and Usluel (2010) [23]
3	Purpose	10	
4	Educational usage	11	

The respondents of this study are KKKL students in the Information Technology program. For this study, a selective sampling method is used to represent the population of the study. Selective sampling is being done for two classes which contributes 40% sampling from Information Technology program students at KKKL.

4   Findings

The study uses a selective sampling method to represent the population of the study. The respondents of this study are KKKL students in the Information Technology programme from two classes consisting of 27 students for one class and 24 students for the other. Analysis in this study involved descriptive analysis, reliability test, Independent T-test, and ANOVA. The analysis of data is used to identify factors of adoption of digital educational tools in teaching and learning in the Information Technology program of KKKL.

4.1   Demographic Data Analysis

Among the respondents who participated in answering questionnaires, 27 students were using Edmodo and 24 students were using Schoology. 51.9% (14) of the respondents of Edmodo are male and 48.1% (13) are female. Meanwhile, 58.3% (14) of the Schoology respondents are male and 41.7% (10) are female. Respondents also asked about their usage frequency of Edmodo and Schoology per day in this study. The majority of respondents who were using Edmodo has a usage frequency of 6–10 times (51.9%) a day, followed by a usage frequency of 2–5 times per day (37%), and the remaining 3 respondents had a usage frequency of more than 20 times a day. Likewise, most of the Schoology respondents are using Schoology 2–5 times a day (79%), 12.5% of the respondents used Schoology 6–10 times a day, and more than 8% of respondents used Schoology more than 20 times a day.

4.2   Edmodo and Schoology Evaluation

Based on the findings, Edmodo fulfilled the factor of adoption in teaching and learning. Most variables are significant for Edmodo except for Perceived Ease of Use, whereas Schoology has four variables that are not significant. The result of the analysis on adoption of e-learning as a teaching and learning tool is being tested using the Independent Sample T-Test. Based on the analysis that was done, the factors that influence the adoption of Edmodo are perceived usefulness, social influence, facilitating condition, and community identity. Edmodo is able to provide more improvement in terms of perceived ease of use for making students more motivated to learn, and students are more interested because of the easy access and being user friendly. While in the Schoology adoption, only the factor of social influence and community identity has strong positive. The factors perceived usefulness, perceived ease of use, and facilitating condition has a very weak correlation to Schoology adoption. However, both of them have a very strong positive result on the purpose of daily activities. Based on the finding's analysis, it can be determined whether Edmodo or Schoology has factors contributing to the adoption of e-learning in teaching and learning at KKKL. Table 4 shows the finding analysis of Edmodo and Schoology.

Table 4. Edmodo and Schoology comparison.

Variable	Edmodo	Schoology
H1: Adoption		
Perceived usefulness	Significant	Non-significant
Perceived ease of use	Not-significant	Significant
Social influence	Significant	Significant
Facilitating condition	Significant	Significant
Community identification	Significant	Significant
H2: Purpose		
Social relation	Significant	Significant
Work-related	Significant	Significant
Daily activities	Significant	Significant
H3: Educational usage		
Communication	Significant	Significant
Collaboration	Significant	Significant
Material/resource sharing	Significant	Significant
H4: Adoption and purpose of usage	Significant	Non-significant
H5: Purpose and educational usage	Significant	Non-significant
H6: Adoption → Purpose → Educational usage	Significant	Non-significant

Based on Table 5, there are eleven factors involved when measuring Edmodo and Schoology adoption in teaching and learning. The result for Edmodo shows four factors that have a very strong positive correlation which are Perceived Usefulness and Social Influence factors for the Adoption variable, Daily Activities factor for the Purpose variable, and Collaboration factor for the Educational Usage variable. Very weak correlation towards Perceived Ease of Use in Adoption for Edmodo and weak correlation with Work-Related. Meanwhile, the result of Schoology shows two factors that have a very strong positive correlation with more than 0.85 Coefficient value (Daily Activities and Communication), and three Adoption factors (Perceived Usefulness, Perceived Ease of Use, and Facilitating Condition) have a weak correlation with a Coefficient value less than 0.4. The model for Edmodo adoption is illustrated in Fig. 2.

Table 5. The summary of correlation for Edmodo and Schoology.

Latent variable	Factors	Edmodo		Schoology	
		Coefficient correlation			
		r	Strength	r	Strength
Adoption	Perceived usefulness	.859	Very strong positive	.201	Weak
	Perceived ease of use	.158	Very weak	.379	Weak
	Social influence	.817	Very strong positive	.709	Strong positive
	Facilitating condition	.536	Moderate positive	.326	Weak
	Community identity	.729	Strong positive	.624	Strong positive
Purpose	Social relation	.665	Strong positive	.449	Moderate positive
	Work-related	.368	Weak	.644	Strong positive
	Daily activities	.882	Very strong positive	.897	Very strong positive
Educational usage	Communication	.650	Strong positive	.905	Very strong positive
	Collaboration	.853	Very strong positive	.499	Moderate positive
	Material/resource sharing	.732	Strong positive	.487	Moderate positive
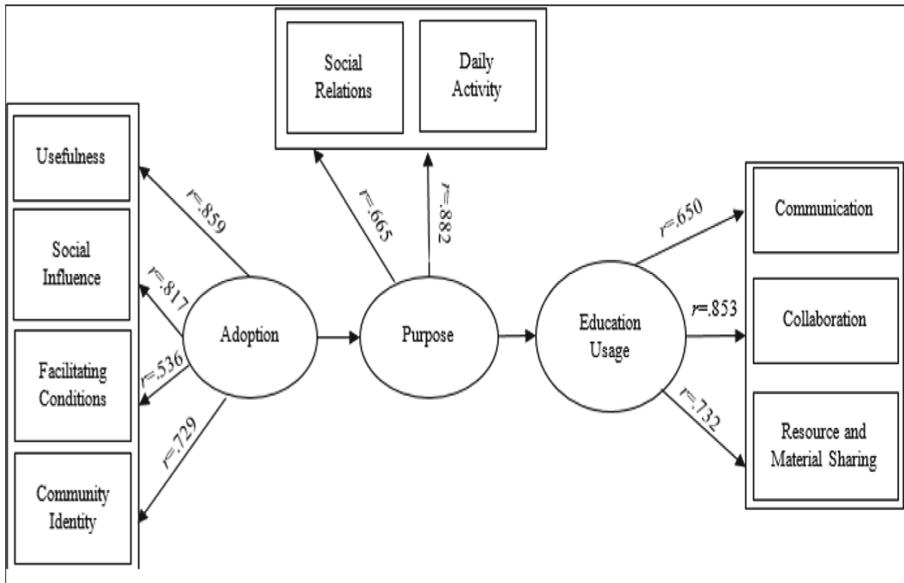
Fig. 2. Edmodo adoption model.

5   Conclusion

In conclusion, based on the results shown, Edmodo is the preferred e-learning tool by KKKL students. Edmodo allows students to increase the frequency and quality of communication, which leads to opportunities to increase their confidence and motivation [24]. Students can continuously access classroom resources such as course documents, videos, images, assignments, and assessments. Four constructs have a strong and moderate correlation with the adoption of Edmodo as a teaching and learning tool. The variable Purpose has only 2 constructs with strong correlation, and Educational Usage has three constructs with strong correlation.

This study indicates the adoption factors of Edmodo and Schoology among students in the Information Technology Programme at KKKL. Besides, based on the findings, the following recommendations are suggested that may contribute to the improvement of learning using e-learning, for example the institution needs to enhance the infrastructure including computers and internet connections because e-learning requires continuous connection to the internet to operate. E-learning attracts students through interactive learning and they can discuss or submit their assignment wherever they are. E-learning used in higher education institutions can enhance the learning experiences of students, communication, and collaboration with instructors or classmates. The advantage of adoption in e-learning as a tool in learning is that it is free of charge and it is easy to use for both instructors and students. In the future, a study on another variable can be conducted to test the adoption of e-learning and understand student's perceptions about using social learning networks to utilize e-learning in learning. Therefore, more adoption perspectives on e-learning can be developed.

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Kansei Engineering in Malaysia and Indonesia: A Systematic Literature Review

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Abstract. Evident in scholarly discussions and literature, Kansei Engineering (KE) has gained growing interest by researcher advocates in Malaysia and Indonesia. Nevertheless, there is no literary studies focusing on the extent and pattern of its adoption in both countries. Hence, in the attempt to provide such knowledge, the study aims to present the current evidence of the adoption of KE in Malaysia and Indonesia. A Systematic Literature Review (SLR) was performed to investigate a diverse range of designs and services that measured, assessed, and concluded via the implementation of KE, attracting scholars in both countries. One hundred and fifty-two papers were used in the synthesis of evidence. The primary focus of the SLR was to understand the pattern of KE adoption or implementation in Malaysia and Indonesia in terms of the domain of interest, the research approach, the analysis, the timeline, and the publication source/database. While the primary reason for the implementation of KE is to gain knowledge on Kansei responses and the indicators affecting the response, and embed the knowledge into new innovative product/service design, the diverse pattern of KE implementation of the studies are of the SLR's interest to outline.

Keywords: Kansei Engineering · Kansei Malaysia · Kansei Indonesia · Systematic Literature Review (SLR)

1 Introduction

SLR is a type of literature review that gathers, assesses, analyzes and critically interprets multiple research studies or evidence through a systematic process. The aim of a SLR is to provide answers derived from the available literature relevant for the research question/s. The systematic process is a scientific investigation in contrast to the more qualitative approach of the traditional narrative review, enabling quantitative analysis which could also support the qualitative analysis. Traditional narrative review uses informal, unsystematic and subjective methods. Although it is often conducted by experts in the domain, it may have preconceived biases. On the other hand, SLR is driven by evidence-based literature and systematically structuring and combining previous research to draw upon a conclusion. Hence, it reduces bias and provides a

reliable basis for decision making. The increasing interest in the adoption of KE in Malaysia and Indonesia has motivated the study to outline the observable evidence in past literature with regards to its implementation in both countries. It is of interest to know the similarities and differences in the adoption of KE in both countries as they share similar culture and climate.

2 The Review Method

The SLR includes exhaustive scientific papers adopting or implementing KE in Malaysia and Indonesia regardless of whether they were investigated from the same domain or be it through theory or application. The primary focus of the SLR is to understand the pattern of interest and influence of KE methodology or Kansei approach in both countries. While the underlying philosophy of KE is to address Kansei, or as it generally translates as psychological feeling and emotion, and the advantage of incorporating this element in innovative design of product or services, the type of domains and the kind of knowledge that scholars from both countries are focusing at, the achievements, and the outcome of the studies are of the research interest to summarize.

The SLR as reported in this paper was performed according to the method described in the following subsections.

2.1 Review Questions

Malaysia and Indonesia have a similar historical background, and KE has been gradually gaining scholars' interest in both countries in the past decade. It would be of interest to outline the atmosphere of the scholarly investigation, thus providing a sound reference for stakeholders including R&D advocates to the future potential of the methodology in theory and practice. Hence, it is important to formulate questions in the beginning of an SLR with regards to the topic addressed, which is the implementation of KE in Malaysia and Indonesia. Therefore, the SLR as reported in this paper aims to answer the following review questions (RQ):

RQ1: What evidence are there regarding the adoption of KE in both countries?
RQ2: What domain has been addressed in past literature on KE in both countries?
RQ3: What research approach was used in past literature on KE in both countries?
RQ4: What analysis method was used in past literature on KE in both countries?

2.2 Develop Protocol

Develop protocol is performed to provide background to give rationale for the SLR based on the RQs. It is set to devise a predetermined selection criterion, a planned search strategy, strategy to identify relevant literature, source of evidence, and plan the data abstraction (DA). These will be elaborated in the following sections.

2.3 Identify Relevant Literature

The process involves a comprehensive and exhaustive search of studies to be included in the review. Search strategies were iterative and benefit from preliminary searches (to identify existing review and volume of studies), trial searches (combination of terms from RQs), checking the search results against a list of known studies, and consulting experts in the field. The study performed the following to construct search string:

1. List the keywords mentioned in the articles found in preliminary searches.
2. Derive major terms used in the RQs (e.g. KE in Malaysia, KE in Indonesia).
3. List the keywords related to the major terms (e.g. Kansei, Design, UX).
4. Search for synonyms and alternative words (e.g. Emotion, Affective, Emotive).
5. Use the Boolean OR to incorporate preliminary searches, alternative spellings and synonyms.
6. Use the Boolean AND to link the major terms, keywords and alternative keywords.

For instance, using the Boolean statement, the study used the following search string to search the relevant literature:

Kansei OR Emotion produces ALL articles that contain ***EITHER Kansei OR Emotion*** anywhere in the text.

Kansei AND Emotion will capture only those subsets that have ***BOTH Kansei AND Emotion*** anywhere in the text.

The primary search process involved the use of 11 online databases: ACM Digital library, EBSCOhost, IEEEXplore, ISI Web of Science, INSPEC, ISI Proceedings, ProQuest, Sage Full Text Collections, Science- Direct, SpringerLink, and Scopus. The selection of online databases was based on the researchers' knowledge of databases that indexed KE related studies and the list of available online databases subscribed by the university library for all categories found in the preliminary search. To avoid biases, the study also has extended the search by:

1. Searching Google scholar database using similar keywords.
2. Reviewing reference lists of retrieved articles to extend the search.
3. Reviewing publications of corresponding authors of published studies found.
4. Manual search to related journals, proceedings, books related to KE adoptions.
5. Using personal references, and emails.
6. Referring to experts in the field.

2.4 Literature Selection

SLR can't include all literature found in its preliminary search, and thus the study needs to set the criteria for including or excluding studies (decided earlier during protocol development, which can be refined later). The inclusion & exclusion criteria were set based on the RQs. The ones with high levels of evidence, good quality, and studies with major problems are kept. Others like case series or case reports are left, as they do not report a complete study.

2.5   Data Abstraction

The study performed Data Abstraction to allow analysis of the eligible literature for the SLR. It is a process to extract the information from the eligible literature into a table of data. The study used an Excel spreadsheet to categorize evidence relating to RQs.

3   Analysis and Interpretation

3.1   Introduction

In this section, the study presents the synthesis of evidence of the SLR, beginning with the analysis from the literature search results. The search result shows a distribution of articles obtained from Scopus, IEEEXplore, ISI Web of Science, and other online databases such as Semantic Scholar, American Scientific Publishers, and Google Scholar. Most articles found are from Scopus database (37%), followed by IEEEXplore (26%), and Web of Science (19%). They compose more than 70% of the total articles, while the rest are from other sources as mentioned earlier. The initial phase of the search process identified 165 studies involving KE in both countries. Of these, only 152 were potentially relevant based on the screening of titles and abstracts. Each of these studies was filtered according to the inclusion and exclusion criteria, specified as in Sect. 2.5, before being accepted for the synthesis of evidence. If titles and abstracts were not sufficient to identify the relevance of a paper, full articles were reviewed. Duplication or similarity of studies were also observed to eliminate biases of the SLR result. Based on the searches, 152 studies (92% of 165 studies) were accepted for the synthesis of evidence after a detailed assessment of abstracts and full text and exclusion of duplicates.

3.2   Research Question

In this section, the results for the SLR's main review questions are presented.

RQ 1: What Evidence Are There Regarding the Adoption of KE in Both Countries?
Evident from Fig. 1, the literature shows an increasing trend in both countries in terms of the number of publications. From the eligible dataset for the SLR, Malaysia showed emergence of its first publication some six years earlier (2006) than its neighbouring country (2012), Indonesia. Both countries showed reasonably steady increases throughout the years. The spike shown in the year 2018 in Malaysia's case seems to be boosted by the International Conference on KE & Emotion Research (KEER) held in the country in that year.

RQ2: What Domain Has Been Addressed in Past Literature on KE?
Malaysia showed the most interest in KE implementation to computing domain, followed closely by product design. The interest in computing domain includes Web UID [1–4], Multimedia [5–7], Interface [8–10], Animation [11], Online Learning [12–14], Games [15], and others. In Product Design, there were studies on Robotics [16–21], Film & Video [22–24], Car Interior [25–27], Assistive & Therapeutic Device [28, 29],
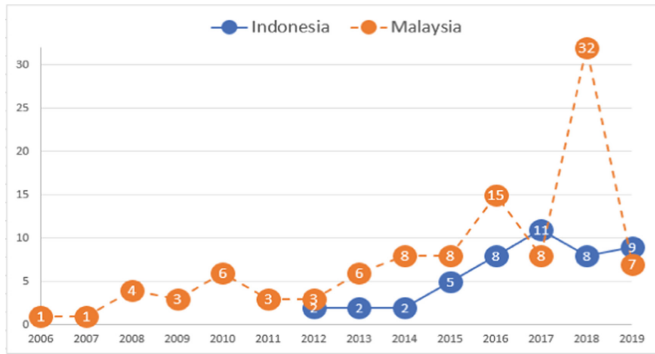
Fig. 1. Literature timeline.

Textile [30, 31], and others. In Services, there were the Happiness Index [32, 33] and LEIQ™ for classification of positive emotion and importance [34].

On the other hand, Indonesia showed interest mostly in product design, while observable attention appears to come from computing and service design. The interest includes packaging [35, 36], Seat [37–39], Batik [40], Household [41–44], Therapeutic & Rehabilitation [45, 46], and others. In the computing domain, there were e-Learning [47, 48], Web UID [49–52], e-Commerce [48, 53], and others. In services, observable attention can be seen from Logistics [54–56]. As can be observed in Fig. 2, in both countries' cases, the body of literature suggested that KE has gained attention in diverse fields of computing, product design, and service design. Both countries did not delve much into methodologies, perhaps due to its relatively newness of the discipline in the region, and most scholars are inclined more to the exploratory implementation.
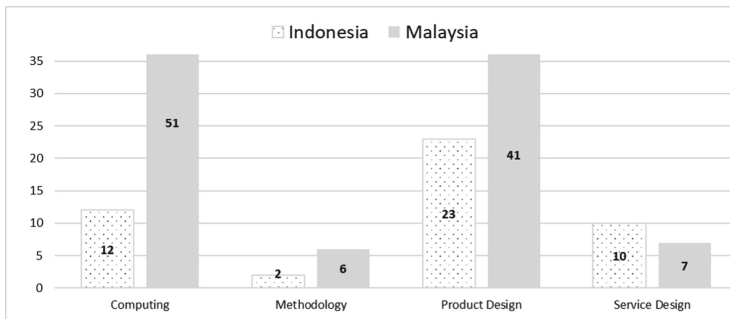
Fig. 2. Literature by domain.

RQ3: What Research Approach was Used in Past Literature on KE?

Figure 3 shows distribution of the type of research approach used in the eligible literature. Quantitative approach was found to be most popular in both countries, followed by mix-method in Indonesia, and qualitative approach in Malaysia.
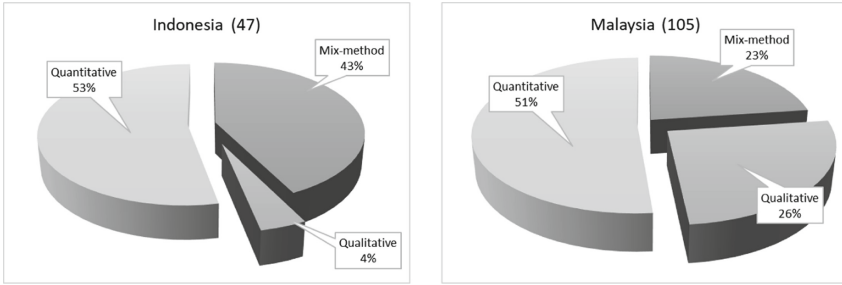
Fig. 3. Research approach by country.

Out of 152 eligible literatures, 47 literatures were from Indonesia as compared to 105 from Malaysia. The quantitative approach involves methods such as a survey questionnaire [26, 33, 36, 38, 40, 57–59], Kansei Checklist [2, 60–64], and other quantitative methods. Qualitative approach includes implementation of KJ Method [32, 65], Laddering [24], Interview [10, 54, 66], and other qualitative methods. Mix-method approach showed mostly implementation of quantitative survey and interview [11, 18, 41, 42, 67–71] and other mix-method [25, 29, 72–77].

In the computing domain, studies have been focused on finding relationships between user's emotional response and the design elements, in the effort to design more appealing user interface [50, 51, 78], establishing personalization [49], and content design [47, 79, 80].

RQ4: What Analysis Method was Used in Past Literature on KE in Both Countries?
The result shows that the most popular analysis method or approach by authors in both countries is Factor Analysis (FA) [7, 11, 38, 50, 58, 63, 74, 81, 82], followed by Partial Least Square Analysis [5, 21, 46, 78, 83], and Principal Component Analysis [7, 39, 45, 52, 83, 84]. There is also implementation of Kano Model [55, 78, 85], KJ Method [28, 32, 68, 74], Quality Function Deployment (QFD) [70, 86], Rough Set Model [35], Quantification Theory Type 1 (QT1) [45, 53], Laddering [24], and Theory of Inventive Problem Solving (TRIZ) [54, 87].

4   Conclusion

The SLR's ultimate goal was to understand the pattern of KE adoption or implementation in Malaysia and Indonesia. Malaysia and Indonesia have a similar historical background, and KE has been gradually gaining scholars' interest in both countries in the past decade. While the primary reason for using the implementation of KE is to gain knowledge on Kansei responses and the indicators affecting the response, and embed the knowledge into new innovative product/service design, the diverse pattern of KE implementation of the studies are of the SLR's interest to outline. The SLR shows interesting results while answering the review questions. One hundred and fifty-two papers were used in the synthesis of evidence. The evidence shows the emergence of

KE in Malaysia seems to begin in 2006, six years earlier than Indonesia, with its first publication found in 2012. Both countries showed reasonably steady increases in the number of published papers throughout the years. On the other hand, the computing domain is mostly focused by both countries' scholars, followed closely by product design, and service design. In terms of research approach, quantitative approach was found to be the most popular both in Malaysia and Indonesia, followed by mix-method in Indonesia, and qualitative approach in Malaysia. Additionally, Multivariate Analysis and Regression Analysis seems to be the most popular analysis method. Other than that, Kano Model, KJ Method, Quality Function Deployment (QFD), Rough Set Model, Quantification Theory Type 1 (QT1), Laddering and Theory of Inventive Problem Solving (TRIZ) are also observable.

The SLR includes exhaustive scientific papers adopting or implementing KE in Malaysia and Indonesia. The study has summarized the pattern of interest and influence of KE methodology or Kansei approach in both countries, the types of domain and the kind of knowledge that scholars from both countries are focusing on, and the analysis approach. The results provide a sound reference for scholars including R&D advocates to the future adoption of KE in theory and practice.

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Fashion and Design

Mathematical Model Describing Design Processes of Fashion Apparels and Management of Fashion Apparel Stores

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Abstract. In order to increase the international presence of Japanese fashion apparel companies, we thought it is important to construct a theory describing fashion apparel design processes to achieve the above purpose. Because it is difficult for Japanese people to understand nuances of adjectives describing the designs of apparels preferred by customers, we constructed our theory by using mathematical words without using the human language. In our theory, a new concept named behavioral space Ω is introduced. Ω represents the set of the composition of human figures dressed by people all around the world. We thought that the most important work of designers is to understand the human figures of the customers and extract subset X which is composed of the human figures of the customers. Thus, from the results obtained by our theory, the recognition for the human figures preferred by the customers is shown to be the most important. In order to confirm the results obtained by our theory, we executed a Monte Carlo simulation. The simulation also obtained the same conclusion.

Keywords: Design process · Fashion apparel · Mathematical theory for fashion apparel design processes

1 Introduction

The international presence of Japanese fashion apparel companies is very weak in the world markets. We suppose that the cause of commercial depression of Japanese apparel companies may be due to the lack of marketability of the Japanese fashion apparel design [1]. From such a viewpoint, we thought that the theory that describes the fashion apparel design processes must be constructed in order to increase the international presence of Japanese apparel companies [2–6].

Until the present day, most Japanese companies have made licensing contracts with world famous companies that are engaged in the commerce of fashion apparels on a global scale, to produce apparels that are sold exclusively to the Japanese people. This means that most Japanese companies have done business only in Japanese markets. Since the beginning of human history, clothes have been a necessity in human life, and therefore the demand for clothing cannot be lost as long as human history continues.

Hence, the increasing need for the ability to design fashion apparels, which can be sold on a global scale, is becoming necessary.

The aim of this study is to construct a mathematical theory, which describes the fashion apparel design processes. In countries, especially where famous fashion business companies exist, the design processes of fashion apparels have been refined gradually throughout the history of the fashion apparel industry. In such countries, the design processes of fashion apparels are routine works. However, a polished method to design excellent fashion apparels does not exist in Japan. The theory of fashion apparel design processes constructed in this paper is intended to be easily understood by the designers in Japanese apparel companies. In order to achieve this, we tried to describe the fashion apparel design processes mathematically, because the nuances of various words, such as elegant, sick, and so on, used in the fashion industry are difficult to be understood by the Japanese people who work in the Japanese fashion industry [2, 3].

2   Mathematical Theory Describing Fashion Apparel Design Processes

In societies all over the world many people are participating in social activities. Such people dress variously in those activities. However, human figures of people cannot be generalized. Human figures of people must be suitable for the type of social activities. Here, we introduce a new concept named behavioral space (hereinafter referred to as Ω), which is the set composed of human figures dressed by people in various type of social activities [1–3].

An excellent designer must have a good understanding of the human figures of his (or her) customers dressed in their fields of social activities. Fields of activities are not necessarily different in each country where the customers live; In fact, the figures and fields of social activities of the customers are considerably common in each country.

Generally, fashion apparels with high sales are preferred by many people independent of their nationality and age as shown in Fig. 1. Because of this, apparels with the same design sell well in the world. This is the reason why fashion companies selling well all over the world can exist. In order to establish such companies, the most important thing is to understand the human figures of the designer's own customers.
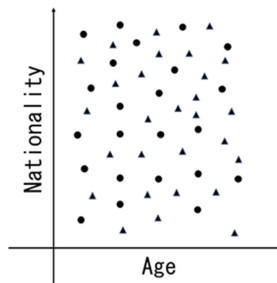
Fig. 1. The distribution of customers in the world schematically.

This process requires the extraction of the subset X which is composed of human figures of the customers from the behavioral space Ω as shown in Fig. 2.
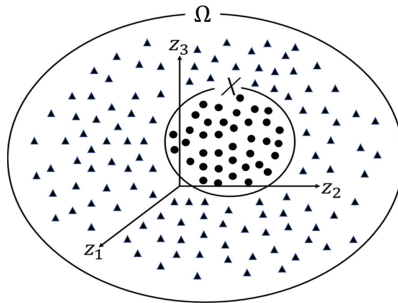
Fig. 2. Human figures of the customers from the behavioral space.

The first step in accomplishing this process is to set up appropriate coordinate axes in Ω, and then find the coordinate variable range representing the human figures of the customers. We call the coordinate variables, thus obtained as image variables. The work of an excellent designer is to extract the precise image variables representing his/her own customers.

In general, various adjectives are used to represent a designer's brand such as chic, elegant, and so on. However, these words generally depend on each other with the appropriate correlation coefficient as shown in Fig. 3.
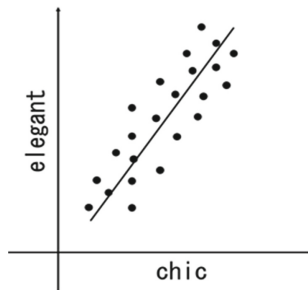
Fig. 3. Example of adjective words with some correlation coefficient.

Therefore, they are not appropriate as image variables, because they must be independent variables. Many adjectives depend on each other with some correlation coefficients in most cases. We think image variables representing the human figures of the customers who support some designer's brand must be understood well by the designer. The designer who is supported by such customers must have these image variables representing his (or her) supporter's (customer's) human figures in his (or

her) mind. On this account, the designer must extract image variables, which represent the human figures of the customers supporting the designer, from some adjectives (variables) in general use.

Here, we think of adjectives that represent the human figures of customers supporting a designer's brand as numerical variables $x_1, x_2, \cdots, x_p$. Number of variables p and their corresponding variables $x_1, x_2, \cdots, x_p$ were set in advance by the designer. The designer's work is to extract independent variables $z_1, z_2, \cdots, z_p$ from $x_1, x_2, \cdots, x_p$. Here, we attempt to describe the job of extracting independent variables $z_1, z_2, \cdots, z_p$ from $x_1, x_2, \cdots, x_p$ mathematically.

Two variables selected arbitrarily from variable set $x_1, x_2, \cdots, x_p$ are generally correlated with each other with some correlation coefficient as described above. Here, we will write the correlation coefficient between variables u_i and u_j as r_{ij}. Here, the variable $u_i (i = 1, 2, \cdots, p)$ is a normalized variable defined by $u_i = \frac{x_i - \overline{x_i}}{s_i}$, $\overline{x_i}$, and is the average value of x_i derived from the sample collected in the designer's mind, and s_i is the standard deviation of x_i. The correlation matrix R is the matrix composed of correlation coefficients r_{ij}.

$$R = \begin{pmatrix} r_{11}\, r_{12}\, r_{21}\, r_{22} & \cdots & r_{1p} & \cdots & r_{2p} & \vdots & r_{p1}\, r_{p2} & \ddots & \cdots & r_{pp} \end{pmatrix} \tag{1}$$

The job, which must be done by the designer, is to derive the set of independent variables $z_1, z_2, \cdots, z_p$ from the linear combination of $u_1, u_2, \cdots, u_p$ as

$$z_i = a_{i1}u_1 + a_{i2}u_2 + \cdots + a_{ip}u_p \qquad (i = 1, 2, \cdots p) \tag{2}$$

Here, vector $A_i = (a_{i1}, a_{i2}, \cdots, a_{ip})$ is the eigenvector of matrix R. Eigenvector A_i and eigenvalue λ_i are usually selected in the descending order. All eigenvalues $\lambda_i (i = 1, 2, \cdots, p)$ satisfy the relation:

$$\lambda_1 + \lambda_2 + \cdots + \lambda_p = p. \tag{3}$$

From new variables z_i thus obtained, the designer extracts the variable ranges of $z_i (i = 1, 2, \cdots, p)$, which constitutes X, corresponding with a subset composed of human figures of his (or her) customers.

$$X = \{ z_{1s} \leq z_1 \leq z_{1l}, z_{2s} \leq z_2 \leq z_{2l}, \cdots, z_{ps} \leq z_p \leq z_{pl} \} \tag{4}$$

The subset X thus extracted from behavioral space Ω is shown in Fig. 4 which represents the suitable figures of the customers. An excellent designer understands his (or her) customer's X well and makes fashion apparels which expresses the values of $z_i (i = 1, 2, \cdots, p)$ included in X.
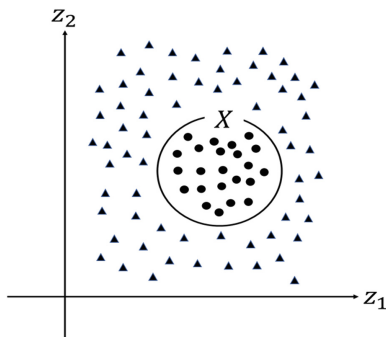
Fig. 4. Extraction of subset by setting appropriate coordinate axes in. Here, we selected the number of variables is 2 (2-dimension) for the simplicity.

3   Importance of Recognition of Subset X Containing the Figures of Customers

As described above, it is very important to recognize the subset X composed of human figures of the designer's own customers. If he (or she) cannot recognize his (or her) subset X, he can not achieve satisfying sales. In order to show the importance of the recognition, we executed a Monte Carlo simulation. The model adopted here is explained below. Figure 5 shows the schematic diagram showing the outline of the simulation.
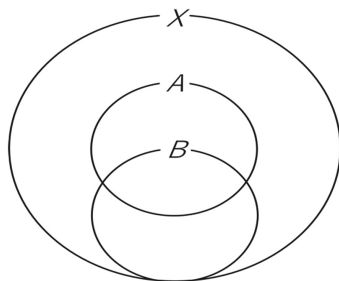
Fig. 5. Subset of figures preferred by the customer and subsets A and B, which describe figures of apparels designed by designer a and b, respectively.

The circle X shows the subset composed of the human figures of the customers of a fashion apparel company x. Here, the dimension for the number of variables z_i, (p), of X is also 2 for the simplicity similar to Fig. 4. We assume here that the company x employs two designers. We call them tentatively as designers a and b, respectively. The designer a is a very excellent designer and understands well about the human figures

preferred by the customers supporting the company x. On the other hand, the designer b can't understand well about the human figures preferred by the customers. Circles A and B expresses the coordinate variables range expressing human figures dressed in apparels designed by designers a and b, respectively. The apparels designed by designer a expresses the human figures which cover the circle A. On the other hand, apparels designed by designer b expresses the human figures which cover the circle B. The customers supporting x are distributed all over X according to the normal distribution as the function of distance r from the center of the X as shown in Fig. 6. The solid line representing circle X expresses the circle having the radius 2σ of the normal distribution, where σ is the standard deviation of the normal distribution.
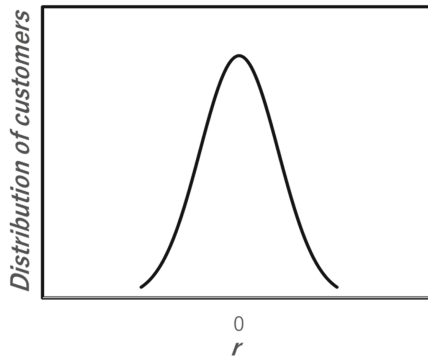
Fig. 6. Distribution of customers who prefer figures including subset.

In the simulation that we executed, the number of customers who visited the store of company x is assumed to be 1,000 persons every season. Furthermore, we also assume that the customers who visited to the store are all women for the sake of simplicity, and each customer has preferred values of variable set $z_i(i = 1, 2, \cdots, p)$ contained in circle X, and buys apparels corresponding to her preferred variable set. Customers who visited the store are generated according to the normal distribution shown in Fig. 6. If a customer generated in the simulation process prefers a variable set contained in circle A or B, she has a 0.6 probability of buying a commodity (or commodities). From the simulation, we derived the distribution of the number of persons who buy a commodity (or commodities). The derived results are shown in Fig. 7 and 8. It is obviously from the results that the number of persons who buy commodities designed by designer a is much larger than that of designer b.
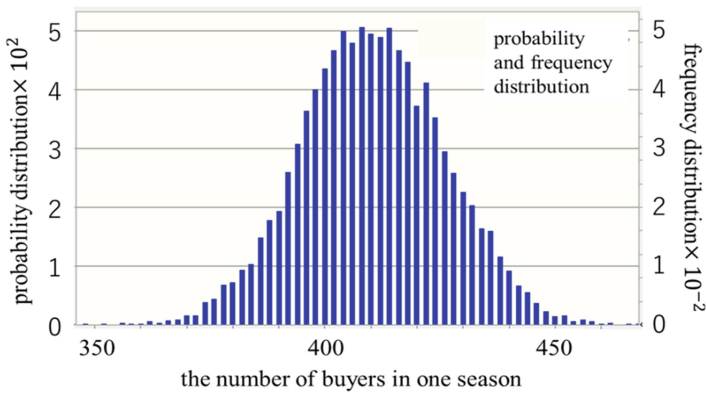
Fig. 7. Distribution of the number of persons who buy commodity (or commodities) described by image valuables contained in circle A.
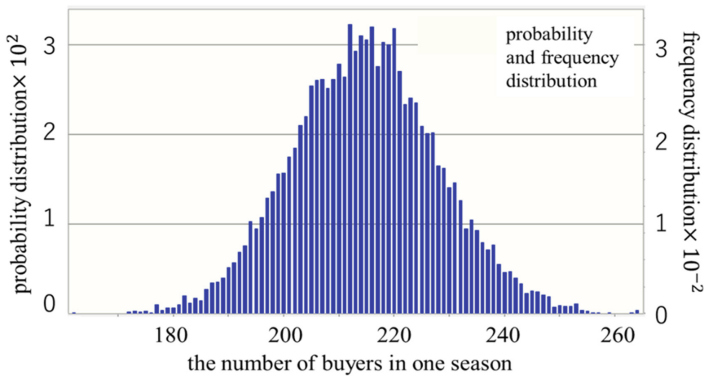
Fig. 8. Distribution of the number of persons who buy commodity (or commodities) described by image valuables contained in circle B.

4 Conclusion

The recognition of the subset X by a designer has shown to be very important. The reason why international presence of Japanese apparel companies is weak may be due to the poor ability to recognize subset X of their customers.

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Kansei Modeling: Theory, Methodology and Applications

State-Space Modeling of Temporal Dominance Responses to Stimuli: A Case Study Using Strawberry

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Abstract. Our perceptual and affective responses change in a dynamic manner upon experiencing some stimuli; however, there are few mathematical models describing their dynamics. In this study, we propose state-space modeling as a method to represent their relationships based on time-dependent perceptual and affective responses acquired by the temporal dominance (TD) method. We used canonical variate analysis to compute and define the state variables. For this purpose, the TD responses were bootstrap-resampled to generate a sufficient amount of training data. We applied this method to the TD responses to the strawberries reported in our previous work. The estimated model could represent the temporal evolution of some affective responses with a good accuracy index. The proposed model consists of three latent variables, and the meaning of each of these could be reasonably interpreted.

Keywords: Canonical variate analysis · Affective dynamics · Latent variables

1 Introduction

The perceptual and affective responses in humans are known to evolve in a dynamic manner upon exposure to stimuli. These dynamic changes in multiple subjective experiences are recorded by the temporal dominance (TD) method [1–3] in the food industry. This sensory evaluation method enables the study of evolution of perceptual (gustatory, osmatic, and textural) and affective responses during food intake. However, since this method has been in use only in recent years, there exists few mathematical approaches to model the time-series data acquired by the TD method. For instance, thus far, methods based on Granger causality [4, 5], Markov model [6, 7], or principal motion analysis [8] have been reported.

In a typical TD task, approximately 10 types of perceptual or affective responses are evaluated. If a TD task for perceptual responses or affective responses is conducted separately for a single type of food, a maximum of 20 types of responses should be accounted for in a single model. This large number of variables has deterred our intuitive understanding of the model and responses to food. Therefore, a method that represents the entire model in a reductionist manner is required. The aforementioned methods [4–7] are not amenable to the reductionist treatment of time-series data

acquired by the TD method, although the method in [8] was capable of decreasing the model dimensions by using a few non-time-series latent parameters. In the present study, by using state variables, we established relationships between perceptual and affective time-series responses. Usually, the number of state variables is smaller than the number of perceptual and affective responses evaluated in the TD task. The state variables could therefore be utilized for a reductionist representation of the entire model. We then utilized the TD data for strawberries [4, 5] to test the state-space modeling method reported here.

Fig. 1. Example of a graphical user interface used in TD tasks.

2   Temporal Evolution of Perceptual and Affective Responses on Eating Strawberries

2.1   Temporal Dominance (TD) Method

In this study, we used the TD method [1–3] to measure the time evolution of perceptual and affective responses. The TD method enables the simultaneous measurement of multiple types of subjective responses while assessors ingest food. Here, we briefly introduce the method, and more details can be found in previous reports [1–3].

In the TD method, a graphical touch panel interface is used, as shown in Fig. 1. An assessor presses the start button when he or she puts a piece of food into the mouth. S/he then selects a button on the touch panel, the label of which corresponds to the feeling of the assessor on food intake. The selected label is not necessarily the one with the highest subjective intensity. The assessor selects a corresponding button each time the dominant feeling changes and presses the stop button when the sensations in their mouths disappear. The same button can be selected more than once, and not all buttons need to be selected at least once.

TD tasks record the time at which the buttons are selected in each trial, as shown in Fig. 2(a). TD curves are subsequently calculated, as shown in Fig. 2(b), by integrating the records from all the trials and assessors. These curves are smoothened for later computation. The TD curves represent the dominance rate obtained by dividing the total number of times each button is selected by the total number of trials. The temporal base represents the time normalized to the period spanning the beginning of each trial to the moment of disappearance of all sensations in the mouth.
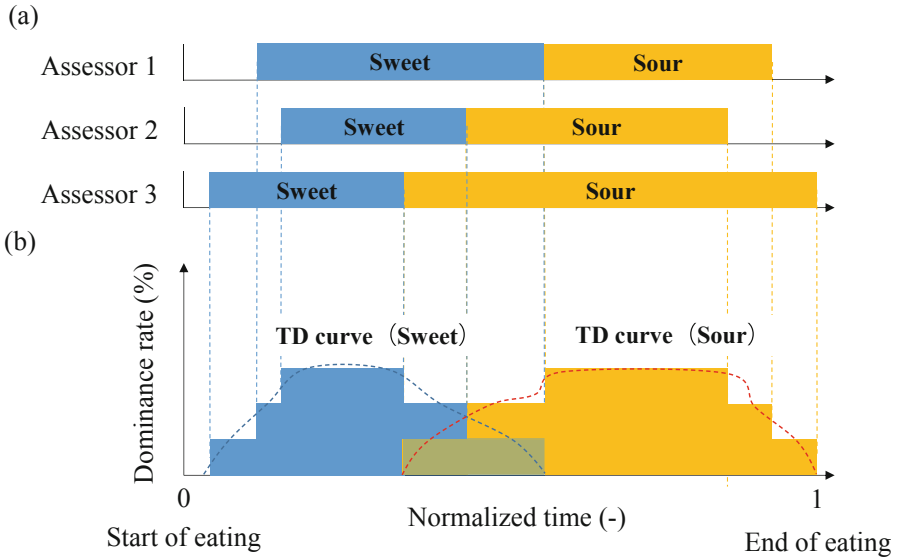
Fig. 2. Calculation of the TD curves. (a) Binary data obtained from the TD method for each assessor or trial. (b) TD curves are calculated by accumulating and smoothening the binary responses shown in (a).

Table 1. Terms used to represent perceptual and affective/evaluative responses in [5].

Perceptual	Affective/evaluative
Sweet	*Like*
Sour	*Delicious*
Watery	*Happy/satisfied*
Refreshing	*Fresh*
Juicy	*Flavorsome*
Melty	*Natural*
Soft	*Elegant*

2.2   TD Curves for Strawberries

In this study, we used TD curves obtained on eating strawberries [4, 5]. These studies employed the sensory and affective/evaluative labels listed in Table 1, and the acquired TD curves are shown in Fig. 3. For the purpose of the present study, we removed the responses to *melty*, *soft*, *happy/satisfied*, *natural*, and *elegant* from the original data because their dominance rates were small and statistically insignificant. We then used the remaining nine types of responses in the present study.
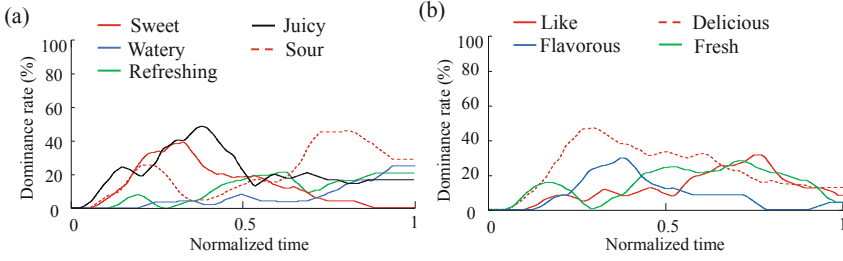
Fig. 3. Temporal dominance (TD) curves for (a) sensory and (b) affective/evaluative responses to strawberries. Modified from [4, 5].

3   State-Space Modeling of Temporal Dominance Curves

3.1   State and Observation Equations

The state and observation equations used in this study are

$$m_{t+\Delta t} = Am_t + Bu_t \tag{1}$$

$$y_t = Cm_t + Du_t + e_t \tag{2}$$

where, y_t and u_t are the output and input vectors at time t, respectively. We established a model that estimates changes in affective responses from those in perceptual responses; hence, the inputs and outputs represent the dominance rates of perceptual and affective responses at time t, respectively. A, B, C, and D are the coefficient matrices related to the variables. These coefficients indicate the strength of influence among variables. e_t and m_t are the vectors for observation error and state variables at time t, respectively. From (1), the present state variables could be determined using the past state and input vectors; therefore, the present state variables implicitly contain information about the past states of the system. Hence, m_t is called the vector of memory.

3.2   Canonical Variate Analysis (CVA)

To define the state variables m_t, we used canonical variate analysis (CVA) for time-dependent inputs and outputs [9]. CVA finds the relationships between input and output variables by computing the canonical variates that are the linear combinations of input and output variables.

The past vector p_t and future vector f_t are defined as follows:

$$p_t = \left[y_{t-\Delta t}^T, \cdots, y_{t-l\Delta t}^T, u_{t-\Delta t}^T, \cdots, u_{t-l\Delta t}^T\right]^T \tag{3}$$

$$f_t = \left[y_t^T, y_{t+\Delta t}^T, \cdots, y_{t+h\Delta t}^T\right]^T \tag{4}$$

where, l and h represent time lags for the past and future, respectively. The time lags determine the temporal orders that should be considered in the model. We determined $l = h = 1$ in the latter computation. Δt is the sampling period used to generate discrete TD curves, with a value of $\Delta t = 0.033$ normalized time, corresponding to approximately 1 s.

We calculate the vector of memory $\boldsymbol{m}_t$ using the past vector $\boldsymbol{p}_t$:

$$\boldsymbol{m}_t = \boldsymbol{W}^T \boldsymbol{\Sigma}_{pp}^{-\frac{1}{2}} \boldsymbol{p}_t \tag{5}$$

where, $\boldsymbol{W}$ is a matrix of the left singular vector obtained by singular value decomposition, as represented in (6). $\boldsymbol{\Sigma}_{pp}$ and $\boldsymbol{\Sigma}_{ff}$ are the variance matrices of $\boldsymbol{p}_t$ and $\boldsymbol{f}_t$, respectively, and $\boldsymbol{\Sigma}_{pf}$ is the covariance matrix of $\boldsymbol{p}_t$ and $\boldsymbol{f}_t$:

$$\boldsymbol{\Sigma}_{pp}^{-1/2} \boldsymbol{\Sigma}_{pf} \boldsymbol{\Sigma}_{ff}^{-1/2} = \boldsymbol{W} \boldsymbol{\Sigma} \boldsymbol{V}^T \tag{6}$$

where, $\boldsymbol{\Sigma}$ is a diagonal matrix of the singular values.

3.3 Bootstrap Resampling

For CVA calculation, the sample size needs to be substantially greater than the number of variables to be analyzed. Usually, TD tasks produce a single set of TD curves from multiple assessors. Hence, CVA cannot be directly applied to TD curves. Therefore, we increased the number of TD curves by bootstrap resampling [10]. The new sample set was generated by sampling the originally observed data with replacements, as described in [8]. The number of assessors for forming one set of TD curves was eight, and a total of 40 sets of TD curves were calculated.

4   Result

4.1   Computed State-Space Model

We established a model including three state variables. The number of state variables was determined based on the ease of interpretation of the state variables. Figures 4, 5, 6 and 7 show parts of the model corresponding to each of the three state variables. In these figures, each node represents the dominance rate of each attribute and state variable, and the edges denote the relationships between nodes. Red and blue edges represent the positive and negative influences, respectively. The values next to the edges are the values of the coefficient matrices corresponding to each edge. Here, the edges whose effect is small are not shown for visual clarity. From (1) and (2), the edges ending at the state variables and affective labels represent influences from the past and present values, respectively.

Figure 4 shows the state-space model related to the first state variable. The first state variable is mainly affected by *juicy* and *sweet* and exhibits a great effect on *delicious*. Therefore, the first state represents the memory of the deliciousness of strawberries.

Figure 5 shows the model for the second-state variable. This state variable is affected by all the perceptual responses and exhibits a positive effect on *delicious* and a negative effect on *fresh*. This state, therefore, represents the memory of comprehensive sensation, and is the average property of subjective responses evoked on eating strawberries.
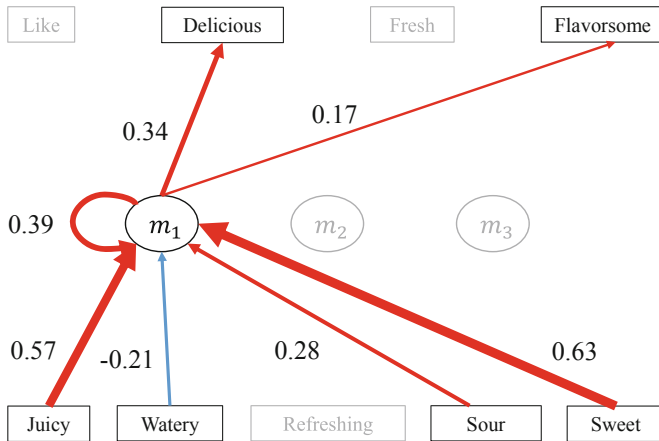
Fig. 4. State-space model related to the first state variable: memory of deliciousness.
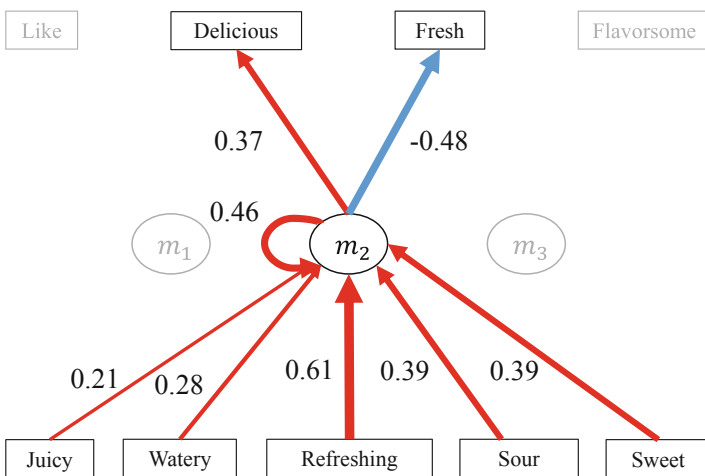
Fig. 5. State-space model related to the second state variable: memory of average experience.
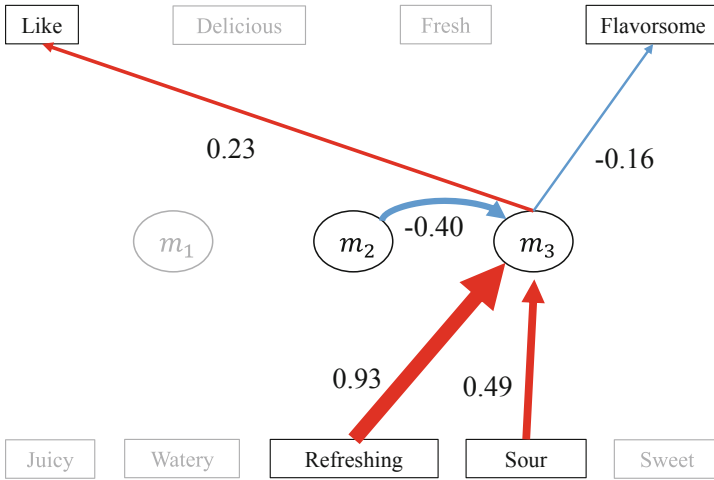
Fig. 6. State-space model related to the third state variable: memory of coolness.
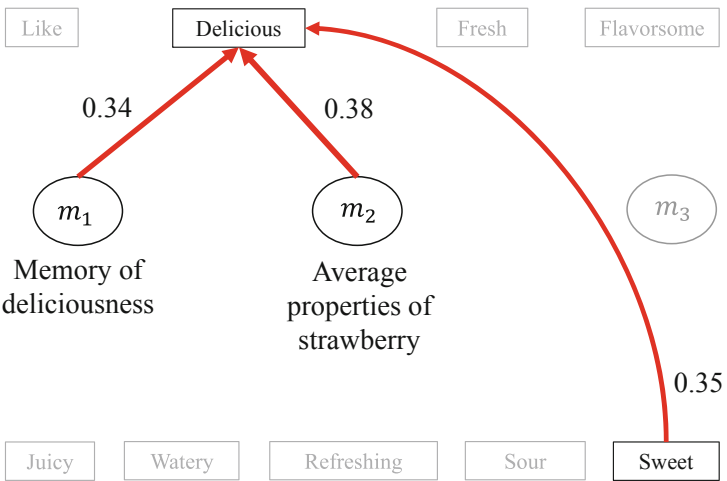
Fig. 7. State-space model related to *delicious*.

Table 2. Correlation coefficients between observed and estimated TD curves.

Responses	Correlation coefficients
Like	0.81
Delicious	0.84
Fresh	0.09
Flavorsome	0.90

As shown in Fig. 6, the third state variable is affected by *refreshing* and *sour*; therefore, it represents the memory of the cool feeling associated with eating strawberries. This state has a positive effect on *like*, whereas it has a negative effect on *flavorsome*.

As an example, we show the edges connected to *delicious* (shown in Fig. 7). *Delicious* is positively affected by *sweet* and the first- and second-state variables.

4.2   Estimation Accuracy

Figure 8 shows the observed and estimated TD curves for the four types of affective responses. The orange and blue lines represent the observed and estimated values, respectively. The correlation coefficients between the observed and estimated values are listed in Table 2.

As shown in Table 2, *like*, *delicious*, and *flavorsome* could be predicted with sufficient accuracy; however, the correlation coefficient of *fresh* was 0.09, indicating that *fresh* was not well-represented by the present model. Furthermore, despite its large correlation coefficient, as shown in Fig. 8(a), the differences between the observed and estimated values of *like* were large. The trends could be predicted accurately; however, the absolute values were not representative of reality.

The optimization of the past and future time lags and the number of states is necessary to increase the estimation accuracy of the model.
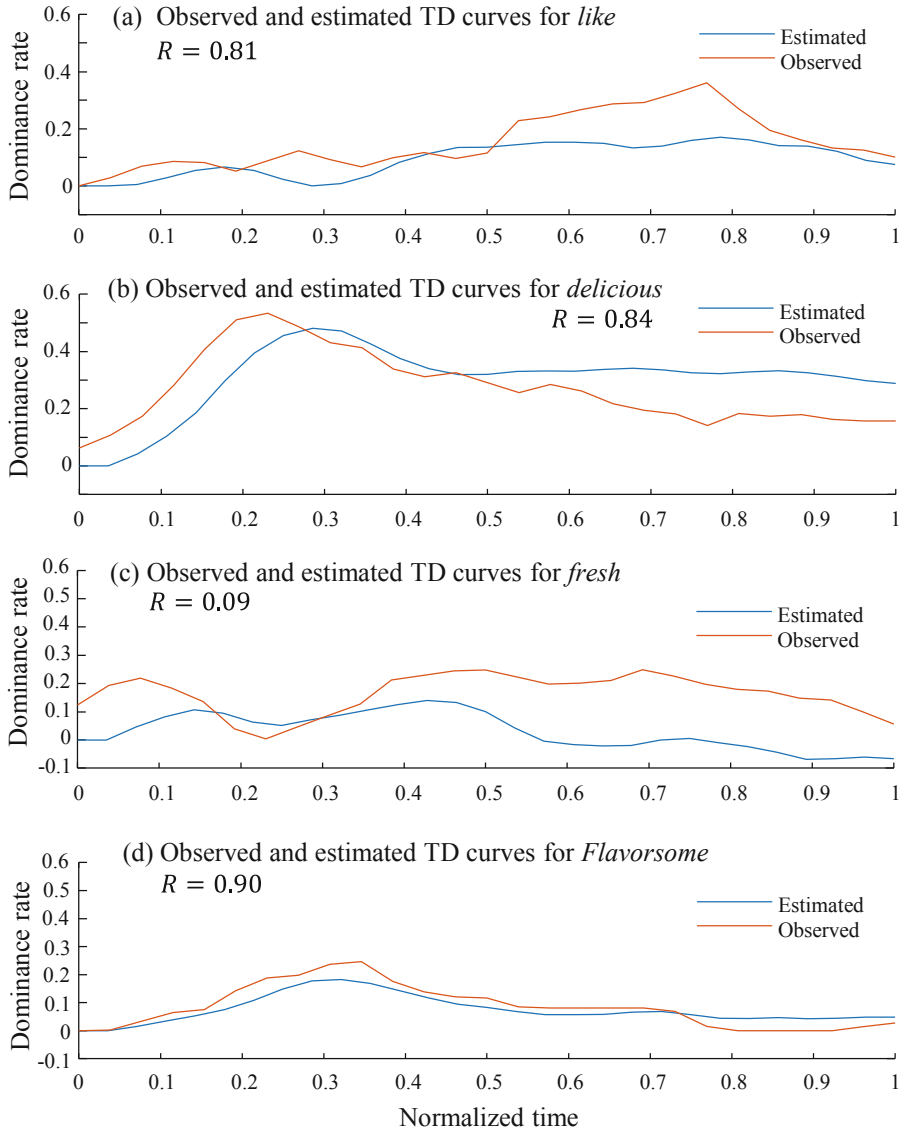
Fig. 8. Observed and estimated TD curves for (a) *like*, (b) *delicious*, (c) *fresh*, and (d) *flavorsome*.

5   Conclusion

In this study, we applied a state-space modeling method to the data acquired by the TD method. To this end, we employed canonical variate analysis of past and future data on resampled TD curves generated for the intake of strawberries. Using state-space modeling, it was possible to represent the temporal evolutions of affective responses,

and the three state variables could sufficiently express the relationship among the nine subjective responses. In the model established here, some attributes could not be estimated with sufficient accuracy. This problem could be solved by optimizing the model. We also need to confirm the generality of this method by applying it to TD responses to other foods. Furthermore, the semantic validity of the model calculated by this method remains to be studied.

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Study of the Impact of Gender Emotion Difference in Cooperative Learning on the Efficiency of Classroom and Online Learning

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Abstract. The purpose of this study is to explore the use of the "cooperative learning" method in the classroom and in online learning, and to compare the effects of the gender cooperative learning emotion differences on classroom learning and online learning efficiency. The results are as follows: (1) Gender emotion in "question comprehension analysis" indicated that there was no significant difference between the male students and female students when applying the "cooperative learning" method in classroom learning or in online learning. (2) The gender emotion in the dimension of "knowledge thinking application" showed that the difficult instruction could be applied to team cooperative learning after understanding, and at the same time, it could improve the learning emotion between peers. (3) Gender emotion in "group observation and learning" showed that male and female students were still used to "learning alone" while they were at school. (4) The gender emotion in "emotional inter-action and communication" showed that in the age of rapid development of network information, the communication mode has changed with the new habit of information communication.

Keywords: Cooperative learning · Gender emotion · Classroom learning · Online learning · Emotion interaction and communication

1 Introduction

With the advent of the digital age, online teaching is becoming more and more popular, and the online learning system combines the characteristics of education and network media across time and space, with the effective design and application of the teaching system, to support the claim of education to be realized through the interactive network system. The online "emotional interaction" refers to the active tendency of interaction between teachers and students, or just between students, in online learning in the dimensions of emotion, attitude, evaluation and so on, and also the interpersonal social

relations and positive inner emotional communication in online learning. Emotional interaction is an important strategy to realize the cognitive goal of online learning, and at the same time, it can also enhance and stimulate the learners' learning motivation and increase their learning enthusiasm. And what's more is, the emotional interaction in online learning can promote communication between teachers and students, thus they can experience the fun of "teaching" and "learning". However, the students' emotional communication and interaction are often neglected in both the classroom and in online learning in the current teaching practice. At the same time, loneliness is also produced as a result of insufficient affective interaction between students in online learning.

Cooperative learning is a learning method by which students work together to achieve their learning goals [1] that is to say, cooperative learning is a structured and systematic learning strategy in which teachers assign students to groups and encourage them to help each other based on their abilities, gender, ethnicity, etc. so as to improve the learning effectiveness of each individual and achieve the goals of the group [2, 3]. Based on this statement, it can be said that "cooperative learning" is a teaching concept that encourages peer-to-peer learning. Through the sharing of experience with others via network technology, knowledge is gradually constructed to form a learning community through the interaction and exchange of knowledge. In online learning activities, learners can exchange information and explore knowledge by means of an online communication platform. In a learning environment, peers can either become collaborators or competitors. In the environment of mutual cooperation and competition, learners can imitate, support, and assist each other in the process of cognitive learning, and interpret and evaluate the performance of others in their own language. In this way, learners can explore, integrate, and evaluate learning activities using new methods and enhance their own metacognitive strategies.

In view of the above background, this paper attempts to explore the cooperative learning method of gender emotion difference in the classroom and in online learning, to preliminarily investigate the use of cooperative learning, and to learn about students' ability in problem analysis and thinking application, so that students can enhance their emotional support towards each other and learn from each other through mutual cooperation, and teachers can have a better understanding of the differences between the classroom and online learning methods.

2 Literature Review

2.1 New Teaching Methods in the Digital Age

Nowadays the digital technology network is becoming mature, and the ways and new habits of information communication have been changed subtly. This trend has gradually affected the education system. E-learning has become a new mode for educators to introduce into the traditional learning method. The whole network space can be regarded as a huge database, or even an encyclopedia, and at the same time extends the physical and temporal limitations and extends the traditional classroom into the virtual space. Multi-learning mode also gives the possibility of all kinds of communication as its content style is very special and forms a brand new teaching mode. Online learning

breaks down the barrier between the school and society, and also promotes interaction and cooperation between the school and the outside world, so that the students can apply what they have learned in the real world, and then achieve the ideal state of combining theory with practice. Effective cooperative learning activity or system development should satisfy the following five elements [4, 5].

Collaborative Group Structure. It includes the size and number of groups, the heterogeneity of group members, the cohesion of groups, and the composition of groups. The size of the group should be determined based on the nature of the learning activity. Using small groups as the core group, the number can be between 7 to 15. In order to reach the heterogeneity requirements, the group members should be from different geographical locations. In addition, before the formal learning activities, the activities which can provide familiarity and opportunity or create shared experiences should be arranged for group members so as to establish an emotional connection within the group since most of the online group members do not know each other. Group cohesion can also be facilitated through complementary role relationships among group members.

Collaborative Task Structure. It refers to the common task where the group is allowed, required, or encouraged to work together to accomplish. The task can be designed in the form of "division of labor" or "collaboration".

Cooperative Incentive Structure. In order to establish cooperative incentives, the reward for groups can be based on its individual members' performance, or based on their common thematic achievements or products. Incentives should be designed to replace external rewards with internal incentives as much as possible, such as making the group's results available for public display or allowing participants to find pleasure in the learning activity itself.

Individual Rights and Responsibilities. Individual rights and responsibilities are made to prevent some members from avoiding work and other issues. Individual rights and responsibilities can be designed to reward groups based on each member's learning ability or the individual completion of tasks. Another way is to give each group member roles and unique tasks.

The Cooperative Environment Structure. The cooperative environment includes the space among group members, so that the group members can "gather" closely to carry out group meetings, discussions, and study work. It also includes the exchange of sub-data, experience, and knowledge among the groups. Pipelines and tools for intra-group or inter-group interaction should be provided as much as possible, but inter-group interference should be prevented.

2.2   Online Collaborative Learning

In online cooperative learning, Sun Chun put forward four goals in 1997 to act as the design direction guidance for online textbooks, and it is called the ASIA principle [6], and the emphasis is divided into four items:

Active learning takes the problem as the core, sets learning goals through discussion, and stimulates learning motivation. Hence the online teaching materials should not repeat the existing contents of the textbooks, but should be designed with a variety of teaching ideas to enable students to explore problems and start thinking.

Simulative learning emphasizes the combination of simulation tools and the design of simulation experiments, i.e. learning by doing. Besides putting forward the experiment with the simulation teaching tool in the textbooks and encouraging students to operate, it should also encourage students to design the experiment and verify its concept.

Interactive learning which guides the students to collect materials, cite online textbooks, and refer to each other. The group cooperation is promoted through structured thematic design and the students can be taught by establishing useful knowledge based on the formation of a community consensus.

Accumulative learning which encourages the observation of finished products and mutual comments, so that the students can mutually discuss what they have learned while improving their depth of knowledge and their ability to evaluate. The learning process should provide the facility for recording the learning process, provide personalized information, and encourage lifelong learning.

3   Research Method

The questionnaire survey of this study uses the full-time students of the Department of Environmental Design of a university as the subject. The questionnaire was designed with the Likert Scale, which gave different grades based on the tendency of statements. This study aims to explore the use of cooperative learning in the classroom and online learning, and to compare the effects of the two types of emotional interaction on learning efficiency by using the "cooperative learning" approach. The questionnaire is divided into four dimensions, namely, "question comprehension analysis", "knowledge thinking application", "group observation and learning", and "emotional interaction and communication".

3.1   Independent Variable

Multifactor variance analysis is taken as the basis and the independent variables of this study are "classroom learning" and "online learning", which are as follows:

Classroom Learning. In this study, the classroom learning in "cooperative learning" is an independent variable. It will be divided into 14 questions consisting of 4 dimensions, that is, "question comprehensive analysis", "knowledge thinking application", "group observation and learning", and "emotional interaction and communication".

Online Learning. In this study, the online learning in "cooperative learning" is listed as an independent variable. It will be divided into 14 questions of 4 dimensions, that is, "question comprehension analysis", "knowledge thinking application", "group observation and learning", and "emotional interaction and communication".

3.2 Control Variable

The control variables of this study are "learning content", "student level" and "teacher", which are as follows:

Learning Content. Teachers mainly use 3D computer software to teach courses, with a total of 5 unit courses, and the teaching schedule is adjusted based on the students' learning efficiency.

Student Level. The subject is 5 junior classes from the Department of Environmental Design of a university, who have studied 3D software courses in their sophomore year, and therefore, the students' ability in software application were similar.

Teacher. The teacher in this study is unchanged and is someone with 8 years of teaching experience in universities.

3.3 Dependent Variable

The dependent variables of this study are "question comprehension analysis", "knowledge thinking application", "group observation and learning", and "emotional interaction and communication", which are as follows:

Question Comprehensive Analysis. The question comprehension analysis of this study refers to whether the students find classroom learning and online learning in the "3Ds max" course helpful for the understanding of the questions for the interaction of peer emotions, and for the enhancement of their analytical ability while using the "cooperative learning" method.

Knowledge Thinking Application. The knowledge thinking application in this study refers to whether using classroom learning and online learning in the course of "3Ds max" for the teaching instructions for the interaction of peer emotions can be applied to the design subject in the way of cooperative learning.

Group Observation and Learning. The group observation and learning in this study refers to whether students can learn the peer-to-peer advantages by using classroom learning and online learning in the "3Ds max" course while using the "cooperative learning" method.

Emotional Interaction and Communication. The emotional interaction and communication of this study is to investigate whether the students can enhance their peer-to-peer learning emotions by using classroom learning and online learning in the "3Ds max" course while using the cooperative learning method.

3.4 Study Subjects

The study subjects are the full-time students of a grade in the Department of Environmental Design in a university, who took the "Sketch up Modeling" course in the last semester of 2019, and the grade is divided into five classes. There are 40 students in Class 1, 41 students in Class 2, 39 students in Class 3, 39 students in Class 4, and 38 students in Class 5. The total sample number is 197.

3.4.1 Courses on Computer Software

The 3D software course used in this study mainly aims to cultivate the students' expressive ability in space simulation design. The "3Ds max" course is also one of the required courses in this department. This course is to guide them in indoor simulation design, and expressing the designers' thoughts through 3D software. To familiarize and refine instructions, step-by-step, through continuous course training. Its teaching simulation mainly focuses on furniture and interior design, and also promotes the students' artistic self-cultivation, so that the students can have a strong practical ability and innovation ability after graduation, and meet the basic requirements of professional learning and the needs of the market and social development.

Table 1. 3D max course instructions.

Unit	Theme	Learning content	Practice case	Time
1	Modeling	Basic instruction operation/deformation instruction operation/move/rotation/zoom/lock point instruction operation/lock point/lock angle/lock ratio/	Classic chair Wine glass tower	12 h
2	Material	Material instructions description/create panel/SU material and V-Ray material/reflection and diffuse material description/convex material/common material	Desk and chair Indoor case	12 h
3	Light	Light instructions description/setting geographical reference/V-Ray rendering scene/Point light source/spot light source/optical domain network (IES) light source	Nordic style Residential design	12 h
4	Application	Interior design case/architectural design case/landscape garden case	Space case	12 h

3.4.2 Experimental Courses and Testing Tools

The computer software course in this experiment is the "Computer Aided Design 3Ds Max" course. This course is 3 credits and the study time is 48 h in total. Take Table 1 as an example. This course is taught three times a week, with four classes each week, and lasts 45 min long per class. Therefore, the study of this course can be completed in four weeks. The experiment subject is the juniors. The course is scheduled for the second semester of the third year. A questionnaire is conducted a week before the course, in which "question comprehension analysis", "knowledge thinking application", "group observation and learning", "emotional interaction and communication", and other scales are measured. The questionnaire scale used in this study was self-designed by the author. Likert's five points were used in this scale. 1 point for "Very disagreed", 2 points for "Disagreed", 3 points for "Not sure", 4 points for "Agreed", and 5 points for "Very agreed". The study efficiency questionnaire is divided into 4 dimensions, that is, "question comprehension analysis", "knowledge thinking application", "group observation and learning", and "emotional interaction and communication". A total of 196 students from five classes participated to answer a total of 14 questions. Cronbach's α coefficient was .870. It shows that this scale has good reliability.

4   Research Result

For the purpose of learning about the effects of cooperative learning emotion on the classroom and online learning efficiency, the questionnaire is divided into four dimensions, that is, "question comprehension analysis", "knowledge thinking application", "group observation and learning", and "emotional interaction and communication". In this study, the independent sample "t-test" was used to analyze the differences between gender cooperative learning emotion in the classroom and in online learning. Multi-factor variance analysis was used to examine the differences among the four structures.

4.1   Effect of Cooperative Learning Emotion on Classroom and Online Learning Efficiency: Independent Sample T-Test Data Analysis

The independent sample is used to examine the differences between genders in cooperative learning emotion in the classroom and in online learning, and we can see from Table 2 that there are significant differences between "group observation and learning" and "emotional interaction and communication" in classroom learning, and that there are differences only in the dimension of "question comprehension analysis" in online learning. This shows that male students are more likely to be distracted by learning online, and therefore, when in virtual worlds (online) they are less likely to interact emotionally with the group during "cooperative learning" and are more likely to accept traditional (classroom) group learning.

4.2   Analysis of Gender in Multi-factor Variance of "Question Comprehension Analysis"

In the case of multi-factor variance analysis in Table 3, the interaction between classroom question comprehension analysis Q1* online question comprehension analysis Q1 "F $(9,178) = .681$, p $= .725$"; the interaction of classroom question comprehension analysis Q2* online question comprehension analysis Q2 "F $(8,179) = .596$, P $= .781$"; therefore, there was no interaction between the genders in these two question-and-answers. It also showed that there was no significant difference in the use of cooperative learning between male and female students in the classroom or online. The author thinks it may be that the students are used to the traditional learning methods and hold a "not sure" attitude towards the use of online learning methods in the digital age.

4.3   Analysis of Gender in Multi-factor Variance of "Knowledge Thinking Application"

There are significant differences in the dimension of "knowledge thinking application" after multi-factor variance analysis. In the case of Table 3, the interaction between classroom knowledge thinking application Q3* online knowledge thinking application Q3 "F $(9,178) = 1.424$, P $= .181$"; the interaction between classroom knowledge thinking application Q4 *online knowledge thinking application Q4 "F

(7,180) = 2.341, P = .026"; therefore, there was interaction between the genders in this question-and-answer. The author thinks it may be that the online video has the characteristic of "repeated viewing", which is very helpful for the computer software instruction comprehension, and therefore, the instructions which are hard to understand can be applied to the group during cooperative learning after understanding, and at the same time, the mutual learning emotion among the peers can be enhanced.

Table 2. Analysis results of gender in independent sample T-test.

Type	Title	Male (103)	Female (93)	Assume that the variance is equal Significance (double tail)	Do not assume that the variance is equal Significance (double tail)
Classroom learning	1	4.24	4.09	.202	.202
	2	4.19	4.01	.134	.132
	3	4.21	4.03	.132	.131
	4	4.25	3.98	.023*	.023*
	5	4.26	4.01	.048*	.048
	6	4.30	4.02	.019*	.019
	7	4.22	4.05	.180	.180
Online learning	1	4.19	3.85	.009*	.008*
	2	4.14	3.94	.122	.120
	3	4.09	3.94	.261	.258
	4	4.09	3.99	.447	.443
	5	4.07	3.94	.332	.328
	6	4.06	3.95	.407	.402
	7	4.08	3.99	.502	.502

4.4   Analysis of Gender in Multi-factor Variance of "Group Observation and Learning"

In the case of multi-factor variance analysis Table 3, the interaction between classroom group observation and learning Q5* online group observation and learning Q5 "(10,177) = .992, P = .452"; the interaction between classroom group observation and learning Q6 * online group observation and learning Q6 "(10,177) = .474, P = 905)"; therefore, there was no interaction between the genders in these two question-and-answers. In the author's opinion, many students are still used to "learning alone" at school, and the group-based learning model, whether in the classroom or online, is still less acceptable to most students.

4.5 Analysis of Gender in Multi-factor Variance of "Emotional Interaction and Communication"

In the case of Table 3, the interaction between classroom emotional interaction and communication Q7* online emotional interaction and communication "(8,179) = .013"; there was an interaction between the genders in this question-and-answer. The author thinks that in the age of rapid development of network information, the way of communication has changed with the new habit of information communication. Therefore, students think that there is no difference in the way of cooperative learning, whether it is in the traditional classroom or through online communication.

Table 3. Effects of gender in cooperative learning emotions on classroom and online learning efficiency: statistical results.

Title	Type III sum of squares	Degree of freedom df	Mean square	F	Significance
Q1 * Q1	1.505	9	.167	.681	.725
Error	43.671	178	.245		
Q2 * Q2	1.192	8	.149	.596	.781
Error	44.783	179	.250		
Q3 * Q3	3.146	9	.350	1.424	.181
Error	43.701	178	.246		
Q4 * Q4	3.759	7	.537	2.341	.026*
Error	41.285	180	.229		
Q5 * Q5	2.427	10	.243	.992	.452
Error	43.294	177	.245		
Q6 * Q6	1.156	10	.116	.474	.905
Error	43.154	177	.244		
Q7 * Q7	4.768	8	.596	2.521	.013*
Error	42.330	179	.236		

5 Conclusion and Suggestion

The study aims to discuss the effects of gender emotion difference in "cooperative learning" on the learning efficiency in classroom and online learning, and to make a questionnaire survey on two classes at the beginning of their semester. Based on the statistics, students are still used to traditional classroom learning in "question comprehension analysis" and "group observation and learning". However, they can accept online platform learning in "knowledge thinking application" and "emotional interaction and communication". In the age of the rapid development of digital information, the "autonomous learning mode" of E-learning seems to have been established. The mode of autonomous education in university should guide students to construct their own knowledge structure. The way of learning should not just be the recitation of words and symbols. There are still many shortcomings in traditional teaching methods. For example, the students can't internalize knowledge through passive learning. In the

author's own experience of computer software teaching, students have significant differences in knowledge, accomplishment, and attitude. The application of the online learning method is to improve the students' ability of problem analysis while improving their learning process and ability of thinking.

Classroom learning and online learning each have their own advantages and disadvantages, but at the same time, they are also unique. If the two kinds of teaching methods can be integrated, then the classroom learning can be used only when knowledge teaching and group cooperation are needed. For example, knowledge thinking and emotion interaction can be taught through the online platform by using the advantages of autonomous learning. This learning method takes advantage of face-to-face discussion, communication, interaction, and learning from each other. The follow-up online platform design research should be combined with appropriate audio-visual software, enrich the content of textbooks, and create a user-friendly interface. If the two learning methods can be applied to each other and can bring the peer learning feelings closer, then the best autonomous learning effect can ultimately be gained.

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Toward Generalized System Modeling Incorporating Kansei

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Abstract. Along with diversified requirements for products, the importance of Kansei is increasing. While Kansei engineering has been studied to handle sense and feeling related to products, most studies are specific to a case. Thus, experiments need to be planned for each case, and the results of those experiments are difficult to be reused in different cases. This hinders wider application in industries. Therefore, construction of a generalized model is required. For the establishment of a generalized system modelling that incorporates Kansei, this paper reviews both Kansei engineering works and system modelling works and discusses possible approaches. Characteristics of system models were analyzed in light of necessary features of Kansei models. As a result, the absence of a generalized calculation model for Kansei engineering was recognized as an issue. For the construction of a generalized system model incorporating Kansei, establishing typology of Kansei seems relevant. As an approach toward system modeling of Kansei, this paper proposes to construct a general calculation model for each type of Kansei metric.

Keywords: System model · Generalization · Kansei engineering · Design

1 Introduction

1.1 Background

Along with diversified requirements for products, the importance of Kansei is increasing. Kansei engineering is a discipline to handle senses and feelings related to products, which has been studied for years to tackle the issue. After the introduction of Kansei engineering, a number of studies and applications have been conducted in the Kansei engineering domain. However, most studies are specific to a case. Therefore, experiments need to be planned for each case. Furthermore, results of those experiments are difficult to be reused in different cases. This hinders wider application in industries.

Therefore, Kansei engineering is still rather an engineering technique than an established scientific discipline due to its lack of generality. Discussing generalization of Kansei metrics and concomitant construction of general models are needed not just to establish Kansei engineering as a discipline, but also for wider industrial application.

1.2   Purpose of This Paper

For the establishment of a generalized system modelling that incorporates Kansei, this paper reviews both Kansei engineering works and system modelling works and discusses the possible approaches.

2   Kansei and Modelling

2.1   Conventional Models and Modelling of Kansei

After the industrial revolution, manufacturing has been drastically changed through the progress of technology. Understanding of a natural phenomenon is shared and made available to anyone. This helps human beings to create advanced, complex products. What makes it possible to share the understanding is a sort of model. When a person understands the outer world, it is impossible to remember all the details of the phenomena faced. Therefore, a person recognizes a phenomenon through abstraction and generalization of similar past events. When facing a situation, estimation is made through the generalized understanding of the past events. For example, a football player has a model of a football game. He can estimate opponent players', teammates' and ball's movements. Therefore, he can plan a pass that goes to a teammate that is expected to be there at the time when the ball reaches, and he can accomplish a pass with just the slightest glance of a part of the field.

A person has many models about the phenomena surrounding him. However, most of them cannot be transferred to others as they do not have an expression format. As it is impossible to transfer the phenomena faced in every detail, a person extracts essence of the phenomena and tells it to others by means of languages. Thus, the expression capability of the language entails transferability of the information.

As many people are involved in current product development, models that are described by the languages everyone can understand play important roles. For example, drawings are primitive but sufficiently transfer information about designs of a product. In recent years, simulation models such as those for finite element methods (FEM) or for computational fluid dynamics (CFD) are shared among design teams.

Along with increased needs for human-centered design, incorporating Kansei into design becomes much more important. A number of research projects have been conducted in Kansei engineering to understand Kansei through a scientific approach. To effectively incorporate those understandings of Kansei into today's complex product development, Kansei has to be described in a model written in common languages, like other engineering fields.

2.2   Necessity of System Model of Kansei

A product may have several different models for different purposes. FEM/CFD is a detailed model for a part of a product in a specific discipline such as the strength of materials or fluid dynamics. There are models of a whole product depicting multiple disciplines as well. Even models in a specific discipline have been sophisticated, and increased complexity of a product urges different approaches to handle it. As many

disciplines are involved in a problem, configuration of a system becomes much more important than problem solving in a single discipline. Thus, the use of system models becomes prevalent. As a system model of a product aims to comprehend behaviors of a system as a whole and their interaction with the outer world, rather abstract descriptions are often adopted. Once the area of a problem is specified by means of comprehensive analysis of a system, a detailed model of the part is employed to solve the specified problem.

It is important to employ a system model when taking Kansei into product design as well. A product may affect a user in quite many different ways. Thus, numerous types of Kansei and features of a product contributing to differentiate them can be considered. To test all possible Kansei metrics and features are impossible due to limited resources. Therefore, Kansei metrics and product features to be considered in detailed user tests have to be focused to an effective area. By incorporating Kansei into system models, specification of important Kansei metrics and effective features of a product are expected to be available. That is, the whole product system is described with abstract expression of Kansei metrics. Then, system analysis specifies important Kansei metrics and features affecting behavior of the system differentiate these Kansei metrics. Afterwards, detailed Kansei engineering experiments can be conducted on the specified problem area.

To make system models incorporating Kansei available to anyone, establishment of system modelling language that can describe Kansei is crucial. This paper discusses the expression format of Kansei in system models. The following sections discuss the schemes of both Kansei engineering and system modelling through literature reviews. By taking both schemes into account, a possible approach to incorporate Kansei into system modelling is discussed.

3 Schemes of Kansei Engineering

This section discusses conventional and state-of-the-art Kansei engineering. As Schütte et al. [1] states, Kansei engineering is a methodology to incorporate Kansei into product design. Thus, it is not a discipline that has agreed theories, theorems or alike. However, as a methodology, Kansei engineering has a firm process and commonly used tools. For the measurement of Kansei metrics, there are two types of techniques. One is a questionnaire, and the other is physiological measurements. As cognitive elements such as emotions and feelings are difficult to measure, questionnaires are commonly used. Semantic differential technique is quite often applied to quantify those measurements. In contrast, physiological responses can be measured by experiments. For example, blood pressure and myoelectric are measurable. Thanks to recent development of neuroscience and equipment, brain measurements are also readily available. For the obtained data, statistical methods are commonly used [2].

Responding to the rising importance of handling user experiences, Carreira et al. [3] proposed a methodology extending conventional Kansei engineering. Likewise, several extensions have been proposed. Even though a number of studies have been made, rarely is a general model of Kansei or emotions/feelings established. Therefore, successors have to follow the methodology and cannot reuse data from predecessors.

4   Schemes of System Modelling

This section shows models of technical systems that depict domains that are not conventional engineering disciplines like Kansei. Upon discussing features of those models, approaches for incorporating Kansei into system models are discussed in the later section.

There are several types of system models depending on the use of the model. This paper categorizes system models into descriptive models and computational models. While descriptive models aim to describe the system, computational models aim to simulate the behavior of the system. The following subsections show examples of these types.

4.1   Descriptive Models

As an example of descriptive models, a model proposed by the author that describes relationships between the life cycle of a product and the feelings of stakeholders [4] is shown in Fig. 1. By describing value chain of stakeholders as a basis, elements of their feelings are depicted and related to features of a product through requirements. By relating features of a product to its design process, it is possible to explain how each design act is affecting the feelings of stakeholders. As the relationships have only positive/negative and strength as their attributes, this model is quite abstract.
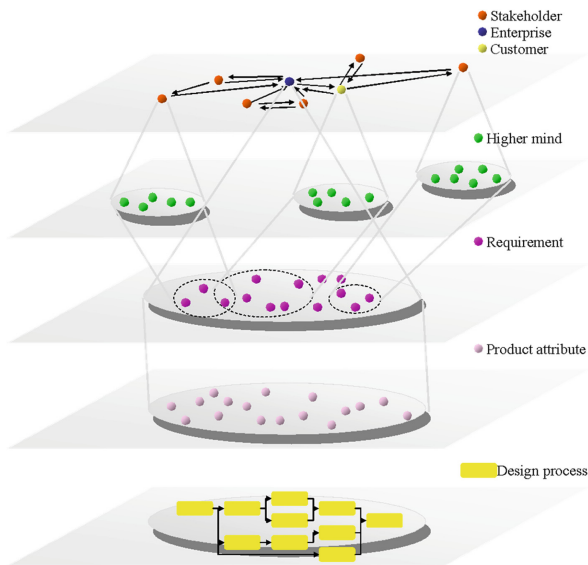
Fig. 1. Descriptive model of relationships between product design and its effects to minds of stakeholders.

By applying structural analysis (e.g. network analyses) or qualitative analysis (e.g. reviews), improvement measures of the design can be discussed. Figure 2 shows a model of a printed wiring board specialized for an environmentally friendly design [5]. This model extends the former model by adding a product life cycle. In this model of environmentally friendly design, the typology of corporate environmental measures was created. For each type, a reference model is defined. First, the current business model is described. By referring to a reference model corresponding to an environmental measure a company would adopt, a model that incorporates the measure is described as well. By comparing these two models (as-is and to-be), the effects of the measures and changes in their process can be analyzed.
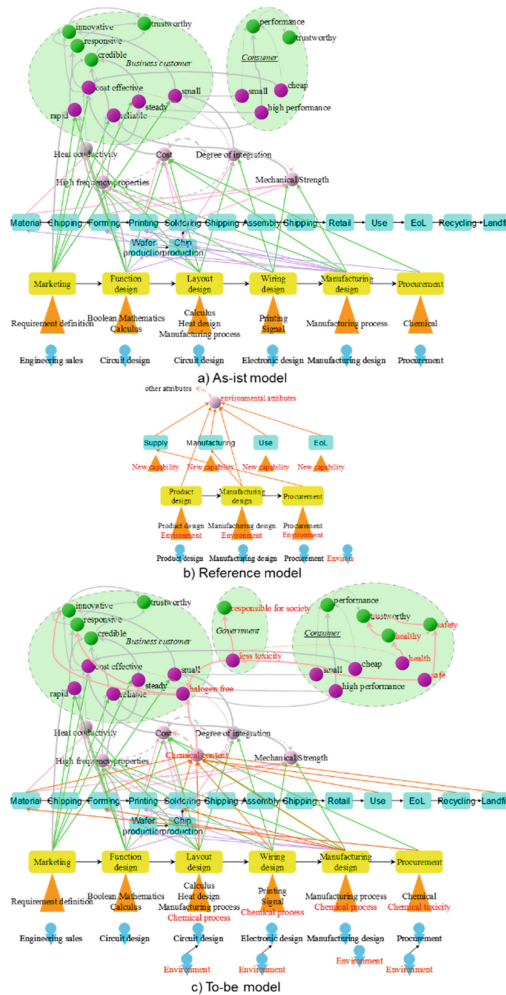
Fig. 2. Models of design and manufacturing of printed wiring board to discuss environmental measures.

By enabling description of the system, it is possible to apply a sort of analysis (e.g. specification of important part). But, such a descriptive model has a high degree of freedom in description and lacks a method to verify the description is proper, which may lead to false and biased description. Therefore, this type of model should be located as an early stage model and be complimented by a model that can be verified at a later stage.

4.2 Computational Models

There are several types for computational models. A type of model implements calculable pieces of information on the model itself (e.g. computational dynamics). On the other hand, the other type merely has quantitative information on the model while the calculation methods are defined outside of the model. In this paper, the former and latter types are called quantitative models and quasi-quantitative models respectively. Quantitative models require detailed understanding of the system behavior. However, they certify accurate calculation and provide changes of behavior in higher resolution. Quasi-quantitative models only require a rough understanding of the system behavior. However, the calculation results are not so accurate and difficult to verify.

4.2.1 Quasi-quantitative Models

As an example of a quasi-quantitative model, a model that extends the above-mentioned model by enabling calculation [6] is shown in Fig. 3. In this model, linear mapping, which is employed in the quality function deployment, is adopted. By mapping the importance values of elements in a certain domain through a matrix depicting relationships between elements of the domain and those of another domain, the importance values of elements in the other domain are calculated. This calculation is applied not only to calculate the importance values but also to estimate effect of features to brand value via the mind of stakeholders. Furthermore, a stochastic model to simulate growth of the brand value was proposed by extending the model [7].
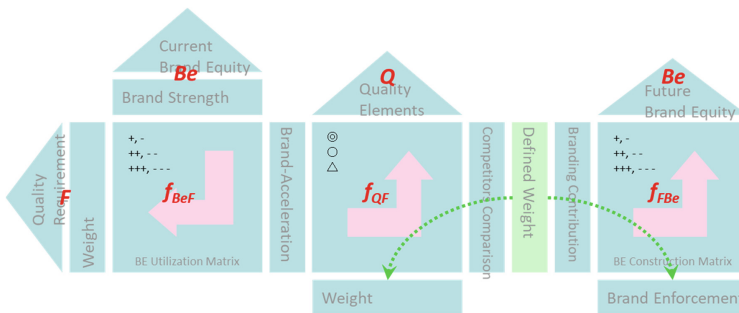
Fig. 3. Calculation method applied to system design adopted from quality function deployment.

As it is quite easy to construct stochastic models from statistical data, this type of model is accessible as a computational model. For example, when semantic differential

method is applied in sensory analysis, resultants can be transferred to a stochastic estimation model.

4.2.2 Quantitative Models

As an example of a quantitative model, Modelica [8] is used in systems engineering. Modelica is a modelling language of multi-domain physical simulation. Physical laws, experimental equations or data tables can be implemented for the calculation of system behavior. Calculable pieces of information are implemented in a "block". By connecting blocks by "connectors" through ports, which defines the type of variables shared between blocks, a system is described. As it has a degree of freedom, it is possible to implement either rough relationships between variables or rigorous physical laws.

To ease the construction of the model, Modelica has several libraries that generalize phenomena, logics, controls and so on, which improve reusability of the model. However, there has not been any generalization of Kansei metrics and construction of the library.

5 Illustrative Case of System Modelling Incorporating Kansei

For system design of a product to enhance Kansei value, the authors propose a method to construct system model [9]. Figure 4 shows an overview of the model. The model is placed as a preliminary description for the Modelica, which is a quantitative model. To construct a quantitative model, a number of experiments are needed. However, as it omits calculable implementation, workload to construct models is reduced. By applying system analyses to a quasi-quantitative preliminary model, significant problems of a product can be specified, thus parts and aspects of a product to be implemented as a quantitative model are focused.
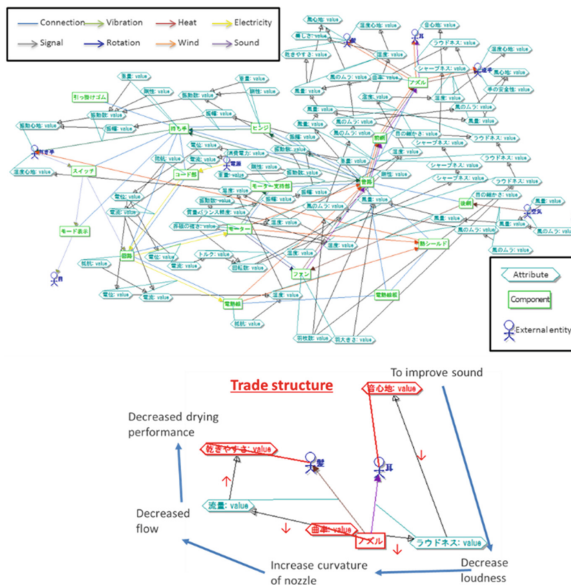
Fig. 4. Preliminary system model for the construction of Modelica model.

6   Approaches for System Modelling Incorporating Kansei

By reviewing the scheme of system models and Kansei, a rather abstract descriptive model seems mostly applicable to the current state of Kansei engineering. As the degree of freedom is so large, modelling methodology should be discussed. By considering detailed calculable models, a stochastic model can easily make use of the results from past Kansei engineering experiments. However, stochastic models that directly handle the experimental results lack generality and are difficult to be reused. Therefore, how Kansei metrics can be generalized and expressed as calculation models is of concern. Establishment of typology seems to be the relevant approach for the generalization of Kansei. Based on the typology, calculation models may be constructed for each type.

7   Conclusion

This paper discusses possible approaches for the construction of a system model that incorporates Kansei. Characteristics of system models were analyzed in light of necessary features of Kansei models. As a result, the absence of a generalized calculation model for Kansei engineering was recognized as an issue. For the construction of a generalized system model incorporating Kansei, establishing typology of Kansei seems relevant. As an approach towards system modeling of Kansei, this paper proposed to construct a general calculation model for each type of Kansei metrics.

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Layered Modeling of Sensory and Affective Responses: Modification by Considering Unique Factors of Affective Responses

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Abstract. Layered modeling is used to understand the semantic structure of sensory and affective responses acquired through the sensory evaluation of products. In this paper, we propose a method for establishing layered models, which considers unique factors, that is, unpredictable components independent of other variables. When creating a layered model, the subjective rate to each verbal criterion of sensory evaluation is treated as a variable, and the variables with the lowest estimation accuracy are remodeled. Conventionally, the determination coefficient of each variable has been used as a criterion for estimation accuracy. However, this value is influenced by unique factors, including random repetition errors. This influence should be removed because the estimation of unique factors is not improved by modifying the model structure. We consider the influence of unique factors of a certain variable by using the determination coefficient of linear regression by using the other variables. We applied the modified modeling method to the sensory evaluation of miso, or fermented soybean paste.

Keywords: Structural equation modeling · Sensory evaluation · Miso

1 Introduction

In understanding and designing the affective responses experienced from products, it is useful to mathematically model the relationship between the sensory and affective responses. Layered modeling is one of the methods used to establish such models [1–6]. Figure 1 illustrates an example of a layered model for tasting experiences. Each node corresponds to the score assigned to a verbal criterion, which is typically an adjective. For example, the score for *mild* is expressed as follows:

$$y_{mild} = -0.31x_{bitter} + 0.25x_{umami} + e \tag{1}$$

where x is the score for sensory word, y is the score for affective and evaluative words, and e is a random error. This formula indicates that food with little bitterness and more umami is considered milder. The layered model expresses the semantic structure of sensory and affective responses in an easy-to-understand manner.
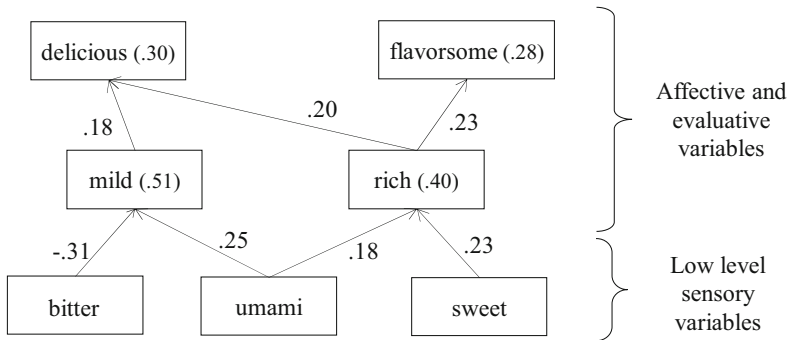
Fig. 1. Layered model of sensory and affective responses to foods.

Figure 1 shows an example of a layered model of sensory and affective responses to foods. The value beside the edge is the strength of the relationship between two variables. The value following the adjective is the R^2 value, which is the estimation accuracy of the variables for the affective and evaluative words. The variables in the bottom layers are correlated to each other.

There are several methods for establishing a layered model. The method in [1] automatically determines the structure of the model, including the number of layers, and validates the model by structural equation modeling, whereas layered models are designed or hypothesized by experienced assessors in other methods. However, there is a concern with the method in [1]. In the process of creating a layered model, variables with the lowest estimation accuracy are remodeled. Conventionally, the determination coefficient of each variable has been used as a criterion for estimation accuracy. However, this value is influenced by unique factors (i.e., unpredictable components that are independent of other variables). Unique factors include random repetition errors. This component should be considered when modeling (see Sect. 2.2), which the method used in [1] did not. In case that the variables include large unique factors, the previous approach may establish incorrect models. In this paper, we propose a method for establishing layered models that consider unique factors, and we apply the method to the sensory evaluation of miso, or fermented soybean paste.

2   Method: Layered Modeling

2.1   Conventional Modeling Method

First, structural equation modeling (SEM) is applied to a two-layered model in which the low-level sensory items are explanatory variables, and the upper-level affective and evaluative items are objective variables, as shown on the left in Fig. 2. The explanatory variable with the lowest estimation accuracy, R^2, is placed in a higher layer to be explained by other affective and evaluative variables, as shown on the right in Fig. 2. By repeating this operation until the statistical criteria of SEM are satisfied, a multi-layer model can be obtained.
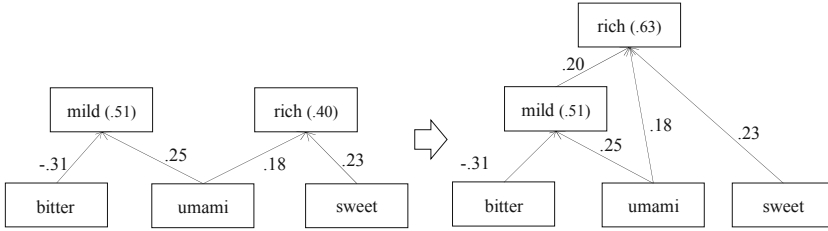
Fig. 2. Stepwise development of the layered model [1]. The variable with the lowest value in the parentheses (i.e., *rich*) is relocated into a higher layer.

2.2   Modification by Considering Unique Factors

As mentioned in the Introduction, the method using R^2, as shown in Sect. 2.1, does not consider the presence of unique factors that are independent of other components. Unique factors are unpredictable by modifying the model structure, so when creating a model, their effects should be removed. Therefore, the objective variable is predicted by linear regression of all other variables as shown in (2), and the coefficient of determination, $\hat{R}^2$, is introduced. This value is the maximum estimation accuracy of linear predictive models in principle.

$$\hat{y}_i = \sum_{i \neq j} a_{ji} y_j + \sum b_{ji} x_j \tag{2}$$

$$\hat{R}_i^2 = \frac{\sum_{k=1}^{n} (\hat{y}_{ik} - \bar{y}_i)^2}{\sum_{k=1}^{n} (y_{ik} - \bar{y}_i)^2} \tag{3}$$

where x is the low-level sensory variable, y is the upper-level affective and evaluative variable, $\hat{y}$ is the estimated y value, $\bar{y}$ is the mean of y, a_{ji} and b_{ji} are the coefficients that show the strength of the connection between variable i and variable j, and n is the number of samples.

The variable with the smallest ratio of R^2 to $\hat{R}^2$ is the one with poor estimation accuracy. Therefore, in the model considering the unique factors, a model is established using $R^2/\hat{R}^2$ instead of R^2.

3   Example Using the Sensory Evaluation of Miso (Fermented Soybean Paste)

3.1   The Sensory Evaluation of Miso

Participants tasted twelve kinds of miso and scored eleven low-level sensory items, and nine affective and evaluative items in seven levels. These items were selected among approximately 200 potential words used for expressing foods by voting tasks involving several assessors. The low-level sensory items are represented by uni-sensory organs

and they represent gustatory, osmatic, and textural aspects, including *salty, sour, bitter, melty, sticky, rough, fermented, umami, moist, astringent,* and *soy sauce-flavored.* The affective and evaluative items are composed of the integration of multiple sensory channels, feelings, and overall significance or importance, which includes *delicious, simple, mild, sharp, rich, flavorsome, mellow, refined,* and *light.* The meanings or definitions of these words were well explained to the participants before the rating task. They rinsed their mouth with tea before each evaluation so that the evaluation would not be influenced by the miso that had been eaten before.

3.2 Participants

The participants were nine people from Nagoya University. None of them studied or worked in the food industry.

3.3 Established Layered Models

The obtained evaluations were standardized for each individual and item, and modeled using the method described above. Figure 3 shows the layered model created by the conventional method, and Fig. 4 shows the layered model considering the unique factors. The values next to the word are R^2 and $R^2/\hat{R}^2$. We present only statistically significant links. The bottom variables are correlated.
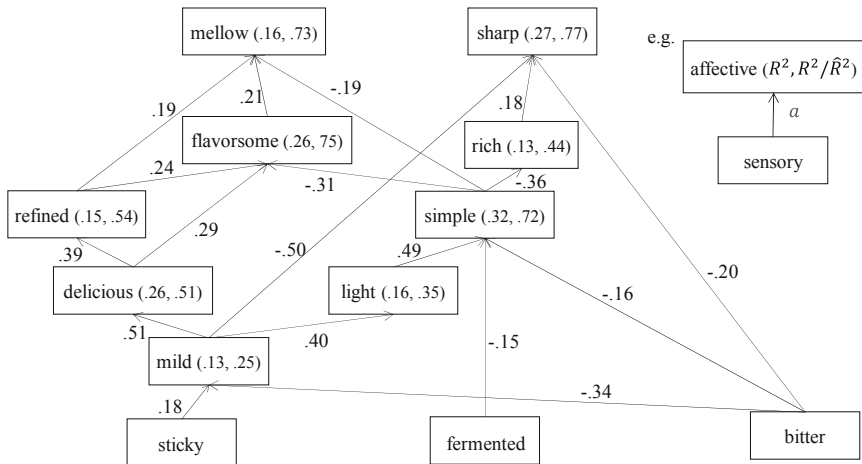
Fig. 3. Layered model established by the conventional method GFI = 0.95, CFI = 1.00, and $\chi^2 = 43.7$ $df = 45$ ($p < 0.53$).
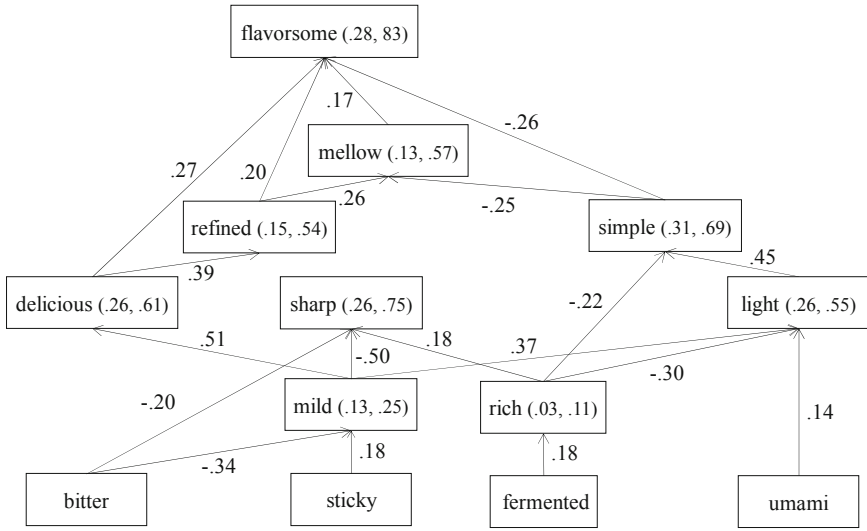
Fig. 4. Layered model established by the new method GFI = 0.95, CFI = 1.00, and χ^2 = 50.3 df = 53 ($p < 0.58$).

3.4   Elementary Screening for the Semantic Validity of Models

As shown in Figs. 3 and 4, in both types of models, the stickier and less bitter *miso* were judged to be mild. *Mild* positively affected *delicious*, and delicious miso was judged as refined and flavorsome. Mild miso was judged as light, and *light* positively affected *simplicity*. A simple miso was not judged as flavorsome or mellow. These results are semantically reasonable.

Some words were placed on different layers between the two models. For example, *simple* was placed on a lower layer than *rich* (the taste which is composed of a greater number of gustatory factors) in the model established by the conventional method, whereas *rich* is placed in a lower layer than *simple* in the model established by the new method. As a result, the end of the edge from *fermented* is *simple* in Fig. 3, whereas it is *rich* in Fig. 4. Although their semantic relationships were similar, *fermented* directly affected *simple* negatively in Fig. 3, but indirectly in Fig. 4. Similarly, *fermented* indirectly affected *rich* positively in Fig. 3, but directly in Fig. 4. However, *simple* and *rich* had a negative relationship.

The two types of models largely agree with each other, except for *umami*. In the model established by the conventional method, as shown in Fig. 3, *umami* was not significantly linked with the other variables; however, *umami* positively influenced *light* in the model established by the new method, as shown in Fig. 4. Nonetheless, this influence was not potent in terms of the coefficient value (.14) between *umami* and *light*. To systematically compare the semantic validity of these two types of models, a method used in [7] can be used, but remains to be studied in the future. In [7], several assessors compared a few layered models regarding their semantic validity.

4   Conclusion

We modified a method of layered modeling for sensory and affective responses, which was originally developed in [1]. The modified method establishes a layered model based on net R^2, excluding the effects of unique factors that cannot be predicted by the combination of variables in the model. We used food samples as an example, but this method is expected to be applied to other types of stimuli.

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Going Green in Mega-Sporting Events

Applying Attractiveness for Sustainable Product Innovation

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Abstract. The emerging literature suggests that mega-sporting events have the potential to negatively impact local ecosystems by causing pollution and waste accumulation. This has raised the issue of "green sports," which is a critical one. This study attempts to contribute a model to the design process to identify factors that attract spectators to sports, provide insights into the dynamics of mega-sporting events, and present a set of sustainable products that could interest sports-goers. A baseball game was selected as an example of a mega-sporting event. The study employed a combined model of the design process for product innovation, which included two in-depth qualitative interview methods: the evaluation grid method and a user journey map. A set of products designated as the "HOMERUN" set were designed based on the findings of the combined model. The result illustrated the possibility of transforming product features to meet users' needs at different stages of the mega-sporting experience. The model applied in this study has implications for transforming product design thinking from a focus on specific points in problem solving to a linear pattern that focuses on a broader picture.

Keywords: Sustainable design · Product innovation · Green sport · Evaluation grid method · User journey map

1 Motivation

A mega-event can be defined as any large-scale organized gathering that draws large numbers of people to a limited geographic area for a relatively short period of time [1]. Such mega-events, for example the Super Bowl and any Major League Baseball game, attract a large number of tourists and have environmental consequences on several levels [2]. The emerging literature suggests that mega-events have the potential to negatively impact local ecosystems by causing pollution and generating waste [3, 4]. As a case in point, in 2010, the Los Angeles Daily News reported that 3.11 tons of trash was produced during a home baseball game [5]. The Super Bowl generated 40 tons of trash; 90% was garbage from the game, food waste, and waste papers [6].

Sustainability is an effort born out of the desire to preserve human well-being now and in the future. The ecological consequences of mega-sporting events spawned an

interest in the greening of sports and sustainability in sports, and these are now considered critical issues. In light of these considerations, it is vital to discover how to generate and use innovative solutions to maintain a continuous flow of services during mega-sporting events in a sustainable way.

2 Purpose of Research

This study attempts to provide a model for a design process that will identify the attractive factors of and provide insights into mega-sporting events so that a set of sustainable products can be made.

In order to develop a solution based on users' needs, we adopted an in-depth qualitative interview method, which used both the evaluation grid method (EGM) and user journey map (UJM) to uncover the characteristics and preferences of our target users. The methods applied in this research can be used to analyze the emotional and affective components of the user experience.

3 Literature Review

In the following sessions, we will briefly introduce the concept of green sport and the design methods adopted in this study, including evaluation grid method and user journey map.

3.1 Green Sport

Green sport is a movement that seeks to incorporate harmonious connections between humans and nature, as well as humans and society [7].

The green movement has swept through almost every aspect of society. This trend can have a significant impact on communities, sporting events, and the environment. Because sporting events have been closely linked with the green movement, more and more policymakers and event organizers are actively advocating for environmental protections [8].

Green event policies have been developed by administrators and associates of the FIFA Club World Cup, the Olympic Games, and other mega-sporting events [9]. The Philadelphia Eagles football team was the pioneer in the green sport movement when it implemented a green renovation for the Lincoln Financial Field Stadium in 2003 [10].

Studies have shown that green events can intensify the fan experience, strengthen community connections, and increase a team's commitment to environmental responsibility [10, 11]. A continued commitment to green practices can help professional sports teams to attract sponsors, build community bonds, create a competitive advantage, and enhance the fan experience [11].

3.2   Evaluation Grid Method

The evaluation grid method (EGM) originated from the personal construct theory [12]. In 1965, the clinical psychologist George Kelly developed the repertory grid method (RGM) for identifying the ways that a person constructs (interprets or gives meaning to) a finite system of cross-references between personal observations and psychological constructs [13]. Japanese scholars Sanui Junichiro and Inui Masao [14] proposed a process called Miryoku engineering and its underlying theory as an improvement on the RGM. The Japanese word Miryoku means the power of attractiveness. Miryoku engineering also referred to preference-based design, which is mainly used in developing attractive products or services [15].

The EGM is a qualitative research method based on semi-structured interviews; it examines the efficiency of an application by focusing on evaluation rather than distinction for the purpose of a pilot study [14]. The primary purpose of the EGM is to thoroughly explore users' inner feelings to gain insight into the details of consumers' cognitive structures and convert them into a hierarchical model based on real factors of assessment to generate new designs [16]. The hierarchical grid structure of EGM (also referred to as the individual model) has three essential layers: (1) abstract reasons, (2) original constructs, and (3) concrete conditions.

3.3   User Journey Map

The user journey map (UJM), also known as the customer journey map, is a user-oriented strategic tool that tracks and analyzes the user experience and assesses the quality of a process or service [17]. The UJM displays a diachronic outline of the user's experience and visually illustrates the user's processes, needs, thoughts, and reactions throughout a user's interaction with a product, service, system, or defined activity [18]. Apart from the chronologic aspects, the UJM considers the user's feelings, perceptions, and emotional reactions throughout an entire experience process [19, 20].

With the UJM, the experience flow is divided into key stages, starting with the initial contact and continuing with the intentions, motivations, and goals of the user. The most common structure of the UJM is a two-dimensional diagram. Its horizontal axis (timeline) shows the sequential phases of the experience, and its vertical axis shows the multiple coexisting layers that demonstrate the user's needs and perceptions. The user's (customer's) processes, needs, and perceptions are the three elements required for forming a basic UJM [21].

4   The Procedure of the Experiment

The research process is shown in Fig. 1. The research setting of each step will be detailed in the following section.
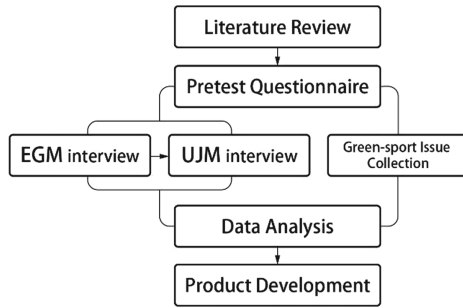
Fig. 1. Research procedure.

4.1 Participants and Experimental Samples

Participant selection is a vital part of qualitative research. For this study, an online pretest questionnaire was used to filter out persons who were less involved in sports. It was felt that intense involvement on the part of the participant would help to profoundly deconstruct the baseball game–viewing experience. In order to discover a broad group of facts and challenges in the game-viewing experience, the online questionnaire was also used to collect feedback regarding the issue of sustainability.

The pretest questionnaire was composed of 15 questions and was divided into two parts, including: (1) basic information about the participant and (2) information about the participant's habits and experiences while watching a baseball game. A total of 216 valid questionnaires were collected. Based on their comprehensive considerations of the on-site viewing experience, viewing frequency, and stadiums visited, three interviewees were selected. Each participant was interviewed individually in the laboratory. Each was asked to participate in the EGM interview first and then the UJM interview. The data collection sessions for the EGM and UJM interviews each lasted approximately one hour.

4.2 Evaluation Grid Method Interview

Based on replies to the pretest questionnaire, pictures of sports stadiums were prepared as stimulant samples for the interviews (Fig. 2). The operational steps of the EGM interview in this study were as follows:

1. Original evaluation items: Participants were asked to view stimulant samples and compare pairs of stimulant samples. Responses of "most/least preferred" to interview questions determined the preferred characteristics of a product or service.
2. Laddering: Supplementary questions were used to identify the abstract reasons (ladder up) and concrete conditions or features (ladder down) found in the original evaluation items.
3. Organizing a personal evaluation hierarchical map: Steps 1 and 2 were repeated for all evaluation items provided by the participants, and the evaluation items were arranged in a three-layer hierarchy to form a personal evaluation hierarchical map.

Fig. 2. Stimulant samples.

4. Organizing an overall evaluation hierarchical map: The personal evaluation hierarchical maps of all of the participants were compiled and the number of overlapping evaluations was calculated to plot an overall evaluation hierarchical map.

4.3   User Journey Interview

After a one-hour EGM interview, our interviewees were asked to share their experiences of viewing a baseball game in a one-hour UJM interview. The interviewers noted all the experiences on a sticky note and ordered them chronologically. Interviewees could see and adjust the order and add further details to it. As Fig. 3 shows, the journeys of three interviewees were plotted together for further evaluation.
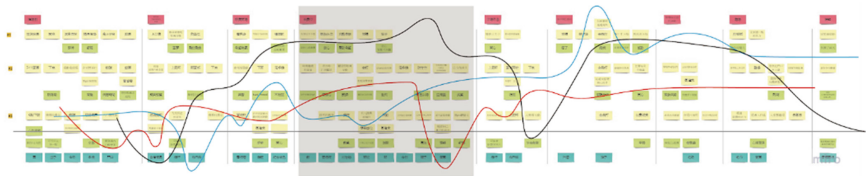
Fig. 3. Baseball game–viewing journey of three individual interviewees.

Looking at the journey of baseball viewing shown above, the horizontal axis represents the timeline of games and the post-it in red highlights the stages of the baseball game. The three curves illustrate the emotion of each participant.

4.4   Mapping of the EGM and UJM

At this stage, the researchers mapped the results of the EGM and UJM interviews together. First, the researcher combined the three individual journey maps of the baseball game–viewing experience. Eighteen steps before, during, and after the game were identified (Fig. 4). The second step was to discover the factors identified in the EGM and plot them on a flow chart chronologically; they included emotions, attractiveness factors, and specific conditions.
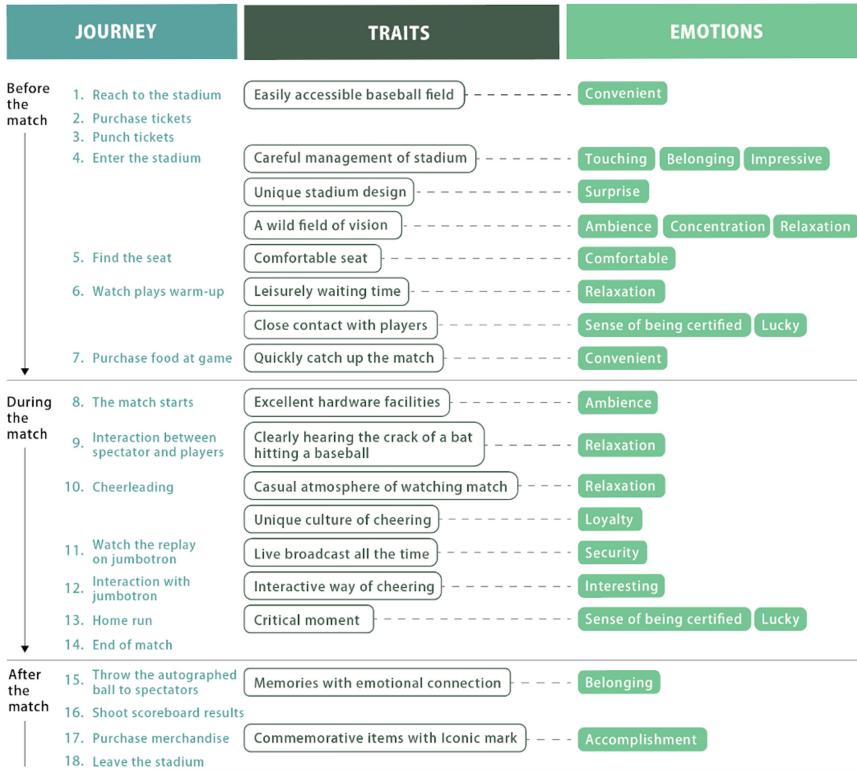
Fig. 4. Baseball game–viewing journey.

Some rare factors were identified in the mapping session, such as comments about the weather. Because this factor was mentioned only a limited number of times, weather conditions (e.g., "brisk weather") were not included in the study discussion.

5   Findings

In this section, we look briefly at the critical issues and attractiveness factors in the baseball game–viewing experience. The critical issues were gathered from both the online pretest questionnaire and qualitative interview results. The issues mapped and attractiveness factors identified were used to generate innovations in sustainable products, which are introduced at the end of this section.

5.1   Critical Issues in Mega-Sporting Events

Based on the feedback from the online pretest questionnaire, issues related to sustainability at sporting events were listed systematically and sequentially in the following paragraph.

Approximately 85.6% of the respondents stated that they liked to purchase food and drinks at the stadium before a game. They noticed that the eating area inside the stadium was crowded at the time. More than 80% of the respondents liked to encourage and support their team by cheering, waving cheering sticks and cheerleading signs, and blowing trumpets. Some of these implements were discarded after the game because they were awkward to carry, and fans were not certain they would reuse them. A few respondents reported smoking and hygiene issues at the stadium. After the game, respondents might choose to take meaningful and memorable souvenirs home and would throw away other meaningless items inside the stadium. Respondents reported that the stadium was covered with trash left by spectators.

5.2   The Attractiveness of the Baseball Game–Viewing Experience

Based on the results of the EGM interview, we identified two groups of important factors in the baseball game viewing experience. The first group included references to the amenities of the stadium and playing field, which were described as "convenient", "relaxed", and "comfortable". The factors in this group included the accessibility of the field and the openness of the field of vision. The second group included references to the stadium design (being "unique and commemorative"), camaraderie of the cheering culture, and iconic emblems of the teams.

By carefully looking at the factors and the order of the journey map, we found that the first group of factors (convenient, relaxed, and comfortable) were mainly related to experiences before and during the first half of the game. Before the game started, spectators took more notice of the physical facilities at the sports stadium. One can assume that this was because the spectators had not become immersed in the game at that point. They focused more attention on their physical comfort (e.g., having a wide field of vision and a comfortable seat, appreciating the physical design of the sporting field). The sensation of "unique and commemorative", on the other hand, continued throughout the entire baseball game–viewing experience (Fig. 5). The attractive factors in this group were mainly related to the game, for example, close contact with the players, interactive ways of cheering, excitement during critical moments of the game, and the purchase and use of commemorative items (souvenirs). In the following section, we will see how these attractive factors were used for product innovation.
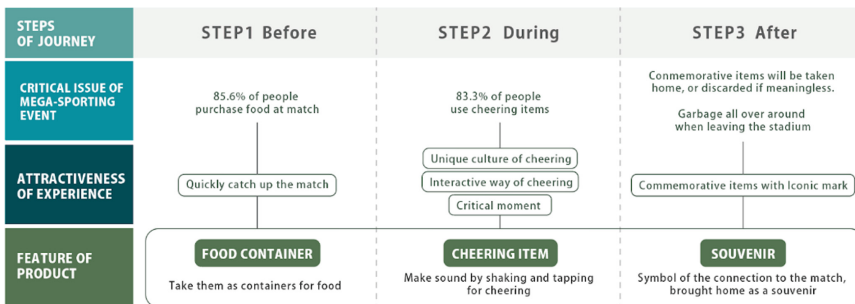
Fig. 5. Critical issue, attractiveness, and feature of product.

5.3   An Example of Product Innovation

We connected the issues and attractive factors based on the timeline of the game-viewing journey (Fig. 6). A set of cheering gadgets were designed and given the name **Homerun**. Features of the product set were transformed in a unique way to follow the experience flow of the spectators.

Fig. 6. The HOMERUN set of cheering gadgets.

Three cheering gadgets were included in the HOMERUN set: a cheering stick, shell bell, and hambongo (see Fig. 6). These products were designed to be used as food containers, and they were used in that way before the game. Once they were empty, the food containers gradually became gadgets for cheering and making noise. At the end of the game, the products could become symbols of the stadium or team and be taken home as souvenirs and brought back to the stadium at an upcoming event.

6   Discussion and Conclusion

In this study, we used a design process model for developing a sustainable product and used a baseball game experience as an example. In the research process, we applied the EGM and UJM interviews as a model to chart the journey and the attractiveness (preferred characteristics) of the experience. After mapping the results, a series of attractive factors were put in order according to the stage of the journey at which they arose. The experience journey contributed significantly to the understanding of the relationship between the attractive factors (see the graphic representation in Fig. 4).

The list of attractive factors provided a clear view of opportunities for sustainable product innovation. The HOMERUN set of products illustrated how products could be transformed to meet users' needs at different stages of an experience (see Fig. 6). The model applied in this study has implications for transforming product design thinking from a focus on a certain point or points in problem solving to a linear thinking pattern that focuses on a broader vista. We hope that future research will provide more detailed

results that may differentiate these views from one another, but this is an exciting first step.

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Conceptualization of User's Rage Assessment Using Chatbot Interface by Implementing Kansei Engineering Methodology for Information Security

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Abstract. Rage is considered one of the prominent emotions that play a crucial role in information security, especially in a user's behaviour in upholding security policies compliance. However, in current studies, there is a notable gap in the method for assessing the implication of rage as an emotion in influencing the human behaviour in protecting the security of information within an organization. Thus, there is a need to develop a method to assess a user's rage level at any time during work time to reduce the risk of information security breach or sabotage. We are proposing on designing a chatbot rage assessment method using Kansei Engineering (KE) methodology. The method could be embedded in the organization's information security policies as one of the security measures and serve as a preventive step to avoid any harm to the organization from the user's rage outburst. This paper reported the preliminary study in defining and characterizing the functionality of an assessment method using a chatbot interface to measure the user's rage level, specifically for threats in information security that may be caused by a user's behaviour caused by the emotion of rage. Findings obtained in this research could potentially provide new essence in emotion assessment research specifically in the information security domain field through KE methodology focusing on rage and contributing to the foundation of emotion embedded artificial intelligence.

Keywords: Rage · Emotion · Kansei · Affective · Information security

1 Introduction

Information security threats are being categorized as external and internal threats. Internal threats can occur when an individual has authorized access to a system or network [1]. Bauer, Bernroider and Chudzikowski [2] opined that human aspects such as behavioural and emotional traits are the pillars that influence users' non-compliance act in information security. This can be supported by AlHogail [3] who orated that non-compliance act by users is due to their emotion. Thus, the human aspect is indeed crucial

to be considered as a threat while assuring information security compliance. Therefore, organizations need to assess how such human aspects can affect users' non-compliance act towards information security procedures. One of the potential reasons that could cause internal threats in an organization is the employee's malevolent intention towards the organization or intentional noncompliance to information security measures. On the other hand, an external threat arises from individuals or organizations that are outside of the organization. Information security domain's main focus is to protect confidentiality, integrity, and availability of information [4] that includes the involvement of humans as the end-user. Thus, to make users protect the security of information, there are several guidelines for information security procedures and policies established for users to comply to, and for managing both internal and external threats [5].

A study done by Ishak et al. [6] shows that the emotional traits in the information security domain are trust, fear, stress, and rage. Employees' level of rage towards the organization should be monitored from time to time because the employees could be influenced by the emotion of rage towards the organization due to many reasons such as either the employee considers himself or herself as being mistreated by the organization, or as an act of revenge for any personal reasons. The expression of rage emotion by the employees of an organization is typically related to dissatisfaction over work activity that the employees are obligated to deliver to the customers [7, 8] that could lead to information security violation act resulting to demotion, or the mistreatment faced by the employees of an organization [9]. Such actions may result in an act of revenge towards the organization. Examples of such actions are disclosing the organization's confidential information to a competitor or destroying any information assets. Information leakage and any act that is related to releasing any information will have a grave effect on the organization that could even risk a human's life [10].

Thus, due to the risk of consequences that could happen in the information security domain, there is a need to conceptualize the rage emotion assessment in information security. This study proposes that the rage assessment should be done using an artefact that is frequently being used by the employees. The artefact could be any form of user interface design. In this research, we are proposing chatbot as the user interface to measure the employees' rage emotion. However, there is a challenge in finding the correct methodology for the rage assessment using the user interface design. From the previous research, Kansei Engineering (KE) methodology had proven to provide precise results for the assessment of human emotion towards artefacts [6]. Thus, we are proposing the usage of KE methodology for the rage assessment.

This research will serve as a foundation for emotion injection into user interface design that will contribute to the advancement of emotion assessment in the field of information security.

2 Introduction

2.1 Emotion

Emotion is often defined as an individual's mental state associated with thoughts, feelings, and behaviour. In the late 19th century, Darwin and Prodger [11] initiated

emotion theory. Then, Plutchik [12] categorized emotion into eight primary types, visualized by the wheel of emotions. PANAS-X presented the human emotion theories [13], while the Discrete Emotions Questionnaire (DEQ) proposed a process to determine the discrete emotion of humans effectively [14]. Besides, Basque Emotion Lexicon is a cluster analysis of sorting data collected in the Basque Country that revealed five basic levels of emotion categories similar to those found in American English and Indonesian (love, happiness, anger, sadness, and fear) as well as five other small positive emotion categories. The basic level categories in Basque fell within two large superordinate categories: positive and negative emotions. Each of the five large basic level categories contained several subordinate level categories. The results from the study suggest that the emotion lexicons, and the corresponding conceptualizations of the emotion domain, in 3 different countries with different cultural and demographic characteristic are similar in term of positive and negative emotions distinction as it is fundamental and universal cross-culturally [15]. There is limited published work focusing on rage. In the PANAS-X scale, DEQ scale, and Basque Emotion Lexicon, rage is a word that is categorized in the same category of the negative emotion "angry". Thus, in this study, we will develop KW for negative emotion that will include anger and rage for the information security domain.

In the era of technological advancement, users are interacting through a user interface design where emotions could be captured and analyzed. The analysis could be used to predict user behaviour in a particular context. Lange et al. [16] suggested that visualizations could be enriched with personalization mechanisms that better fit each user's specific needs and abilities [16]. Thus, the user interface design such as chatbot could be enhanced using a personalized mechanism to capture emotions such as rage. With technology advancement, computing power could be utilized to optimize the usage mechanism to capture rage.

2.2   Kansei Engineering Methodology

Kansei is a Japanese word that was defined as an impression of an individual towards artefacts, situation, or surrounding. Nagamachi [17] stated that Kansei was defined as a person's psychological feelings and a new image of products or artefacts. Past studies show researchers implemented KE methodology in determining the exact emotions of a user upon a product and their desired needs. Eventually, KE has been proven as an excellent methodology to measure a human's emotion towards any products and services. Khean et al. [18] implemented KE in finding which designs of eyewear that are desired by users. Besides, the notable research done by Lokman and Noor [19] in measuring user's emotion upon an e-commerce website opened a new chapter in the HCI field. KE has been widely used in integrating emotions in product design ranging from physical product to IT artefacts [20].

KE also has been used to establish a new design concept that matched with the users' implied requirement, and thus associate them with such design characteristics that appeal to users' perception and emotion. In other words, KE is useful in investigating users' emotion towards products and services [21]. The interaction of an employee with the chatbot with specific design characteristics could be utilized as a technique to assess an employee's rage. By applying this concept to our research, a

design of a chatbot can be associated with rage assessment in the information security domain. Meanwhile, KE methodology is typically carried out through a qualitative and quantitative approach using a self-reporting system such as Semantic Differential (SD) or free labelling in measuring Kansei [20–22]. This is carried out through the establishment of the questionnaire which consists of emotional descriptive words or known as Kansei Checklist. Emotional descriptive words are regarded as Kansei Word (KW), which reflects the user's emotion. In this study, we are proposing to use the quantitative approach by developing a questionnaire related to the design characteristic to be used for the measurement of rage. The usage of chatbot can be justified by the common usage of a chatbot as a medium of interaction, education, and awareness to the employees in delivering their daily task. The chatbot also can be embedded in information security policies as a method to uphold security policies compliance of the employees in the organization.

2.3   Chatbot Design

A chatbot is a software application that was designed to mimic human-to-human interaction where the chatbot engages with users in a general conversation [23]. Among the user interfaces that are frequently being used is a chatbot - a program that attempts to simulate typed conversation with the aim of at least temporarily fooling the human into thinking they were talking to another person. A chatbot is a machine with a natural language processor that is capable of conversing logically with a human in a particular subject. Chatbots may function in many ways, including customer support, social and emotional support, information, entertainment, and also links the user to other people or systems [24]. Nowadays, chatbots are seen particularly as a potential alternative to conventional customer service. Users will be able to communicate effectively with chatbots as they can get answers to their questions, product and service response, and updated information almost immediately [25]. Chatbot is also being utilized in the healthcare field due to the ability of a chatbot to be a medium of communication and improve some process of weight management and issues by examining historical medical records and patients' data using various algorithms that were installed. These systems can collate feedback from users and provide advice or suggestions based on previous user records with similar issues [26].

Chaves and Gerosa [27] discussed how the design of a chatbot could trigger the emotion of the user because the design could appear pleasing, or trigger their dissatisfaction, anger, or frustration. However, the challenges in this study include the design of the chatbot, which can also be ignored by a user. Neururer et al. [23] suggested that it is crucial to design such a chatbot to be acceptable by a user at first sight to avoid their ignorance and to avoid the failure of detecting emotions that can lead to non-compliant behaviour of users towards information security procedure [28]. In some cases when users need to interact with a chatbot, they find that those chatbots are annoying, and not functioning as it is designed to [29]. Studies suggested that the appearance of computer security communication such as a dialogue box could manoeuvre users to comply with security procedures [30]. Usage of computer security communication plays a significant role in educating and increasing users' awareness of information security issues and notifying users of the consequence of malicious acts

[31, 32]. This role is also significantly supported by a chatbot software application. A chatbot could be the next generation of IT security services tool. Chatbot also could be used to educate or assist users in deciding without compromising information security [33]. Most research are focusing on chatbot's effect on user attitude and impressions. To date, a chatbot has been designed and redesigned by focusing on its cognitive functionality. Cognitive functionality is image manipulation and rationale utilizing functions in a product [34]. For example, Angga et al. [35] proposed to design the chatbot with an avatar to increase user's interaction.

3   Proposal for Rage Assessment Using Chatbot Interface in Information Security Domain Using Kansei Engineering Methodology

This paper reports a proposal for user's rage assessment by adopting KE methodology using a chatbot as an artefact for the information security domain. Selection of chatbot as the interface is due to its existence in many websites and systems, and its role in providing education and awareness on information security to the employee. To uphold the security policies compliance of the employees in the organization, the chatbot needs to be embedded into information security policies as a method to monitor users' emotions. We are proposing that chatbot will pop up periodically on the user's computer screen with the designated design characteristics and topics to measure an employee's rage emotion level.

However, research on developing and designing a chatbot that could measure the level of user's rage emotion is yet to be conducted. Thus, we are proposing a process to conceptualize user's rage assessment by adopting KE methodology using a chatbot as an artefact for information security. The proposed process is divided into four phases: Phase 1: Instruments Preparation, Phase 2: Emotion Measurement, Phase 3: Emotion Conceptualization, Phase 4: Design Requirement Formulization.

3.1   Phase1: Instruments Preparation

This phase starts with identifying the suitable instruments for the respected domain. The instruments consist of target participants, artefacts to be used, and Kansei Word (KW) for Kansei Checklist.

Table 1 shows the instruments proposed for the study. Chatbot artefacts will be collected through an existing application such as Google Alexa, Amazon, Google Assistant, and Facebook Bots in reference to Janarthanam [36]. Meanwhile, an employee of an organization related to information security practitioners will be the suitable target participants as they are engaging with a chatbot in their working schedules. As for Kansei Checklist, extraction of KW is from rage emotion.

Table 1. The instruments.

Instruments	Description
Artefact	Chatbot as the suitable artefacts for the information security domain
Participants	The employees of an organization (information security practitioner) are target participants
Emotion Word/Kansei Word (KW)	KW of rage emotion characterization

3.2   Phase 2: Emotion Measurements

This phase is explained in two steps which involve the establishment of Kansei Checklist and Extraction of User Interface (UID). Kansei Checklist, which is a form of questionnaire consisting of KW. As rage emotion's cluster is yet to be conducted in the information security domain, this study will apply the KE Method to determine the KW of rage emotion. Once KW is determined, a Kansei Checklist for rage in the information security domain can be fully developed. The process of developing KW will be according to KE Type 1 [37]. Then a 5-point or 7-point SD scale will be established.

Meanwhile, the extraction of chatbots UID will be based on literature review. UID refers to any visible design element of artefacts that provides interaction [34]. Table 2 shows the extraction of design elements of chatbots UID with their respective category and item for this study.

Table 2. Extracted chatbots UID.

Instruments	Description
Timing [38]	• Appear timing • Reply timing
Typography [39]	• Font size • Font type • Font color
Color [40]	• Color of chatbot
Voice tone [35]	• Voice tone of chatbot
Button [41]	• Size • Color • Functionality
Topics [42]	• Templates of topics

3.3   Phase 3: Conceptualization of Rage Based on Statistical Measurement

This phase can be conducted once participants have evaluated Kansei Checklist upon the chatbots UID. The data are then analyzed using multivariate analysis. Multivariate analyses to be used are as Principal Component Analysis (PCA) and Factor Analysis (FA). PCA is mainly used to determine the structure of emotion and artefacts. Meanwhile, FA is used to determine significant emotions.

3.4   Phase 4: Design Requirement Formulization

After relationships between emotion and design elements, a design requirement UID in designing chatbot that embeds rage emotion can be formulated. This requirement will serve as the chatbot's UID design guide for rage emotion that can be applied by the application and software designer or other information security practitioner in designing a chatbot with the design characteristics that embed the employees' rage emotion. Figure 1 shows the proposed process to conceptualize user's rage by adopting KE methodology using a chatbot as an artefact for information security.
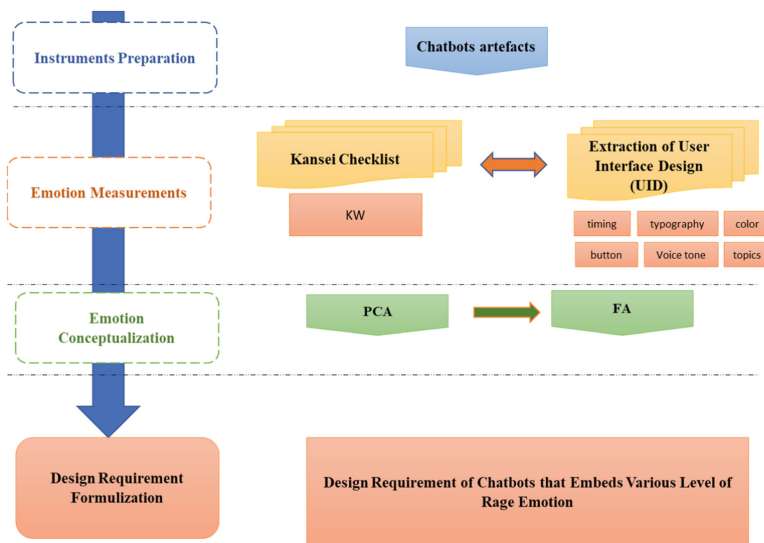
Fig. 1. Proposed process for conceptualization of user's rage assessment using chatbot interface by implementing KE for information security.

4   Conclusion

This paper proposed a process to conceptualize rage emotion and its influence to the information security domain by adopting KE methodology. This is an ongoing work of conceptualizing the assessment of rage emotion in the information security domain

through chatbots UID as the artefact. As continuation for this work, empirical studies that include experimental activities will be carried out to develop KW for rage in information security. After that, a test to validate the proposed process will be conducted by respondents with different demographic backgrounds. The demographic background will include gender, race, knowledge background, and work experience. These demographic backgrounds will enable analysis on more accurate relationships in representing the specific demographic sector of the employees. Also, in recent years, there have been changes in the way of delivering business with the help of technologies. The changes resulted in leveraging the task from humans to tools that apply the human-machine interaction concept that increased efficiency and simplification of work tasks. Information security measures and policy have also changed in parallel with the introduction of these tools, However, the changes lead to a low, middle, and high acceptance level from the employees in the business organization. The low acceptance level could result in non-compliant behaviour towards the new policies and can result in becoming an information security threat. As an output from the experiments and data, a design guide for the chatbots that could assess rage emotion will be developed.

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The Assessment of Trust in Information Security Using Kansei

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Abstract. Trust is one of the four prominent emotions in the information security (IS) domain that requires a comprehensive study. Trust assessment in IS must also consider human behaviour instead of only focusing on technical factors. Characterizing trust will start with defining and determining trust's basic elements and emotions that have influence on trust and its relationship with the IS domain. Furthermore, trust assessment also needs to cover a wider demographic background in an organization to gain a better understanding of trust's impact in the IS domain. The emotional context of the users towards information security policies and systems, or the organizations may contribute to the users' non-compliance to security policies or even malicious behaviour. Past literature indicated that there is a lack of methodology for trust assessment in the IS domain. This paper proposed a concept for assessing trust in information security implementations. The method was proposed based on past literature on information security and human behaviour research.

Keywords: Trust · Emotion · Kansei · Affective · Information security

1 Introduction

With the imminent arrival of IR4.0 and IoT, usage of vast data from various resources is inevitable. Such data and information will be shared back and forth in providing prodigious technology services. Hence, it fortifies the urge of securing such information. This is because such information could be targeted by threats such as information being leaked in security incidents, the aftermath to any organization [1]. Examples of other significant security incidents are unauthorized information sharing, espionage, breach, leakage, and lastly denial of service [2, 3]. Such incidents and their aftermath could even risk human lives in the worst-case scenario.

When there's a risk of security incidents, the implementation of Information Security (IS) becomes appropriate [1]. As an example, advanced technologies used for combating threats were implemented in the firewall and intrusion detection system (IDS) for better protection of computers and networks [4, 5]. However, R. Von Solms and Van Niekerk [6] suggested that the process of securing a computer and network goes beyond the technical aspect. Meanwhile, Mahfuth et al. [7] also suggested that

focusing only on the technical aspect and leaving out the human aspect in IS is tactless. This claim is supported by a similar study done by Dupuis [8], and Komatsu [9].

In information security, a human is regarded as the weakest link as they are prone to compromising the security. Hence, there is an urge within scholars to include the human factor in creating a good IS culture [10]. Humans play a big role in dealing with information and computers. Thus, the risk of having a security incident is inevitable. One could preserve security while others could create a risk of threat to an organization. Hence, an organization should consider human factors such as behaviour and attitudes, assumptions, and emotion to ensure user compliance with IS [4, 11].

Numerous researches regarding human factors were done. Evans et al. [12] proposed a model on investigating human behaviour. While a study by Ahlan et al. [13] highlighted how human attitudes could influence information security. The most prominent emotions in the IS domain are said to be trust, fear, rage, and stress [14–16], and emotions have an immense influence on user behaviour in regard to IS compliance [17, 18]. Researchers suggest that the making of IS policies must consider human aspects such as behaviour and emotion for better compliance [13]. A study by Bauer [2] has shown that despite the making of IS policies, the level of compliance of the user is still low. Hence, this emphasizes the lack of methodology for assessing trust emotion in IS policies. Studies have also proven that trust is also influenced by other emotions, which are divided into positive and negative emotions. We hypothesize that by measuring the positive and negative emotions that influence trust, it would increase the precision in assessing trust level for IS policy. As a result, IS policies could be made with consideration to the emotions element before they can be implemented wholly in an organization.

Henceforth, this paper conceptualizes the basic elements of trust, and the positive and negative emotions that could influence trust, and also propose the process to determine and measure all the emotions characteristic and its relationship with IS through the adoption of KE methodology.

1.1 Trust in Information Security Domain

Trust has been investigated across various disciplines such as social studies, psychology, information security etc., which brings various definitions and frameworks of trust associated with each respective field of study. Generally, trust is defined as the willingness of an individual or institution to depend on another entity, be it individual or organizations. An organization has an organizational culture which is also known as the security culture. In the IS domain, trust is crucial as it is highly needed for effective organization management. The two main pillars of security culture, which are assumptions and belief, are the factors that help an organization to understand their staff's behaviour and relationship [7, 19]. Hence, such culture is deliberate to provide better management of organization among employees.

Trust in organization consists of three basic elements which are: i) trust in an organization (among employees), ii) trust between organizations, and iii) trust between an organization and their customers [20]. As an example, a study done by Dietz and Hartog [21] examines trust in an organization to strengthen the security of an organization. While Bansal et al. [22] illustrated the importance of trust between

organizations including the third party, which are their customers, regarding their personal data management.

Meanwhile, Dun et al. [23] studied trust using a survey instrument and found that negative emotions such as anger had a strong negative influence on trust. The study discusses the effect of emotion on trust will depend on two factors: the emotion's valence (whether it is positive or negative), and the emotion's cognitive appraisal, which leads the trustor to apply this valence to the trust decision. Meanwhile, Myers [24] investigated how emotional states could influence behaviour using a designated trust game and observed how negative emotions could influence trust. The findings are reported in Table 1 which shows the five emotions examined in the study. Three negative emotions (anger, guilt, and anxiety), and two positive emotions were tested. The emotions are characterized into the dimensions according to how likely it is to affect trust, and the competing predictions made about effect on trust according to their control type and level of certainty. Numerous studies discussing the influence of emotion on trust were done. Gadarian et al. [25] suggested that anxiety has important effects on trust.

Table 1. Characterizing emotions by valance, control and certainty from [24]. The influence of emotion on trust.

Emotion	Type of control	Certainty	Valance	Predicted effect on trust	
				From control	From certainty
Anger	Individual control – Other	High	Negative	↓	None
Guilt	Individual control – Self	High	Negative	None	None
Anxiety	Situational control	Low	Negative	None	↓
Happiness	Individual control – Other	High	Positive	↑	None
Self-assuredness	Individual – Self	High	Positive	None	None

The findings show that negative emotions can decrease trust, only if those negative emotions produce low certainty appraisals. Anxiety, a low certainty emotion, has a negative impact on trust while anger and guilt, two emotions that differ in their control appraisals, induce the same high level of certainty, appear to have no clear effect on trusting behaviour. However, the effect of certainty appraisal on trust among positive emotions was not observed.

Research by Roca et al. [26] and Tamjidyamcholo et al. [27] expressed that it is quite difficult to assess trust in the IS domain. Schlienger et al. [28] suggested the measuring of trust in an organization through artefacts. The measurement of trust in IS could include the structures of IS policies, contents, process, procedure, workflow, the typography of each structure, etc. Measuring emotion in artefact can be implemented

KE in the target to incorporate the emotional appeal in the product design. In this research, we are proposing the use of KE to asses trust in the IS domain. The study investigated positive and negative emotions by categorizing all emotions including from PANAS-X [29] and determined their relationship with trust.

2 Kansei Engineering Methodology

The term 'Kansei' in the Japanese language refers to emotion or known as an impression of a person upon something. Kansei is an expression of one's impression towards artefacts, situations, and surroundings. Nagamachi [30] posited the closest interpretation of Kansei is 'psychological feeling' and image of products, ideas, artefacts, surroundings or situations. While in the psychological domain, Kansei means balancing mental state of knowledge, emotion, and sentiment [31–34]. Although Kansei is often translated as feelings, sensitivity, sensibility, and needs relating to a product, the concept could also be extended to measure people's emotions towards a non-physical product. As an example, a study was done by Abd Kadir [31] in assessing the emotions of humans towards political propaganda videos.

KE captures the information from the five senses as an input. KE has been widely used to incorporate the emotional appeal in product design ranging from a physical consumer product to IT artefacts [35]. KE study is typically carried out through qualitative and quantitative research steps. Researchers have used the KE method in expressing people's emotion and feelings once they see products. This methodology by its quantitative approach uses an emotional descriptor or Kansei Word (KW) to reflect users' emotion through self-reporting systems such as the Different Emotional System (DES), the Semantic Differential system, or the free labelling system. Yanagisawa et al. [36] proposed a Kansei model in user-product interactions that relates the physical world and the mental world. The physical world is involving a product, a user, and an environment and the mental world involving a series of cognitive processes. The mental world interacts with cognitive components, such as meanings, appraisals, emotion, and motivation. Meanwhile, the cyclic interactions of the user's actions and the work sensations acts as an interface between the physical world and the mental (physiological) world and it continues repeatedly throughout the user's interaction with a product. User interaction towards the physical world initiates a stimulus and generates a product stimuli feedback that resulted in the interpretation of certain emotions to users [36].

3 Trust Assessment in Information Security Using KE

Since IS policies have been used in controlling user's action to preserve the security of information in an organization, the compliance level towards the policies are arguable. Trust undeniably plays a vital role in employee behaviour towards IS compliance and is selected as the scope of this study due to its important role in the IS domain. In assessing trust as emotion in the IS domain, this study considers three basic scenarios of trust in an organization which are the trust between employees, trust between

organizations, and trust between an organization and their customers. The research suggested a concept for trust assessment in IS policy by adopting the Kansei model in user-product interactions by Yanagisawa et al. [36]. The research proposed a concept for trust assessment in IS policy interaction and divided it into 2 segments which are the physical and psychological segments as shown in Fig. 1.
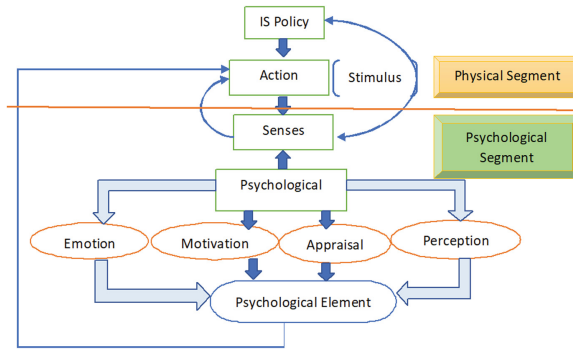
Fig. 1. A proposed concept for trust assessment for is policy interactions.

Additionally, based on past literature, trust could be influenced by positive and negative emotions, and all emotions and their relationship with trust should be considered [23, 37, 38]. The positive emotion elements include the three basic elements which are benevolent, integrity, and ability [39]. Benevolent refers to a user's loyalty and interest in preserving the safety of an organization's assets by not being self-interested nor attempting to gain benefit for oneself through a breach or leakage of an organization's information. Integrity implies the feelings of honesty and fairness of users upon complying towards security procedure or policies. Ability refers to the skill and competency of an employee upon understanding and being compliant to the security procedure or policies. However, there are numerous other positive and negative emotions that could be related to trust. Thus, we proposed to apply KE in the process of determining and grouping all possible emotions that have an influence and relationship with trust.

The first step is the Instrument Preparation. This step determines the instruments which are the artefacts and the subjects that will be used in research. Artefacts include the structures of IS policies, contents, process, procedure, workflow, the typography of each structure, etc., whereas subjects are normal users, such as technical staff, security technical implementer. Managers that have a direct impact on the compliance towards the IS policy in an organization. The summary of subjects and artefacts for the trust assessment in IS are shown in Table 2.

Then, a Kansei Checklist will be developed via brainstorming sessions according to the subject groups to gather all possible words for positive and negative emotions that are considered able to influence trust. The Kansei Checklist will be sorted into KW groups by the group of subjects. Then, a questionnaire will be developed to measure the assessment of trust towards the artefacts using the IS policy samples. Subjects will

Table 2. Subject and artefacts for trust assessment in information security.

Subjects	Artefacts
Normal users	Structures of IS policies
Technical staffs	Contents
Security technical implementor	Process
Managers	Procedure
	Workflow
	Typography

be recruited to respond to our questionnaire. Then, after the evaluation process is completed and data are collected, the next phase is to perform data analysis through the statistical tool of Principal Component Analysis (PCA). Factor Analysis (FA) also will be used to conceptualize trust assessment in the IS domain. Based on the results, a guideline on designing IS policies that embeds the level of trust according to the objectives of the development of IS policy will be developed. Figure 2 shows the proposed methodology for trust assessment in the IS domain adopting KE methodology.
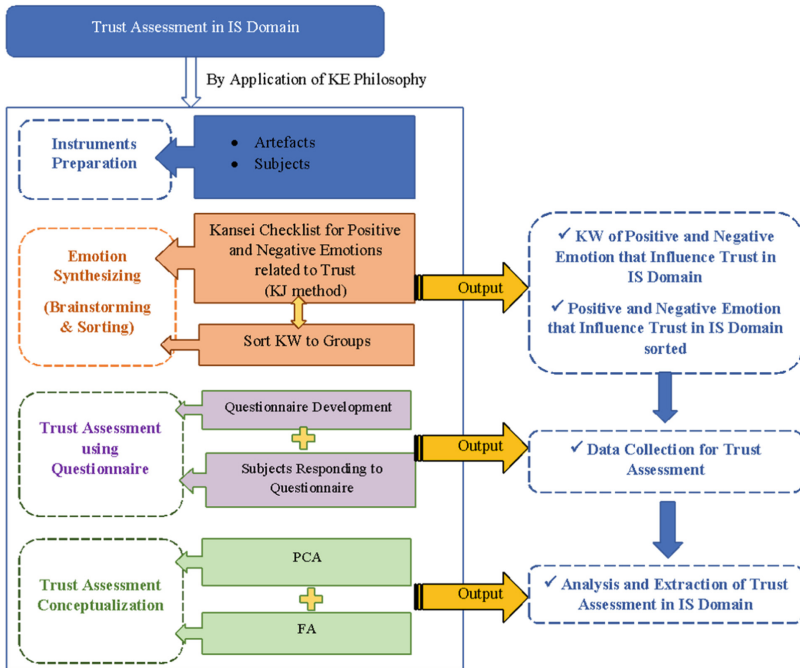
Fig. 2. The proposed methodology for trust assessment in the IS domain.

This methodology will be able to collect data on subjects' affective responses towards IS policy development. Factor loadings for each component will determine IS policy design relationship with the subjects' trust level. The collected data will enable the research to analyse elements related to trust and determine subjects' trust responses to the IS policy.

4   Discussion and Future Works

This study attempts to assess and quantify trust in the IS domain using the positive and negative emotions that can affect trust through the adoption of KE methodology. Nevertheless, measuring and assessing emotion in the IS domain is quite complicated as the concept of emotion is broad. Additionally, based on past literature a gap in assessing emotion in IS domain was identified. Therefore, this study was done to address trust assessment in the IS domain, by taking into consideration the positive and negative emotions that could influence trust. The proposed methodology could contribute to the development of IS policy that will contribute to a higher user compliance.

As a continuation for this work, an empirical study will be conducted. Empirical results should be provided as evidence on trust assessment by taking positive and negative emotions affecting trust into consideration for the IS domain. A validation process that includes experts and professionals will be done to provide accurate information in respond to the proposed methodology. Also, in future work, we will test user compliance level toward IS policy according to three hypotheses: Hypothesis no. 1: Organizations can trust that their employees will comply with the IS policies if positive emotion suggests that the user is high in integrity; hypothesis no. 2: Organizations can trust their employees to comply with the IS policies if positive emotion suggests that the user is high in benevolence; hypothesis no 3: Organizations can trust their employees to comply with the IS policies if positive emotion suggests that the user is high in ability. These three characterizations of trust are the keys to determining the trustworthiness of an employee in an organization.

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Creating New Values for Children's Luggage Using Kansei Engineering Methodology

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Abstract. The popularity of parent-child travel cannot drive the sales of children's luggage well. This is because the design of current children's luggage cannot satisfy the expectations of parents. Products with novelty and versatility are more likely to appeal to consumers and meet consumers' needs in pursuit of high quality of life. Therefore, new values need to be created for children's luggage to increase its competitive advantage. However, the methods for creating values for a new product are still lacking. To support the sales of children's luggage and its industrial development, this study aims to show the way the Kansei Engineering methodology targets children's luggage to create new values in a new perspective. A total number of 26 new values of children's luggage were selected for evaluation. The framework of creating values for new children's luggage in this study can improve the attractiveness of a product. Consequently, the children's luggage as well as other kinds of products that are facing elimination can have a chance of development.

Keywords: Value creation methods · Kansei Engineering · Children's luggage

1 Introduction

Parent-child travel in China is regarded as an important mode for children's education. Since children's luggage is a highly related product of parent-child travel, its importance can be similar to a schoolbag in this situation [1]. However, the sales volume of children's luggage is far less than that of schoolbags. It can be seen that every elementary school student has a schoolbag, but very few elementary school students have children's luggage. This situation could impede the growth of the children's luggage industry.

Chinese parents are willing to invest in growth and education for their children [2]. As a result, the economy is not the important determinant in preventing parents from purchasing luggage for their children. Therefore, to increase the sales of children's luggage, it must focus on the quality of children's luggage. Companies experiencing mature business environments should organize themselves in order to understand the way customer value is created and the way these processes can be organized to produce value [3] because superior product value creation occurs with actual or perceived

benefits to the consumer, subsequently, successful value chains can generate competitive product benefits [4]. Therefore, in order to support the growth of the children's luggage industry, new values need to be created for children's luggage to stimulate parents' desire to purchase children's luggage.

2   Literature Review

The term value has been used in many articles from different disciplines that define the value based on the research object. Value to a consumer is the perceived benefits accrued from an offering that is based on the cost they are willing to give up for the needs they are seeking to satisfy. Product is one of the sources of perceived value [5]. For the purpose of this paper, value is focused on the product of children's luggage. Children's luggages of a high percentage of value are deemed to be physically good. Any properties of children's luggage that can offer benefits to consumers constitute a part of the value of the luggage.

Kumar and Reinartz [5] have indicated that the nature of product should be considered in identifying the source of value. Since products with novelty and versatility are more likely to appeal to consumers and meet consumers' needs in pursuit of high quality of life, together with the fact that the current children's luggage is unable to stimulate parents purchase decision well, this study focuses on values that do not exist on the current children's luggage, that is, potential values. The creation of potential values for children's luggage can increase the function of children's luggage. Therefore, a method that can identify the potential values for children's luggage can create values for a new children's luggage. Theoretically, Kansei Engineering is a design method that can translate consumer impressions, feelings and needs on existing products or concepts to design solutions and parameters. It shows the way impressions, feelings and needs of consumers are translated into product design [6]. Value is a subjective experience that flows from the person (or institution) who is the recipient of resources [4]. As a result, value is a kind of consumer impression, and potential value is also a kind of consumer impression. Therefore, Kanssei engineering can express the potential values of children's luggage.

Since Nagamachi established the Kansei Engineering methodology in 1974, many researchers from different disciplines have contributed to the Kansei Engineering methodology. Currently, the procedure of Kansei Engineering Type I formulated by Schütte is the procedure often used by many researchers: 1) Choice of domain. 2) Span the semantic space and the space of properties. 3) Synthesis. 4) Test of validity. 5) Model Building. However, most of the previous research on Kansei Engineering methodology focused on increasing the existing values of a new product [7–9] instead of creating potential values for a new product. Therefore, this study adjusted the detailed procedure according to the need to create potential values for a new children's luggage.

3   Methodology

The method used in this study was Kansei Engineering Type I. In order to create potential values for children's luggage, two details need to be adjusted. First, replace the Kansei words describing potential values with the Kansei words describing existing values. Second, use concept picture samples instead of product samples. Since potential values do not exist on the current children's luggage, these values need to be associated with consumers via a given medium when evaluating consumer attitudes. The medium is a clue that can trigger associations of customers; it can be an item or an event. Concept pictures can convey abstract concepts intuitively, it can let parents understand the concept of potential value better and inspire parents' imagination, and thus this study interprets potential values with pictures. Since the procedure in this study was different from the previous procedure shown in Fig. 1 above, a detailed procedure of translating potential values into children's luggage was formulated, as shown in Fig. 1.

The Kansei analysis helps designers to add new values on children's luggage. For instance, if children like eating rainbow candy, designers can design the color of rainbow candy on children's luggage. If children like seven-star ladybug, the shape of the children's luggage can be designed as a seven-star ladybug. If children like riding, the function of a scooter and a rocking horse can be designed on the children's luggage. In this way, Kansei Engineering Type I can be used to create potential values for a new children's luggage.
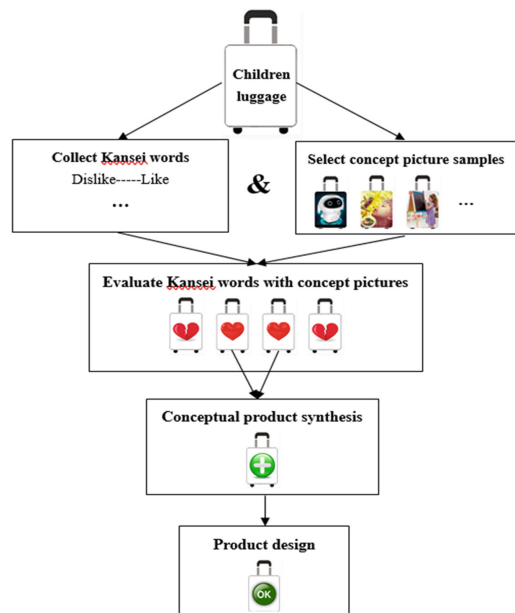
Fig. 1. Translating potential values into children luggage.

3.1   Choice of Domain

This study focuses on the product domain of children's luggage. The users are children between the ages of 6 to 12. Because the children cannot express their opinions well at the age of 6 to 12 the target group of this study is parents of these children.

3.2   Collection of Kansei Words

In order to collect the Kansei words of potential values for children's luggage, the properties of children's luggage must first be understood. This study collected the Kansei words from two major online retail platforms (e.i. Tmall.com and JD.com) and websites in China. It is found that when buying and evaluating children's luggage, parents usually pay attention to the appearance, material, smell and function of the luggage. As a result, this study is determined to create new potential values of the appearance, material, smell and function for children's luggage design. Then, this study classified the collected Kansei words for these four properties. A total of 150 Kansei words related to children's luggage were collected. In order to properly construct the questionnaire, the collected number of Kansei words needed to be reduced. Synonyms or similar words were eliminated in the first selection. The Kansei words that were not associated with potential values were eliminated in the second selection. Finally, the remaining Kansei words were paired up, which are antonyms of each other. A total of 15 pairs of different Semantic Difference words, which are important to the modified product, were carried out by the group discussion. The details are as shown in Table 1.

Table 1. The semantic difference words and properties of children luggage.

Product properties	SD words used in the pilot test		Emotional responses
	Conscious thoughts		
Appearance	Ugly-Beautiful	Outdated-Novelty	Dislike-Like Undesired-Desired
	Meaningless-Meaningful	Boring-Interesting	
Material	Uncomfortable-Comfortable	Dirty-Clean	
	Unhealthy-Healthy	Boring-Interesting	
Smell	Dizzy-Refreshing	Harmful-Harmless	
Function	Useless-Useful	Backward-Advanced	
	Troublesome-Convenient	Dangerous-Safe	

3.3   Selection of Concept Picture Samples

Potential values refer to values that do not exist in the current children's luggage, and thus in order to discover potential values for a children's luggage, new consumer preferences need to be identified first. This study identified preferences by analyzing activities that children do during their travel journey and by observing things that they

like in their daily lives. A total of 26 concept picture samples were selected through a group discussion, indicating potential values that do not currently exist in children's luggage, as shown in Table 2. For the appearance, the properties of robot, RC car, Teddy bear, Minnie balloon, Kinder joy and self-signed were identified. For the material, the properties of cotton, silk, stone, water, sand, and thermochromic material were identified. For the smell, the properties of flower smell and fruity smell were identified. For the function 1, the properties of Ipad holder, umbrella holder, water bottle holder, mobile phone holder, book holder and desk were identified. For the function 2, the properties of artboards and brushes, piano, Lego toys, blanket, ashbin, digital map were identified.

Since the potential value has not come into existence and it is difficult for consumers to imagine, this research used concrete pictures to convey the concept. The pictures can transform abstract text into concrete objects. Therefore, consumers can understand the concept of Kansei words accurately and intuitively.

Table 2. Concept picture samples used in the pilot test.

Properties	Concept pictures					
Appear-ance	1.Robot	2.RC car	3.Teddy bear	4.Minnie balloon	5.Kinder joy	6.Self-signed
Material	7. Cotton	8. Silk	9. Stone	10.Water	11.Sand	12. Thermo-chromic material
Smell	13. Flower smell	14.Fruit smell				
Function 1	15.Ipad holder	16.Umbrella holder	17.Water bottle holder	18.Mobile phone holder	19.Book holder	20.Desk
Function 2	21.Artboards and brushes	22.Piano	23.Lego toys	24.Blanket	25.Ashbin	26.Digital map

3.4 Evaluation of Kansei Words

A set of questionnaires was developed at this stage to investigate the potential values expressed in the concept picture samples. The questionnaire used semantic differential scale of 5-rating scale. The range of each Kansei word was set from −2 to +2, whereby the +2 means the maximum value for the positive semantic, while the −2 means the maximum value for the negative semantic. A total of 36 parents, including 28 mothers and 8 fathers took part in the study. These parents represented children of 15 girls and 21 boys. The Alpha for this study was 0.989.

4 Results and Discussion

4.1 The Mean of Each Potential Value

The result of parents' perceptions allows the calculation of a weighted value for each concept, as represented in Table 3. It shows the mean ranking value of each Kansei value and primarily reveals the distinction for certain concepts. For example, sample code 1 represents the concept picture 1 with "Robot".

The concept "Robot" received a higher Kansei value of "Dislike-Like" than the rest of the concepts; this means that parents were anticipating the design of the properties of a robot into the appearance of children's luggage. In contrast, the concept "Minnie balloon" received a lower Kansei value of "Undesired-Desired" than the rest of the concepts; this means that parents were not anticipating the design of the properties of Minnie balloon into the appearance of children's luggage. The results in Table 3 showed that most of the Kansei values are optimistic, indicating that parents were willing to add new values to the design of children's luggage.

4.2 The Mean Differences of Each Potential Value

Parents have a positive attitude towards the potential value, but their preference for each potential value may be different. By using the one-sample t test, the mean of each children's luggage property has been tested for differences. Table 4 showed the mean differences of each children's luggage property. The higher the mean difference, the more parents are willing to have the children's luggage with this property.

For the appearance, the result showed that parents are willing to have the children's luggage appearance with smart function properties, not simple shape properties. For the material, the result showed that parents preferred to have the children's luggage with funny and functional property, not hard and rough properties. For the smell, the result showed that parents preferred to have the children's luggage with flower smell property. For function 1, the result showed that parents preferred to have the children's luggage with accessory learning tools property. For function 2, the result showed that parents are preferring to have the children's luggage with accessory learning tools property.

Table 3. The mean of each potential value.

Properties	Kansei words	Mean					
Appearance	**Sample code**	**1**	**2**	**3**	**4**	**5**	**6**
	Dislike-Like	1.22	0.97	0.5	0.11	0.67	1.03
	Undesired-Desired	1.22	0.97	0.47	−0.14	0.56	0.89
	Ugly-Beautiful	1.06	1.03	0.86	0.14	0.50	0.78
	Meaningless-Meaningful	1.19	1.00	0.44	0.08	0.56	1.00
	Outdated-Novelty	1.31	0.97	0.5	0.03	0.75	0.94
	Boring-Interesting	1.33	1.17	0.64	0.28	0.81	0.86
Material	**Sample code**	**7**	**8**	**9**	**10**	**11**	**12**
	Dislike-Like	0.28	0.22	0.17	0.89	0.78	1.22
	Undesired-Desired	0.17	0.17	−0.08	0.83	0.78	1.19
	Uncomfortable-Comfortable	0.33	0.47	0.11	0.86	0.69	1.22
	Unhealthy-Healthy	0.58	0.67	0.39	0.81	0.58	1.14
	Dirty-Clean	0.42	0.53	0.25	0.78	0.53	1.00
	Boring-Interesting	0.44	0.33	0.28	1.03	1.00	1.42
Smell	**Sample code**	**13**	**14**				
	Dislike-Like	0.89	0.78				
	Undesired-Desired	0.83	0.69				
	Dizzy-Refreshing	0.86	0.81				
	Harmful-Harmless	0.89	0.78				
Function 1	**Sample code**	**15**	**16**	**17**	**18**	**19**	**20**
	Dislike-Like	0.72	1.11	1.06	0.69	1.28	0.94
	Undesired-Desired	0.67	0.97	1.03	0.97	1.03	1.00
	Useless-Useful	0.81	1.17	1.08	0.97	1.33	0.89
	Troublesome-Convenient	0.67	1.08	1.11	0.89	0.97	0.78
	Backward-Advanced	0.72	0.92	0.83	0.81	1.19	0.78
	Dangerous-Safe	0.61	0.83	0.92	0.86	0.97	0.81
Function 2	**Sample code**	**21**	**22**	**23**	**24**	**25**	**26**
	Dislike-Like	1.08	1.06	0.97	0.86	0.64	1.25
	Undesired-Desired	0.92	1.00	0.83	0.81	0.31	1.33
	Useless-Useful	1.11	0.92	1.03	0.94	0.61	1.39
	Troublesome-Convenient	0.89	1.00	0.83	0.83	0.39	1.42
	Backward-Advanced	0.92	0.83	0.89	0.75	0.56	1.31
	Dangerous-Safe	0.72	0.97	1.11	1.06	0.56	1.33

Table 4. The mean differences of each potential value.

Properties	Kansei words	Mean difference (Test value = 0)					
Appearance	**Sample code**	**1**	**2**	**3**	**4**	**5**	**6**
	Dislike-Like	1.222	0.972	0.500	0.111	0.667	1.028
	Undesired-Desired	1.222	0.972	0.472	−0.139	0.556	0.889
	Ugly-Beautiful	1.056	1.028	0.861	0.139	0.500	0.778
	Meaningless-Meaningful	1.194	1.000	0.444	0.083	0.556	1.000
	Outdated-Novelty	1.306	0.972	0.500	0.028	0.750	0.944
	Boring-Interesting	1.333	1.167	0.639	0.278	0.806	0.861
	Mean	1.222	1.019	0.569	0.083	0.639	0.917
Material	**Sample code**	**7**	**8**	**9**	**10**	**11**	**12**
	Dislike-Like	0.278	0.222	0.167	0.889	0.778	1.222
	Undesired-Desired	0.167	0.167	−0.083	0.833	0.778	1.194
	Uncomfortable-Comfortable	0.333	0.472	0.111	0.861	0.694	1.222
	Unhealthy-Healthy	0.583	0.667	0.389	0.806	0.583	1.139
	Dirty-Clean	0.417	0.528	0.250	0.778	0.528	1.000
	Boring-Interesting	0.444	0.333	0.278	1.028	1.000	1.417
	Mean	0.370	0.398	0.185	0.866	0.727	1.199
Smell	**Sample code**	**13**	**14**				
	Dislike-Like	0.889	0.778				
	Undesired-Desired	0.833	0.694				
	Dizzy-Refreshing	0.861	0.806				
	Harmful-Harmless	0.889	0.778				
	Mean	0.868	0.764				
Function 1	**Sample code**	**15**	**16**	**17**	**18**	**19**	**20**
	Dislike-Like	0.722	1.111	1.056	0.694	1.278	0.944
	Undesired-Desired	0.667	0.972	1.028	0.972	1.028	1.000
	Useless-Useful	0.806	1.167	1.083	0.972	1.333	0.889
	Troublesome-Convenient	0.667	1.083	1.111	0.889	0.972	0.778
	Backward-Advanced	0.722	0.917	0.833	0.806	1.194	0.778
	Dangerous-Safe	0.611	0.833	0.917	0.861	0.972	0.806
	Mean	0.699	1.014	1.005	0.866	1.130	0.866
Function 2	**Sample code**	**21**	**22**	**23**	**24**	**25**	**26**
	Dislike-Like	1.083	1.056	0.972	0.861	0.639	1.250
	Undesired-Desired	0.917	1.000	0.833	0.806	0.306	1.333
	Useless-Useful	1.111	0.917	1.028	0.944	0.611	1.389
	Troublesome-Convenient	0.889	1.000	0.833	0.833	0.389	1.417
	Backward-Advanced	0.917	0.833	0.889	0.750	0.556	1.306
	Dangerous-Safe	0.722	0.972	1.111	1.056	0.556	1.333
	Mean	0.940	0.963	0.944	0.875	0.510	1.338

4.3 The Differences in Attitudes of Parents Towards Each Potential Value

The differences in attitudes of parents towards the same potential value can be understood through an analysis of standard deviation. The lower the value of the standard deviation, the more consistent the attitude of parents. The results of standard deviation analysis for each potential value of children's luggage are shown in Table 5. The mean standard deviation of all potential values ranges from 0.908 to 1.460. This means that parents' attitudes toward the same potential value are relatively similar. The results showed that the standard deviation value of the potential value with a high mean value is low, while the standard deviation value of the potential value with a low mean value is high. This means that for the potential value of unpopularity, parents' attitudes are quite different. Therefore, designers should consider carefully whether the potential value with a higher standard deviation should be adopted.

Overall, the findings of this study indicated that parents liked children's luggage to have more novelty and versatility, as this kind of children's luggage will help meet the needs of parents in pursuit of high-quality travel and is fun for children. Silva [10] indicated that the product value concept was particularly crucial in the competitive markets. As a result, the findings of this study can provide new values that can improve the function of children's luggage, and the new children's luggage can support the sales of children's luggage and the development of the children's luggage industry.

Past research on Kansei Engineering methodology focused on increasing the existing values of a new product instead of creating the potential values for a new product. This study took on a new perspective of Kansei Engineering and this has enriched the efficacy of Kansei Engineering methodology. Therefore, the Kansei Engineering Methodology can be extended with the function of creating values for new products.

Table 5. Standard Deviation (SD) analysis for each children luggage property.

Properties	Kansei words	Standard Deviation (SD)					
Appearance	Sample code	1	2	3	4	5	6
	Dislike-Like	0.929	1.134	1.298	1.369	1.219	1.207
	Undesired-Desired	0.832	1.134	1.424	1.437	1.297	1.260
	Ugly-Beautiful	0.893	0.910	1.125	1.376	1.231	1.174
	Meaningless-Meaningful	0.920	1.121	1.182	1.339	1.252	1.219
	Outdated-Novelty	0.920	1.055	1.254	1.23	1.131	1.145
	Boring-Interesting	0.956	0.941	1.099	1.301	1.167	1.222
	Mean	0.908	1.049	1.230	1.342	1.216	1.205

Table 5. (*continued*)

Properties	Kansei words	Standard Deviation (SD)					
Material	**Sample code**	**7**	**8**	**9**	**10**	**11**	**12**
	Dislike-Like	1.365	1.588	1.342	1.214	1.222	0.959
	Undesired-Desired	1.276	1.577	1.317	1.276	1.267	0.951
	Uncomfortable-Comfortable	1.394	1.576	1.326	1.268	1.305	0.866
	Unhealthy-Healthy	1.36	1.373	1.178	1.283	1.381	1.018
	Dirty-Clean	1.402	1.253	1.317	1.198	1.362	1.121
	Boring-Interesting	1.182	1.394	1.365	1.183	1.331	0.937
	Mean	1.330	1.460	1.308	1.237	1.311	0.975
Smell	**Sample code**	**13**	**14**				
	Dislike-Like	1.26	1.267				
	Undesired-Desired	1.363	1.305				
	Dizzy-Refreshing	1.268	1.261				
	Harmful-Harmless	1.237	1.312				
	Mean	1.282	1.286				
Function 1	**Sample code**	**15**	**16**	**17**	**18**	**19**	**20**
	Dislike-Like	1.406	1.09	1.068	1.305	1.059	1.241
	Undesired-Desired	1.414	1.23	1.134	1.32	1.082	1.242
	Useless-Useful	1.489	1.183	1.105	1.207	1.042	1.369
	Troublesome-Convenient	1.474	1.228	1.141	1.237	1.253	1.376
	Backward-Advanced	1.279	1.204	1.082	1.215	1.037	1.222
	Dangerous-Safe	1.315	1.320	1.180	1.150	1.253	1.305
	Mean	1.396	1.209	1.118	1.239	1.121	1.293
Function 2	**Sample code**	**21**	**22**	**23**	**24**	**25**	**26**
	Dislike-Like	1.025	1.120	1.108	1.125	1.313	0.996
	Undesired-Desired	1.156	1.265	1.159	1.261	1.327	1.014
	Useless-Useful	1.008	1.228	1.108	1.145	1.315	1.076
	Troublesome-Convenient	1.166	1.195	1.207	1.231	1.379	1.079
	Backward-Advanced	1.156	1.183	1.166	1.156	1.229	1.037
	Dangerous-Safe	1.210	1.207	1.036	1.094	1.275	1.219
	Mean	1.120	1.200	1.131	1.169	1.306	1.070

5   Conclusion

This study used Kansei Engineering Type I to create new values for children's luggage. A total of 26 new values were identified for children's luggage through Kansei analysis. This can provide a reference for designing a new children's luggage to support the sales of children's luggage and the development of the children's luggage industry. Meanwhile, a framework for creating values for new children's luggage was formulated. The new application case in this study has enriched the utility of Kansei Engineering methodology.

The limitations of this study are that the selected potential values of children's luggage are limited because the consumers' preferences are too many and they are difficult to ascertain all the customers' preferences. Future research can focus on the systematic identification of full potential product values; hence, the framework to create values for a new product can be more effective, and the children's luggage as well as other kinds of product that are not selling well in the market can be developed.

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Key Clarity is Blue, Relaxed, and Maluma: Machine Learning Used to Discover Cross-Modal Connections Between Sensory Items and the Music They Spontaneously Evoke

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Abstract. Semantic differential is often used to investigate the relationship between music and other sensory modalities such as colors, tastes, vision, and odors. This work proposes an exploratory approach including open-ended responses and subsequent machine learning to study cross-modal associations, based on a recently developed sensory scale that does not use any explicit verbal description. Twenty-five participants were asked to report a piece of music they considered close to the feel/look/experience of a given sensory stimulus. Results show that the associations reported by the participants can be explained, at least in part, by a set of features related to some timbric and tonal aspects of music.

Keywords: Cross-modal correspondences · Sensory scales · Audio features · Sound and music computing

1 Introduction

Music, When Soft Voices Die, /Vibrates in the Memory –/ Odours, When Sweet Violets Sicken, / Live Within the Sense they Quicken. [1] An intriguing aspect of music is its capacity to elicit a rich number of sensations and images. Many studies have investigated the relationship between music and colors, tastes, vision, and odors, suggesting that people can exhibit consistent cross-modal responses in different sensory modalities [2–7].

According to Spence [8, 9], these connections can be explained by structural correspondences due to similarities of neural coding across modalities. However, the more complex and rich associations conveyed by sections and whole pieces of music are hardly explained by this interpretation. Correspondences may also develop through statistical learning: regularities in the environment – such as the fact that larger objects

tend to create louder sounds – would cause an internal link between the senses. Other correspondences may have a semantic origin: "high" pitches and "high" elevations use the same terminology, which could lead to an association between pitch and elevation. According to Schloss et al. [10], a mediating factor (emotion) can provide a more parsimonious explanation for the correspondences between music and color. Kansei models also investigate the connotative meaning of music: Sugihara et al. [11] characterized 12 music pieces from various repertoires by means of 40 pairs of Kansei words. Kinoshita et al. [12], using Osgood's semantic differential, investigated the implementation of a Kansei music selection system that automatically selects suitable music in car audio systems according to the external scenery.

One of the shortcomings of the semantic differential technique is related to the difficulty to grasp the denotative meaning of language. By "denotative" Osgood [13] refers to the descriptive use of signs as contrasted with their emotive or affective use. In the sentence "we set a wall between us", the word "wall" is used to suggest a physical boundary, which is its denotative meaning, but it also implies the idea of an emotional barrier. Osgood's descriptive scales are more concerned with frequency of usage rather than dictionary meaning. Another limit of Osgood's semantic differential is represented by the question of sensitivity – the ability to reflect as fine distinctions in meaning as are ordinarily made. Can the semantic differential tease out nuances in meaning which are clearly felt but hard to verbalize deliberately?

In our opinion, sensory scales can represent a valid approach to understand the relationship between music and other sensorial experiences and may reveal a useful tool to investigate perceptual aspects of synesthesia and cross-modality in a low dimensional space [14]. Evaluation based on sensorial information seems to be not (or less) mediated by verbal association. In our previous experiments we compared the results obtained through the evaluation of musical excerpts by means of sensory and verbal scales [15]. One limitation is that we employed only musical excerpts taken from the classic repertoire and, only recently, we applied sensory scales to the evaluation of jazz music investigating the relationship between bebop and cool jazz [16].

A methodological risk of using experimenter-selected for rating via sensory scales is that given our nascent understanding of cross-modal responses to music, the experimenter may introduce uncontrolled biases in the selection processes, such as selecting music that contrasts in emotion, rather than because of possibly contrasting sensory experiences. In the experiment we reported here that we asked participants to freely associate sensory scales to musical excerpts without any limitation of repertoire. Participants were asked to watch, touch, lift and interact with various objects and to report spontaneously which musical pieces came to mind.

The aims of the paper are: (i) to check for each sensory item what unmediated musical characteristics were set forth; (ii) to validate the sensory scale with best generalization performance; (iii) to offer new insights in the field of cross-modal correspondences.

2 Experiment

2.1 Participants

Twenty five participants completed the study. The sample contained 17 females (68%), 5 males (20%), and 2 unspecified participants (8%). Age ranged from 18 to 48 years ($M = 25$ years, $SD = 6.8$ years). Participants were asked how many years they had played an instrument for (range 0–25; $M = 8.7$, $SD = 6.4$), how many years they had received training on an instrument (range 0–15; $M = 7.3$, $SD = 4.9$), and how many hours they listened to music in a day (range 0–6; $M = 2.9$, $SD = 1.4$).

2.2 Materials

The sensory scale used in this study (see Table 1) was developed to replicate to the extent possible the sensory scale developed at the CSC of University of Padova (see [17]). Due to Ethics limitations for the present study, one pair of items from the existing scale (Bitter-Sweet) was excluded, and a second (Cold-Hot) was modified so that it entailed two visual representations of temperature instead of cups of cold or hot water.

The objects were placed on a guide sheet (Fig. 1) which had images of each of the objects. The objects and the guide sheet were contained within a box, with the guide sheet printed on A3 paper in landscape orientation. Letters were placed on each object in discrete locations (e.g. the underside of the bottle) that matched with the items on the guide sheet, and doing so enabled participants to easily identify the sensory scale items and the correct pole orientation (i.e., which bottle equated to "C", and which equated to "D"). After pilot testing, we added a simple instruction on the guide sheet to make clear how the participant was to interact with each sensory scale item by using the text "look", "hold", "touch" and so on, being careful to reduce chances of the description potentially mediating the sensory experience. For example, the expression "feel" was avoided.

Table 1. List of sensory items used in the present study. Each item was part of a matched pair, labelled with two letters.

Item labels	Sensory scale poles	Description of items	Guided interaction
A–B	Cold - Hot	Images depicting a cold (A) and a hot (B) temperature. Dimensions of each: 4.3 cm × 4.3 cm	"Look"
C–D	Light - Heavy	Two plastic bottles wrapped in black tape, with one bottle empty (C – 5 g) and the other full of liquid (D – 600 g). Due to the tape, participants were not able to visually distinguish between the two bottles	"Lift"
E–F	Hard - Soft	A cylindrical piece of wood (E), and a cylindrical piece of polystyrene foam (F). Dimensions: 16 × 3 × 3 cm; 16 × 6 × 6 cm	"Hold"

(*continued*)

Table 1. (*continued*)

Item labels	Sensory scale poles	Description of items	Guided interaction
G–H	Orange - Blue	Images of the two colors (NCS notation: S 1080-Y70R [G]; S 2055-B10G [H]). Dimensions of each: 4.3 cm × 4.3 cm	"Look"
I–J	Tense - Relaxed	Two plastic, lidless boxes with a piece of wire attached across the opening (I), and a rubber band attached across the opening (J). In each case, black tape was used to cover the wire/rubber band so that participants were not able to visually distinguish between the two strips	"Press the strip"
K–L	Takete - Maluma	Images containing a computer visualization of the two visual forms Takete (K) and Maluma (L); see [4]. Dimensions: each 4.3 cm × 4.3 cm	"Look"
M–N	Smooth - Rough	Two strips of sandpaper, rated at N1200 (M) and N30 (N). Dimensions: each 15 × 10.5 cm	"Touch"
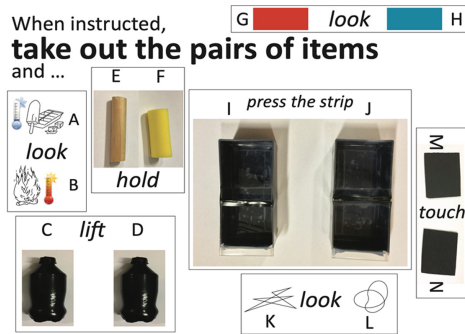
Fig. 1. Guide sheet for sensory scale (see https://www.dei.unipd.it/~canazza/ItemMapHD.pdf to download the HD photo).

2.3 Procedure

Participants were greeted by a lab assistant, completed an Ethics consent form, and were asked to wash their hands before entering the laboratory. They were seated at one of six workstations where they were asked to follow instructions on a computer, as presented by a survey that was created in Java programming language to randomize stimulus order and to collect responses. The room was quiet, and when the survey began participants were asked to try to work in silence, raising their hand if they had any questions. Questions were dealt with quietly and discreetly. Participants were initially presented with the following instructions via the computer survey:

This study is about your spontaneous musical response to a variety of stimuli. You will be asked to feel, lift, look at and/or experience a number of objects with the aim to see if any piece of music was spontaneously evoked in your mind. There are no right or wrong answers, and you can report whatever music comes to mind. You do not need to justify any of your answers. We do not expect you to have any reason at all for a piece of music coming into your mind, other than it occurred when you felt or experienced the object. Please do not use your hand-held device during the experiment.

The subsequent experiment was split into two sections. For Sect. 1, participants were given the below instructions. These instructions were repeated for each pair of items with labels as shown in Fig. 1 (in a randomized order). In this example we use the item pair A and B:

Take out of the box objects A and B. Feel them/look at them/experience them for a while. Imagine a piece of music that is as close to the feel/look/experience of the object A (in comparison to the object B). You may need to wait for a few moments until something comes to mind, or you may hear something that comes to mind instantly. Either way, try to be as relaxed and spontaneous as possible. Write down as much about the piece as you can, filling the following form. Leave blank if you have absolutely no idea. When you have finished, return the objects to their original location in the box and click Next/Submit.

For each item pair, response boxes were supplied for "Title", "Section", "Composer", "Artist/Performer", and "Any other general information". Once responses had been made for each item pair, participants progressed to Sect. 2. In Sect. 2 participants were asked for further details on each of the responses that they made in Sect. 1, to gain a better understanding of why the pieces came to mind (if any did). For each item pair, the responses the participant had provided in Sect. 1 were displayed on the screen to ensure accuracy (e.g., "For stimulus A [in reference to B] you reported the following details"). Participants were then asked "Which of the following best described the process of music coming into your mind", and selected one of the following responses:

1. No music came into my mind;
2. Music came into my mind spontaneously in response to the item and I cannot explain why;
3. Music came into my mind spontaneously in response to the item and I think I can explain why (Brief explanation);
4. Music came into my mind after some thought but I cannot explain what the thinking process was;
5. Music came into my mind, and after some thought I could explain what the thinking process was (Brief explanation);
6. If none of the above, please describe what you recall happened in your mind.

If response 3, 5, or 6 was selected, an extended response text box was provided. Following this, participants were asked "To what extent would you say the piece that came to your mind 'felt' like the feeling/experience of the object?" Participants responded with an 11-point scale, with 0 labelled as "Not at all", and 10 labelled as "Completely/Perfectly". Finally, participants were asked to enter any additional details for the piece of music they had entered in Sect. 1, including a Youtube link if possible. Headphones (Sennheiser HD280 Pro) were provided for participants to verify any links that they provided. This study received ethics approval (UNSW Human Ethics Approval HC190152).

3   Results

The YouTube links chosen by the subjects are available at http://www.dei.unipd.it/
∼roda/sensory/links.pdf. Starting from this list, a thematic analysis was carried out
separately by three researchers in order to highlight those musical pieces selected by
participants without the mediation of visual, semantical or autobiographical aspects.
For the question concerning the process of music coming into the participant's mind
(see above), responses were discarded if either no answer was selected, or the response
"1. No music came into my mind" was selected. This left a remaining sample of 20
participants. As a result of this selection, 61 responses of 132 (46%) were considered
by experimenters as spontaneous/unmediated. In addition, in 25% of cases participants
could not explain why they made the response they did (sum of items 2 and 4), and in
56% of cases participants explicitly described the experience as being spontaneous
(sum of items 2 and 3).

Each participant's response represents a cross-modal association between a sensory
item and a musical piece. The goal of the following analysis is to understand if the
pieces associated to the same sensory item share some characteristics that can explain
this association. A fully automated analysis method based on machine learning tech-
niques was implemented. This method, already used in literature (see e.g. [18]), allows
the quantitative analysis of a great amount of data, using many advanced tools
developed in the last few years by the machine learning scientific community. The
audio signals of the selected pieces, with the data extracted from the participants'
responses, were processed according to the following pipeline: a) data augmentation
was required to have an adequate number of samples for the training phase of the ML
algorithm; b) for each sample a set of numerical features was calculated; c) various ML
models were tested to identify which was the most effective in representing the asso-
ciations between music pieces and sensory scales; d) finally, the most effective features
were selected, following a Sequential Forward Selection approach.

Pre-processing: Data Augmentation. To increase the statistical power of the results, a
preliminary phase of data augmentation was followed, as suggested in all the cases
where the observations are not numerous enough in relation to the number of studied
dimensions [19]. This entailed (a) addition of white Gaussian noise, (b) application of
low and high pass filters, and (c) splitting of the music pieces into frames. First of all,
due to the addition of zero mean and 0.05 standard deviation white Gaussian noise, the
number increased going from the original set of 61 music samples to the new set of
122. Then, a filtering process, in which an optimal order high pass elliptic filter with a
cut-off frequency of 2000 Hz and an optimal order low pass elliptic filter with a cut-off
frequency of 200 Hz (both with 95% ripple in Bandpass and 5% ripple in the Band-
stop) were applied. This allowed the music pieces to increase from 122 to 366. Finally,
due to the splitting of each music into frames of 15 s, overlapping each other by 5 s,

the number of 8376 music excerpts was reached. Frames characterized by the presence of applause, silence or other elements not belonging to the original music were deleted to avoid outliers.

Features Extraction In the feature extraction phase, the datasets relating to each pair of sensory scales were created. The 'MirFeatures' function relating to the MIR Toolbox version 1.7 [20] was applied to each 15 s length excerpt from the 8376 ones obtained as explained in the previous paragraph, obtaining the 60 features listed at http://www.dei. unipd.it/~roda/sensory/features.pdf, a set largely used in the Music Information Retrieval field [21].

Model Selection. In the Model Selection phase, the performances of several machine learning algorithms, useful for the classification of the music excerpts as associated to one of the sensory scales, were assessed through the datasets coming from the experiment described in Sect. 2. The used classifiers were: K-Nearest Neighbor, Random Forest and Support Vector Machine (SVM). Each dataset related to a pair of sensory stimuli was divided into two complementary subsets: approximately 75% for the Training Set and 25% for the Test Set. For each of the classifiers, models with different hyperparameters were created: in the K-NN, the number of neighbours and the distance used in the metric space were changed; in the SVM, different kernels (linear, quadratic, cubic, and Gaussian) were used; in the Random Forest, two different values (30 and 100) were used as number of trees. Finally, the performances of the various models were measured for each pair of sensory scales on the remaining portion of approximately 25% of the Dataset. The accuracy of the various models in the prediction of independent observations is shown in Table 2.

Features Selection. The features selection phase has been done through the use of Sequential Features Selection (SFS). As SFS nature is Wrapper type, it was necessary to select one between the previous classifiers. In agreement with Table 2, it was decided to combine the musical features selection algorithm with Linear SVM, as the one with globally better performances of classification. In fact, no pair of sensory classes was characterized by an accuracy level below 70%, obtaining the 100% for one pair, and near to 100% in the other two pairs of classes. The entire datasets were used for the application of sequential features selection. At each iteration, the algorithm added a new feature, starting from an empty set, based on the impact on the performances that the adding operation has on the calculation of the mean error of a 10-fold cross validation. At the end of the execution, all the musical characteristics prior to the one found in the elbow of the cross validation error curve were chosen. Table 3 shows the selected features for each pair of stimuli.

Table 2. Classifier performance in the Test Set.

	A–B	C–D	E–F	G–H	I–J	K–L	M–N
NN Euclidean	0.98	0.72	0.89	0.80	0.90	0.82	0.61
10-NN Euclidean	0.75	0.55	0.79	0.61	0.97	0.77	0.54
NN Cosine	0.99	0.74	0.93	0.83	0.94	0.82	0.67
10-NN Cosine	0.83	0.54	0.80	0.66	0.98	0.77	0.55
Linear SVM	1	0.72	0.99	0.73	0.99	0.75	0.72
Quadratic SVM	0.92	0.73	0.91	0.66	1	0.83	0.68
Cubic SVM	1	0.60	0.96	0.68	0.98	0.82	0.42
Gaussian SVM	0.84	0.45	0.73	0.54	0.99	0.79	0.40
RF - 30	0.98	0.62	0.90	0.48	1	0.83	0.52
RF - 100	0.99	0.58	0.85	0.54	1	0.85	0.53

Table 3. List of selected features for each pair of sensory stimuli.

	Features selected
A–B	spectral.mfcc.Mean [4] - fluctuation.peak.PeakMagMean - tonal.hcdf.Mean - spectral.mfcc.Mean [5] - spectral.skewness.Mean - spectral.mfcc.Mean [7]
C–D	tonal.hcdf.Mean - spectral.mfcc.Mean [2] - spectral.mfcc.Mean [10] - spectral.mfcc.Mean [6] - spectral.mfcc.Mean [9] - spectral.mfcc.Mean [8] - spectral.mfcc.Mean [1] - spectral.skewness.Mean
E–F	spectral.mfcc.Mean [2] - spectral.mfcc.Mean [6] - spectral.mfcc.Mean [10] - spectral.irregularity.Mean - spectral.ddmfcc.Mean [6]
G–H	tonal.keyclarity.Mean - spectral.irregularity.Mean - tonal.chromagram.peak.PeakMagMean - fluctuation.peak.PeakMagMean - spectral.centroid.Mean - spectral.mfcc.Mean [12] - spectral.mfcc.Mean [7] - spectral.mfcc.Mean [2] - spectral.ddmfcc.Mean [13] - spectral.mfcc.Mean [13] - spectral.flatness.Mean - tonal.chromagram.peak.PeakPosMean
I–J	fluctuation.peak.PeakMagMean - tonal.keyclarity.Mean - spectral.mfcc.Mean [2] - spectral.mfcc.Mean [9] - timbre.spectralflux.Mean - spectral.mfcc.Mean [7] - spectral.spectentropy.Mean - spectral.mfcc.Mean [13]
K–L	tonal.keyclarity.Mean - fluctuation.peak.PeakMagMean - spectral.centroid.Mean - spectral.mfcc.Mean [5] - tonal.chromagram.centroid.Mean - spectral.dmfcc.Mean [6] - tonal.chromagram.peak.PeakPosMean - spectral.roughness.Mean
M–N	tonal.hcdf.Mean - spectral.mfcc.Mean [2] - spectral.irregularity.Mean - timbre.spectralflux.Mean - timbre.zerocross.Mean

4   Conclusions

A perceptual experiment was carried out to study cross-associations between music and other sensory modalities, such as touch and vision. The experiment used a recently developed sensory scale that does not use any explicit verbal description. Participants' responses were analyzed following an approach based on machine learning techniques.

Results show that algorithms trained on the experimental data are able to predict, with an accuracy greater than 70% (see Table 2), the associations between music and other sensory stimuli, showing that such associations can be explained, at least in part, by a set of quantitative features directly extracted by the music excerpts. In particular, according to Table 3, Mel Frequency Cepstral Coefficients (MFCC), which are a set of features related to the spectral envelope, are involved in all the classification tasks, implying a relevant effect of timbre in mediating the cross-modal associations with music. Moreover, the Harmonic Change Detection Function (HCDF), related to more or less rapid changes of the tonal harmony, appears to be involved in the association with Cold-Hot, Light-Heavy, and Smooth-Rough; whereas Key Clarity is involved in Orange-Blue, Tense-Relaxed, and Takete-Maluma. Future work will include the comparison with other verbal and non verbal scales and an analysis of the influence of factors such as musical training and personality [22].

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Kansei Research and Emotion Design in China

The Study of Interface Design for Museum Mobile Learning from the Relationship Between Visitor's Behavior Needs and Information Transmission

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Abstract. The study is focus on the analysis of interface design for museum mobile learning between the visitor's behavior needs and information transmission. When we design learning environment system within the museum including exhibitions, objects, tour guide, education activity etc., the whole museum design should be considered about the user-friendly learning environment as a whole system to reduce visitor stress within the museum and to help visitor avoid museum fatigue. So, it's important to museum for how to avoid the visitor's cognition differences between the visitor's behavior needs and information transmission. This study would try to propose the principle of interface design for the museum mobile learning system.

Keywords: Interface design · User-friendly learning environment · Museum mobile learning

1 Introduction

When a museum visitor enters a large museum, what kind of visiting behavior will he take? Take the Museum of science and technology in Taiwan as an example. Suppose this visitor has three ways to do it:

1. If he wants to visit the museum in detail one by one, there are ten exhibition halls in the museum. Each hall has 20 exhibition units, and each exhibition unit takes five minutes to estimate. It will take him 16 h and 40 min to see the whole museum, which is almost impossible for ordinary visitors.
2. If he has only four hours to visit, then for the same example, if he wants to see the whole museum, each display unit can only stay for one minute and twelve seconds.
3. If he has only two hours to visit, it is estimated that each exhibition unit will take five minutes to complete one and a fifth of the exhibition hall.

The first and second ways above will lead to a kind of visiting model. It doesn't help museums or visitors. The third way depends on the design of Museum mobile learning system to achieve the best learning effect. However, how to use limited space and time to transmit unlimited guide information to museum visitors? That needs some

method to solve it for museum. Museums are one of the most important institutions providing students with the opportunity to gain knowledge, experience cultures, and develop different interests in an informal learning setting. Technology now is playing a significant role in museum learning. Due to the development of more advanced technology in wireless communication in recent years, wireless or mobile devices, such as personal digital assistant (PDAs), tablet PCs, and cell phones have been introduced into educational fields [1]. The mobility and powerful computing functions of mobile devices provide an opportunity to allow each student to have his/her own device in an educational context [2, 3].

The concept of mobile learning was proposed by Revans from England in 1982 which has been more than 25 years [4]. Revans [4] offers an iterative model, successively alternating experience and preparation/reflection, which is a useful paradigm for mobile learning [5]. However, scholars perceive mobile learning in different ways. The following section contributes to various explanations of mobile learning by international scholars: m-learning is e-learning through mobile computational devices: Palms, Windows CE machines, even your digital cell phone [6].

Mobile learning is a context-based learning by using mobile technology medium and is learner-centered. The flexibility of mobile learning in a proper location allow learners to interact with other learners and instructors and conduct technology learning, content learning or context-based learning that is proactive, instant, distant/approximate, individual or group-centered. Moreover, learner will experience meaningful knowledge construction through this process [7].

2 Related Literature

2.1 Visitors' Behavior in Museum

The use of technology and digital artifacts to guide and inform museum visitors takes place in an environment of architectural and exhibition space. After the end of the eighteenth century and the beginning of the nineteenth century, the type of building used gradually became more specific to the purpose of the museum. Since the beginning of the twentieth century is the form of the museum building has reflected the importance place present on its functions more than had happened in the past.

In order to attract a large audience to visit the museum in the twentieth century, the museum building needed flexible exhibition spaces and various ways to get the natural light indoors to make people more comfortable while they are in the museum environment [8]. In order to improve the visitors confidence during their visit to the museum, there should be an effective, clearly delineated route and information as a primarily task to reduce visitors stress within the museum environment. The museum atmosphere is also important as their needs to be an interconnection between the visitor's emotion and the museum environment [8–10]. User-centered architectural and digital design can help visitor avoid museum fatigue.

Perception, cognition, experience and interpretation are essential factors of the visitor experience. When people visit a museum, they firstly apply their personal perceptions and understanding to the object that they are interested in, then, through the

particular interpreter or relevant explanation labels around the exhibition, they add to their knowledge of that object and integrate their newly acquired specialized knowledge into everyday life.

Falk and Dierking [9] suggested that interactive experience in the museum is at the intersection of three dimensions: personal context, social context and physical context. These interact with the visitor's perspective to explain the experiences of visiting the museum. Personal context incorporates a variety of experience and knowledge of the content and design of the museum, and also includes the visitor's interests, motivations and concerns. Social context is a phenomenon, because people visit the museum in a group, i.e., adults in family groups and adults in adult groups, or children on school field trips and visiting with their families; and physical context include the architecture and feel of the building, as well as the objects and artifacts contained within.

What are the real needs of the visitors when they visit the museum again? According to the survey of museum visiting behavior, can they meet the demand of audience? As an informal educational institute, the science museum with its unique and specialty provides visitors typical informal learning experience. Serrel [11] asserted that good exhibition should be visitor-centered and he also pointed out three criteria for visitor-centered exhibition, such as visitors are able to orientate themselves quickly and consciously. Most researchers clarify that the definition of museum learning, and declared the human constructivism can be the theoretical foundation of museum learning. In spite of the various definition of museum learning, while comparing with formal learning, there are remarkable differences between museum-based learning and school-based learning [9, 12].

Table 1 concluded that the characteristics of museum-based learning have four aspects: the learners, learning pace, learning pattern, and learning context [9, 13].

Table 1. Characteristics of museum-based learning.

Aspects	Museum based learning
Learners	For whole ages without limits For whole citizens
Learning pace	Visitors make choices without time-bound and schedule restriction
Learning pattern	Exploring, self-directed learning, and visitor-centered
Learning context	With designed environment and exhibition, object oriented, activities and hands-on

In 1987, there are eleven famous museums in the United States participated in a research project "insights museums visitors attitudes and expectations". It was found that the reasons for people not visiting museums are as follows:

1. Possible sense of oppression given by the Museum: because the museum itself does not understand art, lacks the ability of appreciation, and believes that the people who visit the museum have art knowledge, which is the gathering place of

upper-class people, resulting in a sense of oppression, resulting in a mentality of not willing to visit the museum.

2. Lack of awareness: most of the non- visitors do not know the exhibitions and works of art of the museums in their areas, and are not sure whether the visiting museums can make them feel interesting.
3. No time: it takes about one to two hours to visit the museum at a time, while the leisure time of the people is not much, which makes it impossible to visit.
4. Lack of interest.
5. Poor location.

2.2 Digital Museum

With the development of information technology, the exhibition, collection, education, research and other functions of general museums are presented in a digital way [14]. Gillette [15] proposed that the combination of technology and art can provide the general public with quick and convenient tools to obtain information about art works and enjoy happy art experience. Therefore, the development of digital museums, combined with information technology and knowledge denotation, can provide the public with more knowledge connotation.

Different from the limitations of general museums due to architectural or other environmental factors, digital museums provide multiple access links on each web page, and users have absolute autonomy in the arrangement of visiting routes [16]. "User autonomy" is not only reflected in the choice of visiting routes, but also in the fact that visitors may end their browsing at any time. Due to the lack of time and space restrictions on the website of the digital museum, visitors are free to arrange their visit time and conduct visit activities in any place where they can access the Internet without oppression, so they can attract people to visit the Internet. The digital museum will not only reduce the number of visitors, but also make up for the functional limitations of the traditional museum. A digital museum usually includes the following functions:

1. Digital Collection: Digital Museums expand the function of "collection" in general museums, making it easier for the public to acquire the knowledge of artifacts [16].
2. Digital display: at present, the common display forms include virtual exhibition hall and theme display.
3. Long distance teaching: in order to give full play to the educational function of the museum, the rich resources of collection, research and display are integrated by experts and combined with the teaching courses of schools at all levels, which are made into rich multimedia teaching resources. Teaching programs are downloaded on the Internet, or online two-way interactive teaching is provided in real time.

With the advent of information society, the concept of digital learning in museums has become an inevitable trend. In addition to the original web site museum introduction information, museums should also follow up the use of new technology, combined with rich collection resources, to create new values for museums. Today, the role of the museum is not only to provide a tangible display for the local community, but also to make good use of the Internet bits to transmit the museum's education resources to all corners of the world. Museum learning is a place of life, happiness and

interaction. But what kind of mobile learning content should be provided to our people in the next century's museum?

As modern culture rapidly advances from analog to digital media and from atom to bit, the role of Science Museum in the collection of objects has changed. Through the reproduction and reproduction of exhibits, information and communication technology will become more important for the creation, sharing and preservation of Museum cultural resources. The presentation concept of museum should include the following views:

1. The museum not only shows the history, evolution, application and influence of an exhibit, but also expresses the internal situation and concept.
2. Display should be a form of full participation in feedback, not only eye interactive or pushing button interactive.
3. The exhibition should encourage the visitor to participate in the interaction of each other, not just the interaction with the machine.
4. The display should guide the visitor to observe, feel, experience and explore with their perceptual perception of joy, anger, sadness and joy.
5. Use scientific methods to build learning model for problem solving and hands-on exhibition.
6. Provide exhibition contents for visitors of different ages and educational background.

However, does the concept of content presented according to the museum's physical display also conform to the design need of the museum in the development of mobile learning? I believe that the answer should be positive. In terms of digital exhibition and educational content planning, museum curator must think about the value of museums for the knowledge value-added. As mentioned above, the museum is a lifelong learning environment, a place to learn the history, art and science, a place to create knowledge imagination, a place to explore the progress of science and technology, a place for hands-on learning, a place to connect the museum's global village, so that educational resources around the world can be reproduced here. To reach the goal, the study tries to propose principles for how to create these learning environments and provide audiences with an ideal digital display and educational content.

3 Principles of Interface Design of Mobile Learning in Museum

According to perspectives introduced above, three principles of digital exhibition development can be generalized as follows.

3.1 The Content of Exhibition is the Key

Exhibition goals and target visitors (adults, adolescents or children) shall be set during planning and designing stage. New medium technologies keep innovating and developing along with the evolvement of educational technologies. However, no single medium can be referred to as the best [17, 18]. A medium itself is nothing but a tool for communicating information [19–22].

This is not an important factor that can influence the achievement of educational goals for exhibitions, while it is the content design that will affect the results of teaching and learning. Gayeski [23] proposes that:

1. To recall relevant key experience through proper representation methods.
2. To provide contents so that visitors will find useful in their daily lives.
3. To point out clearly teaching goals.
4. To facilitate memorizing, contents shall be presented as introduction, key points and conclusions.
5. Contents shall be structured with proper paragraphs and sections.

3.2 Mutual Interactions in the Communication Between Human and Computers

Friendly communication lies in the fact that both sides are able to express their own views and have mutual understanding of the subjects that both feel interested in. If there is only one-way communication, information receiver will not be able to give any feedback. This is also true with digital exhibition in museums which also need two-way information communication.

An interactive communication behavior full of "actions" ought to be real time and easy to understand, so that the mood for communication between man and computers can be encouraged. Hsien-Hui [24] proposes six principles in his Introduction to Interactive Multimedia:

1. Be able to conduct two-way interactive communication;
2. Be able to conduct real time communication with the sense of presence;
3. With contents easy to understand;
4. With contents easy to search for;
5. With pleasant visual effects;
6. All performance gives a synergy effect that will constantly enhance the mood for communication between man and computers.

3.3 Visitors' Capability of Operating User Interface Property

When a visitor comes to a museum website, they have only the interface to tell them what the site has to offer and how they can make use of it. If the interface is not clear, your audience might not be able to make it to your content. If the interface is not engaging, your audience might not be motivated to try. There are several phases and processes in the user interface design some of which are more demanded upon than others depending on the project [25].

1. Functionality requirements gathering – assembling a list of the functionality required of the system to accomplish the goals of the project and the potential needs of the users.
2. User analysis – analysis of the potential users of the system either through discussion with people who work with the users and/or the potential users themselves.

3. Information architecture – development of the process and/or information flow of the system.
4. Prototyping – development of wireframes, either in the form of paper prototypes or simple interactive screens. These prototypes are stripped of all look and feel elements and most content in order to concentrate on the interface.
5. Usability testing – testing of the prototypes on an actual user.
6. Graphic Interface design – actual look and feel design of the final graphical user interface (GUI). It may be based on the findings developed during the usability testing if usability is unpredictable, or based on communication objectives and styles that would appeal to the user.

From the view of usability, [26] thinks that there are five attributes to follow:

1. Easy to learn: The user can quickly go from not knowing the system to getting some work done with it.
2. Efficient to use: Once the user has learned the system, a high level of productivity is possible.
3. Easy to remember: The infrequent user is able to return to using the system after some period of not having used it, without having to learn everything all over.
4. Few errors: Users do not make many errors during the use of the system, or if they do make errors they can easily recover from them. Also, no catastrophic errors should occur.
5. Pleasant to use: Users are subjectively satisfied by using the system; they like it.

When both of exhibition contents and interactive effects have met the requirement, we need to consider whether visitors are able to use operation interface and functions. To avoid making a mistake, according to [24] the Principles for Design of Web Interface can be good references for digital exhibitions in museums to follow those including layout, color scheme and context design:

1. The color of script shall be distinctive against the background color with proper font size. Font 16 is recommended for Chinese characters.
2. User interface in captions, icons and fonts shall be consistent. Captions shall be represented in a uniform and not-too-fancy manner. Font types shall be limited to three.
3. Standardized operation factors shall be effectively employed and avoid too many types of operation interface.
4. Description information shall be solid with not-too-loose layout design.

About the page layout, [27] further generalizes the three main criteria in optimizing a page layout for a certain screen size as follows:

1. Initial visibility: Is all key information visible above the fold so users can see it without scrolling? This is a tradeoff between how many items are shown vs. how much detail is displayed for each item.
2. Readability: How easy is it to read the text in various columns, given their allocated width?
3. Aesthetics: How good does your page look when the elements are at the proper size and location for this screen size? Do all the elements line up correctly – that is, are captions immediately next to the photos, etc.?

4 Conclusion

In regard to learning motivation, researchers have attempted to identify important factors that would influence learners' motivation. According to [28], if an article aims to be interesting and easy to be remembered, the content has to include surprising messages, goal-directed activities, and parts that can relate to readers. In addition, [29] also proposed that situated interest, such as novelty, character identification, and life themes played significant roles in motivating learning.

These aforementioned characteristics are often associated with affection factors which evoke readers' emotions of being surprised, fresh, curious, and touched while they are reading the article. However, [30] argued that simply using these characteristics to stimulate learners' emotional arousal might not enhance learning. On the other hand, if learners, after reading, are able to use the article content to find an appropriate position in their own knowledge structure, then they can acquire comprehension which might help the readers gain more interest. Kintsch [30] called this type of interest "cognitive interest".

In order to promote cognitive interest in museums, one can design a guide system for learning pattern and learning context which incorporates adjuncts such as abstract information about exhibits, outlines of exhibitions, or pictures to assist visitors in attaining deeper understanding about the exhibition being visited. By providing these adjuncts to visitors, digital museum will not only be able to increase visitors' interaction with exhibits, but also will be able to facilitate the visitors' cognitive interest – that is, by providing visitors with such an adjunct, they had the opportunity to explore related aspects of the exhibits.

The role of the museum has gradually changed from the past, with its use of collections and exhibitions only, to the current expansion into the areas of recreation and education. A systematic mobile learning system can optimize the relationship between the museum's public relations, education functions and research development; whilst at the same time it can also bring out visitors' interests to ensure an enjoyable visiting experience during the mobile learning process in the museum. An effective mobile learning system acts as a mediator; it can establish the inter-relationship between the museum and the visitor. It can also enforce the exhibition and education function in the museum.

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A Study on Teaching Method for the History of Industrial Design

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Abstract. Industrial Design History is a basic course in industrial design college. It allows design students to develop products with greater insight as it relates to the historical perspective of the users. In Industrial Design History courses, teachers' research methods in combination with new-generation designers and designers throughout history will achieve this goal. Despite the prevalence of industrial design history knowledge, there is still a lack of studies which address industrial design history education, which needs to be reflected upon. In this way, industrial design history teaching methods can be integrated into design education and practice. The purpose of this study is to show a case study in industrial design history teaching method "from styling perception to styling creation". In the past 15 years, there has been considerable development of critical literature about design. Journals such as Design Issues, The Journal of Design History, etc., have demonstrated that design is a subject that can sustain critical discourse just as well as art, architecture, or literature. The conclusion includes a summary of key findings on the teaching of industrial design history. The significance of this case study is to further research into teaching methods of Industrial Design History as well as providing a common frame for the course.

Keywords: Design history · Design education · Styling perception

1 Introduction

Most of industrial and product design education originated from the late 19th century and design history has been considered essential to the students. Some approaches to teaching great works of canon have included presenting a design history. Design history course provides a profound knowledge base for the field of study. It exposes the complexities in the social contexts in which design is produced, and offers a chronological understanding of design evolution so as to evoke design students' critical viewpoints. This case study will address students' learning quality of Industrial Design History and Product Design. The assessment of this study relates to larger narratives surrounding the best practices in learning and teaching. This study will be addressed in three steps; (1) Assign works for creation of specific history appealing. (2) Establish recognition: specific history styling identity and (3) Analyze the descriptions of design works. The most important part is the second step, where the students need to match the specific historical constraints or to identify essential and specific historical styling, establish and search for the principle of styling solutions, and evaluate the aesthetic intent of the designers.

2 Apply "Learning by Doing" in Design History Course Class Works

John Dewey [1] produced pedagogical theories, stating that the action of "doing" offered more learning experiences than "telling." The way that Industrial Design History was taught thoroughly or leaned on history for re-production, was reconsidered in light of Dewey's theories on learning by doing. There are many different approaches to teaching design history, such as the means of assessment that have been placed in the school's curriculum progression which may terminate decisions that have been made. Teachers come from different backgrounds, such as Industrial Design, Art History, and Hand Craft. Therefore, they may approach the history class differently.

As a framework to evaluate these practices, this study will be comparing practices in design education with established methods of effective pedagogy specifically, or teaching and learning more broadly, which results from the fields of cognitive science, and "posits the centrality of problems in learning," where the particular problem is based on learning; and constructionist pedagogy, which stresses that "knowledge is anchored and indexed by relevant contexts". Both of these approaches and evaluations rest on larger ideas put forth by John Dewey [1], who emphasized "education based upon experience" as the best practice for positioning new knowledge for meaningful integration in students' minds.

Most professors favor a course centered on chronology, and this choice seems to be independent of the fact that the students are designers, but rather it relates more to general methods of effectively communicating history course content to any audience [2]. To better the relationship between Industrial Design History and the education of a design student, design history teachers must build stronger connections between the relevancy of industrial design history lesson contents with student's studio practice [3]. However, the education of design history is much more complicated. We see the design history course's goal is to achieve a greater perspective for students. For example, more students are involved in product design, and acknowledge the importance of design history. But how teachers evaluate students' learning quality is still a major concern.

2.1 Assign Class Works for Creation of Specific Design History Appealing Products

Despite the fact that a majority of design history courses had indicated it combined both verbal and pictorial style of learning, it was observed that students were able to comprehend material better when concepts were presented with an emphasis on visualization rather than verbal lecturing. One possibility that explains these findings is that students are not solely visual or verbal learners, rather they use both senses to digest information and tend to exhibit a preference for one method over the other [4]. Another possibility is that the design history course dictates how it must be presented. In the case of design history course, it is possible that visuals are necessary to convey concepts and the various relationships between them [5]. This may be the case because working with the product design department requires the identification of particular visual information.

This research was mainly conducted in the Department of Industrial Design in a state-owned university in Guangdong Province in June of 2018. In correspondence with the curriculum arrangement, 54 participants were sophomore students who took Industrial Design History courses. At the end of the term, students are required to hand in their design assignments. These assignments require students to demonstrate certain styles of design history. Finally, students will evaluate and appreciate each others' works to clarify the design style and feelings of audiences.

2.2   Assignment Framework

The assignment framework is listed as Table 1. The first column is electronic devices and appliances we use nowadays. The first horizontal line indicates 10 most common styles which are mentioned in design history since the Arts and Crafts Movement. Through cross-references, 30 design themes were selected. Students drew lots to decide their design themes and they spent two weeks discussing the proposal. Then, they put forward a render graph and presented the designs.

Table 1. Assignment framework.

	Arts & Crafts movement	Art Nouveau	Deutscher Werkbund	De Stijl	Art Deco	Organic styling	Streamline	Pop Art	Memphis design	Post Modern
VR	2							24		
Power bank		4								
Robovac			6							
Electronic toothbrush				8						
Blue-tooth speaker	3				11		20			
Air cleaner		5				16				
Electric shaver			7				21			
Rice cooker				10		17		26		
Segway					12				28	
Router						19				30
Electric kettle							22		29	
Multi-outlet adapter					15			27		

Finally, 50 participants' assignments were all put together as a 2-m-high, 12-m-long design history poster in a timing sequence. Students were encouraged to exchange their opinions (see Fig. 1 and Fig. 2).

Fig. 1. Design history poster in timing sequence.

Fig. 2. Design history poster in timing sequence.

2.3 View Collection

Participating students should articulate the following questions:

a. What are the transparent characteristics of your selected style?
b. How will you turn the characteristics to your design scheme?
c. What are the most implicit characteristics of your selected style?
d. Except for your own design, which design work do you think can best demonstrate its style?
e. What are the differences between assessing your work by essays and by designing a scheme project in terms of evaluating the learning outcomes of Industrial Design history?

2.4   Participant Students' Feedback

Based on previous questions, specifically, Question e: What are the differences between assessing your work by essays and by designing a scheme project in terms of evaluating the learning outcomes of Industrial Design History? students who participated showed a positive attitude towards this assessment method. All students considered that compared with writing an essay, it is more practical to complete the designing scheme after learning Industrial Design History. Additionally, students claim that they have enough time to observe details of their works and try to recreate the desired results.

As for Questions a to d, it reflects how the students perceive and recreate. All the questions cannot evaluate students' learning outcomes objectively for the course Industrial Design History.

However, it undoubtedly reveals participant students' true feelings of different styles of designing. More specifically, Question d: Except for your own design, which design work do you think can best demonstrate its style? this question urges students to evaluate their peer's work. It shows the students' perception of the design content by means of evaluating each other's designs.

Here are some extracts of students' feedback:

Fig. 3. Bluetooth speaker in the fashion of Arts and Crafts Movement.

The designated theme is Bluetooth speaker in the fashion of Arts and Crafts Movement (see Fig. 3). The student's perception was embodied in the wallpaper, which incorporated flowers and plants patterns. In addition, he changed the original color of Arts and Crafts design and made it gray and white. This change was for the purpose of being more high-tech.

Fig. 4. Bluetooth speaker in the fashion of Arts and Crafts Movement.

The student who created the design in Fig. 4 was also given the same task – to design a Bluetooth speaker in the fashion of the Arts and Crafts Movement. This student has a totally different perception compared with the previous student. He thinks that for Arts and Crafts style, besides flower and plants pattern, a wooden texture should be incorporated as well. Thus, he puts more emphasis on demonstrating the wooden texture and metal knobs, in hopes it gives out a feeling of dating back to that generation.

Fig. 5. A router in the Deutscher Werkbund style.

The design theme for this student (See Fig. 5) is a router in the Deutscher Werk-bund style. This student really appreciated the teapot design made by Deutscher

Werkbund, especially the characteristics of the metal nails on the teapot. So, he incorporated this characteristic with the aim to convey this idea of an orderly-arranged feature of metal nails.
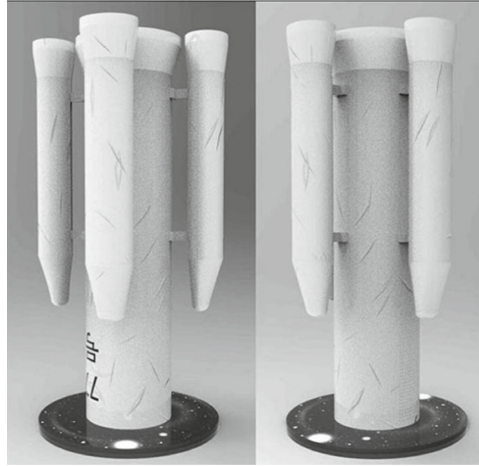
Fig. 6. The postmodernism air purifier.

This theme (see Fig. 6) is an air purifier in the fashion of postmodernism. He thinks postmodernism is to completely deny the existing viewpoints and to think it in a totally opposite way. He got his idea from rockets, which puff great clouds into the air that leads to air pollution. The upside down rocket with the nozzle spray cleans and freshens air to form an ironic image.

Fig. 7. The air purifier in Memphis style.

Figure 7 shows an air purifier in the Memphis style. Memphis style is featured as the combination of geometric figures. Additionally, each component has its own color. These components in different colors are just like building blocks joining together. In particular, the air-inlet grille forms white and black stripes, which is a main characteristic of Memphis style.

Fig. 8. Art Deco rice cooker.

This student chose an Art Deco rice cooker (Fig. 8). He feels the Art Deco is a way of showing off wealth. As such, he intends to use gold metal as the main element for designing a rice cooker. Furthermore, the sunlight pattern, with the metal texture in the fashion of Art Deco, fully demonstrates the flaunting of wealth.

2.5   Conclusion

In this case study, participating students' design works reflect their perceptions of certain styles of design history. Some students differ a great deal in terms of their perceptions of specific styles. Some are paying more attention to details, while some are feeling the spirits. Some perceive the texture of colors, whereas some are observing shapes or characteristics. By demonstrating their own design as well as observing their classmates' design works, students can have straightforward and transparent ways to get to know about various kinds of styles in design history via visual and physical learning methods.

3   Research Prospect

"From styling perception to styling creation" is the main topic of this research. Through the recreation of different styles in design history, students are evaluated by how they perceive design history. Even so, this kind of learning cannot assess whether students

fully and thoroughly understand the whole picture of design history. For instance, their understanding with regards to the sequence of historical events and time in a chronological manner, or the reciprocal effect among the design history, technology history, politics history and intellectual history, even for different style genres. These are all of great significance in design history. However, this research does not cover them. On the contrary, this study focused more on feelings and perceptions of designing instead of merely literal knowledge. Moreover, this study addressed how we can further apply the different styles in design history [6]. Even though the preliminary result has not been shown systematically, this teaching method can truly act as a medium for the perception of different designs between teachers and students. Through students' design works and their answers to questions, teachers can clearly know students' perceptions. Besides, teachers and students can have a concrete scheme for further discussion or extension to feelings or perceptions of specific designing style.

From now on, we appreciate suggestions from professionals, in constructing the characteristics of design history style and refining components and class organizations, in hopes of being more precise in teaching assessment methods in the Industrial Design History course in the near future.

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Exploring Environmental Distance Space from the Perspective of Cognitive Perception

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Abstract. The design of "public space" in terms of distance is often different according to the preferences of designers, and most of them make reference to "ergonomics" behavior as the basis for designing space. The "distance" element is seldom explored in the way of perceptual spatial experience. In this study, the subjects were tested to distinguish the effect of the degree of surrounding perception of distance and analyzed the difference in spatial cognition of distance. At the same time, it investigated the difference in spatial cognition of distance among different personalities and whether the spatial cognition of distance was consistent after a change in venue distance. The study site chose a large plaza area to facilitate the exploration of the perception of differentiation at different distances to and fro. It was found that subjects' spatial perceptions change with spatial distance, thus altering cognitive perceptions of previous distance. The results of the study showed that the subjects' perceived distance to a part of the surrounding perception tended to increase during the round trip measurement, suggesting that although the subjects could adapt to such a space, they could not relieve their spatial cognition from the surrounding perception. Therefore, when designing the distance of the space, attention should be paid to the perception of people, especially in "public space" areas or medical places. In the public space of long-term activities, the surrounding perception is the consideration of the design space to the content of the activities, and the appropriate distance is a necessary element and also a key factor in the design field.

Keywords: Environmental space · Perception and cognition

1 Introduction

The relationship between human beings and the environment is based on the nature of the "spirit of the field", which is the basis of "nature" as the starting point of value perspective in the environment, illustrating the connection between human beings and nature for mutual well-being [1]. The establishment of social culture is the relationship among human beings, and culture is established as extensions of the needs. In this cognitive context, landscape cognition and behavior are important, especially the integration of ecological bearing and art science in all directions. Inherent in the

characteristics of objects, the size of the real-world object affects how we allocate the attention associated with that object in space. The size of the object is the key to object recognition, and experiments have shown that the size of objects in the real world affects the allocation of visual attention; the observed real-world size effect is the result of attentional scaling, attention is the ability to adjust the size and density of the focus, and the perception of objects and their size is only minimally affected by retinal size [2]. Adams [3] proposed that 'space' extends the act of living and experiencing the interior and is used to describe a space in which people are allowed to move and roam as they wish. So the need for interior decoration unfolds, giving space planning design a considered direction.

Space is not scale-independent; in the case of the human psyche, this distinction is between "perceptual" and "cognitive" distance, and it is necessary to study spatial cognition in the context of the environment [4]. Spatial cognition is the structure of space, the knowledge of physical relationships, as well as the representation of cognition, the internal reflection and reconstruction of thought space [5] and perception represents the immediate presence of sensations that stimulate sensations in the brain [6]. Cognitive science is a new field that brings together the understanding of ideas from many disciplines including psychology, linguistics, anthropology, philosophy, and computer science [7]. Loomis [8] illustrated that perception of self-centered distance measurement is a topic of considerable importance for both visual and auditory goals, and it is also important for understanding many other topics involving distance perception. The interdisciplinary nature of cognitive science is part of its essence, and metaphor is a fundamental cognitive process [9], illustrating that metaphor is a fundamental component of human cognition, with many metaphors having spatial fields of discourse. Surrounding perception and cognition of space are defined as follows: intimate space (0–18 feet), personal space (18–48 feet), social space (4–12 feet), public space (over 12 feet), the size of space [10] less than 10 feet of external space seems to be somewhat small, 10–40 feet of outdoor space is intimate, 40–80 feet is a human scale, 80–150 feet has a sense of public scale, and space larger than 500 feet is beyond human scale. This study discussed the personality characteristics and the cognition of distance, and explored the perception of distance in a certain visual environment by the relationship between perception and cognition, and also express the feelings generated by different distances. The purpose of this paper is to give the designer a reference to design spatial distance and the appropriate adjustment of the scale of spatial distance as a necessary consideration.

2   Research Methodology

In this study, a set of cognitive imagery adjectives were employed as variables and analytical methods to explore subjects' spatial cognition, giving subjects an indicator to assess spatial imagery cognition.

2.1   Description of the Subjects' Background

Seven young people were selected for testing in this study. They are physically fit and have clear minds, definite perception and cognitive abilities. They all have a university degree and the background information is as in Table 1. (ABCDEFG is the name code of the person being tested).

Table 1. Background information.

Name	Gender	Education	Age	Height
A	Male	College	22	176
B	Male	College	22	170
C	Male	College	21	181
D	Male	College	22	172
E	Male	College	21	163
F	Female	College	21	162
G	Female	College	22	158

2.2   Description of Research Methodology

Each participant received a questionnaire with personality type test (Source: Deep Communication Power/Books) [11]: consisting of 15 questions with four answers each, in order of 1234. The questions were categorized according to their scores, and the question numbers correspond to the personality types: "1" for Power, Power type; "2" for Popular, Social type; "3" for Peace, Peace type; "4" for Perfect, Perfect type. Basically every person may have all four personalities. And the personality type with the highest number of statistical categories is the tester's dominant personality type [11].

2.3   Test Method

A single square was chosen as the test site, and the relative distance perceptions were divided according to the Richter 7 scale concept, as follows: P7 fully surrounding perception, P6 mostly surrounding perception, P5 partially surrounding perception, P4 feeling good surrounding perception, P3 less surrounding perception, P2 very little surrounding perception, P1 no surrounding perception. Subjects were faced with a solid wall at a height of 240 cm, and the perception test was performed on foot, first from far to near, then from near to far, to complete the experiment. Before each test, participants were asked to close their eyes first, remain calm for one minute, and when the subject is ready, open their eyes and call to start the test, accompanied by a companion to read the timed seconds record. Starting from a distance with no surrounding perception, walk in front of the wall and feel the surrounding perception in order of very little surrounding perception, less surrounding perception, feeling good surrounding perception, partial surrounding perception, most surrounding perception, full surrounding perception. Each stage of perception is the surrounding perception of the distance at which the

subject completes that perception, and then the distance is measured before it can be considered a completed subject test. In contrast, the subjects followed the above movements in order from full surrounding perception, most surrounding perception, partial surrounding perception, feeling good surrounding perception, less surrounding perception, very little surrounding perception, to no surrounding perception. We made a record of each subject's perception of distance sculpting based on their surrounding perception and complete the summary. The graphical comparison of EXCEL was quantified with SPSS, and the correlation performance was sought by linear regression analysis and Scheffe post-hoc comparison, using a Leica DISTO D5 handheld laser optical rangefinder.

3   Findings

Subjects' questionnaires and cognitive perception were recorded according to the research method (Table 2). (ABCDEFG is the name code of the person being tested).

Table 2. Subjects' personality bias scale.

Name\Title	Type1	Type2	Type3	Type4	Main character
A	3	2	4	6	4
B	0	1	12	2	3
C	3	5	3	4	2
D	7	5	2	1	1
E	1	3	6	5	3
F	3	5	7	0	3
G	6	1	1	7	4

As shown in the test, A personality trait is perfect, B personality type is peaceful, C personality trait is social, D personality trait is strength, E personality trait is peaceful, F personality trait is peaceful, G personality trait is perfect. By calculation, 1 person is the strength type, 1 person is the social type, 3 persons are the peace type and 2 persons are the perfect type, for a total of 7 persons. Table 3 below is a description of the personality types. Source from (deep communication books) [11].

Table 3. Different surrounding perception distance

Name/perception	P7	P6	P5	P4	P3	P2	P1
A from far to near	1.03	15.00	29.70	38.50	47.40	57.20	67.40
A from near to far	1.03	9.80	18.50	30.70	43.80	57.38	67.70
B from far to near	3.25	8.25	27.30	39.80	50.70	58.70	67.00
B from near to far	3.25	8.40	15.20	29.00	45.40	55.40	68.70
C from far to near	8.00	34.90	44.90	54.20	63.40	74.00	81.40
C from near to far	8.00	14.00	21.00	27.30	36.46	46.50	62.50
D from far to near	1.90	12.10	27.20	38.60	43.10	48.20	54.70
D from near to far	1.90	5.84	10.30	15.50	15.50	15.90	23.10
E from far to near	1.13	8.00	17.50	24.30	33.80	40.20	46.70
E from near to far	1.13	4.28	5.81	8.56	17.30	25.60	33.50
F from far to near	8.94	26.48	47.26	57.90	68.70	75.90	85.14
F from near to far	8.94	16.10	23.70	32.07	45.10	58.70	73.60
G from far to near	5.30	21.70	33.90	45.78	59.40	72.05	82.86
G from near to far	5.30	14.90	24.70	32.20	40.40	49.70	60.40

P = perception;   Fully   surrounding   perception = p7;   Mostly surrounding perception = p6; Partially surrounding perception = p5; Feeling good surrounding perception = p4; Less surrounding perception = p3; Very little surrounding perception = p2; No surrounding perception = p1

The distance perception and cognitive test results are shown in Table 3. (ABC-DEFG is the name code of the person being tested).

Linear regression analysis shown in the following Table 4.

Table 4. ANOVA.

Model	Sum of square	Degrees of freedom	Mean square	F	Distinctiveness
Regress	273.303	7	39.043	.430	.853[a]
Residual	544.411	6	90.735		
Total	817.714	13			

a. Strain number: height/cm, The results in Table 4 indicate an distinctiveness of 0.853›0.05, which means that there is no association between height and distance perception and perception. Significant performance needs to be less than 0.05

Post hoc multiple comparison unidirectional variation analysis shown in Table 5. (ABCDEFG is the name code of the person being tested).

According to Table 5, there is no definite relationship between personality type and the results of the distance tested. From the data of the study, Table 4 showed that the individual height of the subjects also showed no effect on distance perception and awareness. That is to say, the farther the distance of the surrounding perception, the greater the tendency of perception and cognition of each person in the visually visible

Table 5. Cognitive Relationship between Personality and Environment.

Strain number	(I) CH	(J) CH	The average difference (I-J)	Standard error	Distinct iveness	95% Confidence interval	
						Lower limit	Upper limit
Totally surrounding perception	Power	Social	−6.10	2.89	0.28	−15.74	3.54
		Peace	−2.54	2.36	0.77	−10.41	5.33
		Perfect	−1.27	2.50	0.97	−9.61	7.08
	Social	Power	6.10	2.89	0.28	−3.54	15.74
		Peace	3.56	2.36	0.54	−4.31	11.43
		Perfect	4.84	2.50	0.35	−3.51	13.18
	Peace	Power	2.54	2.36	0.77	−5.33	10.41
		Social	−3.56	2.36	0.54	−11.43	4.31
		Perfect	1.28	1.87	0.92	−4.95	7.50
	Perfect	Power	1.27	2.50	0.97	−7.08	9.61
		Social	−4.84	2.50	0.35	−13.18	3.51
		Peace	−1.28	1.87	0.92	−7.50	4.95
Mostly surrounding perception	Power	Social	−15.48	7.99	0.34	−42.13	11.17
		Peace	−2.95	6.52	0.98	−24.71	18.81
		Perfect	−6.38	6.92	0.84	−29.46	16.70
	Social	Power	15.48	7.99	0.34	−11.17	42.13
		Peace	12.53	6.52	0.35	−9.23	34.29
		Perfect	9.10	6.92	0.64	−13.98	32.18
	Peace	Power	2.95	6.52	0.98	−18.81	24.71
		Social	−12.53	6.52	0.35	−34.29	9.23
		Perfect	−3.43	5.16	0.93	−20.64	13.77
	Perfect	Power	6.38	6.92	0.84	−16.70	29.46
		Social	−9.10	6.92	0.64	−32.18	13.98
		Peace	3.43	5.16	0.93	−13.77	20.64
Partially surrounding perception	Power	Social	−14.20	12.47	0.73	−55.78	27.38
		Peace	−4.05	10.18	0.98	−38.00	29.91
		Perfect	−7.95	10.80	0.91	−43.96	28.06
Partially surrounding perception	Social	Power	14.20	12.47	0.73	−27.38	55.78
		Peace	10.16	10.18	0.80	−23.80	44.11
		Perfect	6.25	10.80	0.95	−29.76	42.26
	Peace	Power	4.05	10.18	0.98	−29.91	38.00
		Social	−10.16	10.18	0.80	−44.11	23.80
		Perfect	−3.91	8.05	0.97	−30.75	22.94
	Perfect	Power	7.95	10.80	0.91	−28.06	43.96
		Social	−6.25	10.80	0.95	−42.26	29.76
		Peace	3.91	8.05	0.97	−22.94	30.75
Feeling good surrounding perception	Power	Social	−13.70	14.56	0.83	−62.26	34.86
		Peace	−4.89	11.89	0.98	−44.54	34.76
		Perfect	−9.75	12.61	0.90	−51.80	32.31
	Social	Power	13.70	14.56	0.83	−34.86	62.26
		Peace	8.81	11.89	0.91	−30.84	48.46
		Perfect	3.96	12.61	0.99	−38.10	46.01
	Peace	Power	4.89	11.89	0.98	−34.76	44.54
		Social	−8.81	11.89	0.91	−48.46	30.84
		Perfect	−4.86	9.40	0.96	−36.20	26.49

(*continued*)

Table 5. (*continued*)

	Perfect	Power	9.75	12.61	0.90	−32.31	51.80
		Social	−3.96	12.61	0.99	−46.01	38.10
		Peace	4.86	9.40	0.96	−26.49	36.20
Less surrounding perception	Power	Social	−20.63	15.57	0.64	−72.55	31.29
		Peace	−14.20	12.71	0.75	−56.59	28.19
		Perfect	−18.45	13.48	0.62	−63.41	26.51
	Social	Power	20.63	15.57	0.64	−31.29	72.55
		Peace	6.43	12.71	0.97	−35.96	48.82
		Perfect	2.18	13.48	1.00	−42.78	47.14
	Peace	Power	14.20	12.71	0.75	−28.19	56.59
		Social	−6.43	12.71	0.97	−48.82	35.96
		Perfect	−4.25	10.05	0.98	−37.76	29.26
	Perfect	Power	18.45	13.48	0.62	−26.51	63.41
		Social	−2.18	13.48	1.00	−47.14	42.78
		Peace	4.25	10.05	0.98	−29.26	37.76
Very little surrounding perception	Power	Social	−28.20	16.34	0.44	−82.70	26.30
		Peace	−20.37	13.34	0.53	−64.87	24.13
		Perfect	−27.03	14.15	0.35	−74.23	20.17
	Social	Power	28.20	16.34	0.44	−26.30	82.70
		Peace	7.83	13.34	0.95	−36.67	52.33
		Perfect	1.17	14.15	1.00	−46.03	48.37
	Peace	Power	20.37	13.34	0.53	−24.13	64.87
		Social	−7.83	13.34	0.95	−52.33	36.67
		Perfect	−6.67	10.55	0.94	−41.85	28.51
	Perfect	Power	27.03	14.15	0.35	−20.17	74.23
		Social	−1.17	14.15	1.00	−48.37	46.03
		Peace	6.67	10.55	0.94	−28.51	41.85
No surrounding perception	Power	Social	−33.05	16.53	0.32	−88.18	22.08
		Peace	−23.54	13.50	0.43	−68.55	21.47
		Perfect	−30.69	14.31	0.27	−78.43	17.05
	Social	Power	33.05	16.53	0.32	−22.08	88.18
		Peace	9.51	13.50	0.92	−35.50	54.52
		Perfect	2.36	14.31	1.00	−45.38	50.10
	Peace	Power	23.54	13.50	0.43	−21.47	68.55
		Social	−9.51	13.50	0.92	−54.52	35.50
		Perfect	−7.15	10.67	0.93	−42.74	28.44
	Perfect	Power	30.69	14.31	0.27	−17.05	78.43
		Social	−2.36	14.31	1.00	−50.10	45.38
		Peace	7.15	10.67	0.93	−28.44	42.74

Power Natures = Power; Social Natures = Social; Peace Natures = Peace; Perfect Natures = Perfect; Characteristic = CH. Significance needs to be less than 0.05 to show that there is a significant difference in the relationship, if not, then there is no difference, it is of similar nature.

range was, but it was found that in the course of the test, the same people showed a great difference in the perception test from near to far and from far to near during the test. As shown in Figs. 1, 2, 3, 4, 5, 6 and 7, it is evident that in the perceptual distance process from (A) near to far surrounding perception and in the perceptual distance

process from (B) far to near surrounding perception, the comparison of the two showed that the perceptual distance from (A) relative to the point of surrounding perception is shorter, which presents the same results in all subjects. Obviously, when attention is focused on objects, the cognitive difference will change according to the degree of awareness and perception of the environment. To put it simply, as one becomes more aware of one's surroundings, one's perception of distance will be shortened. In the design field, it can be provided as a reference for the design of the area such as public areas or private sites. Table 4 illustrated that the average distance between people's perception of no surrounding perception P1 was 63.47 m, very small surrounding perception P2 was 52.53 m, small surrounding perception P3 was 43.6 m, feeling good surrounding perception P4 was 33.89 m, partial surrounding perception P5 was 24.78 m, most surrounding perception P6 was 14.27 m and fully surrounding perception P7 was 4.22 m. This paper suggests that "public space" design considerations should pay attention to the configuration of the space distance, in the stay or activity of the space design, at least for surrounding perception distance, it can be referred to the distance of the following Table 6, such as open space, chatting space, static activity
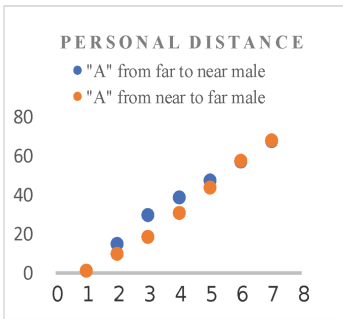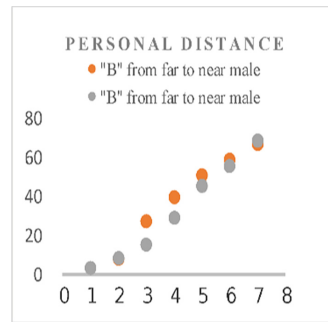

Fig. 1. A personal distance record.
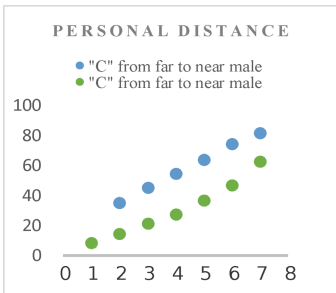

Fig. 2. B personal distance record.

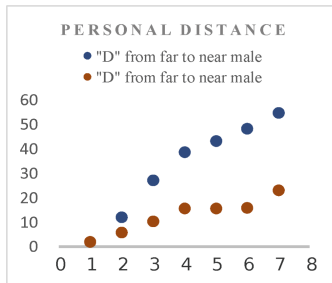**Fig. 3.** C personal distance record.

Fig. 4. D personal distance record.
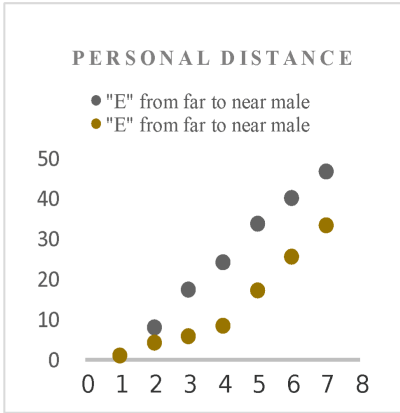
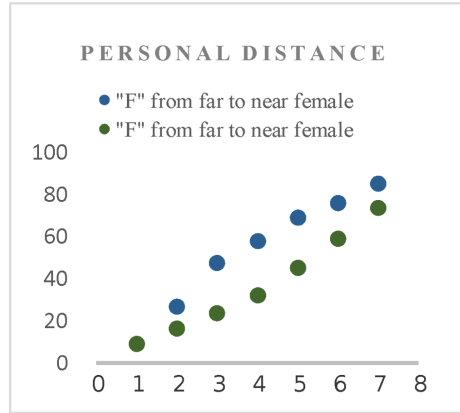**Fig. 5.** E personal distance record.

Fig. 6. F personal distance record.
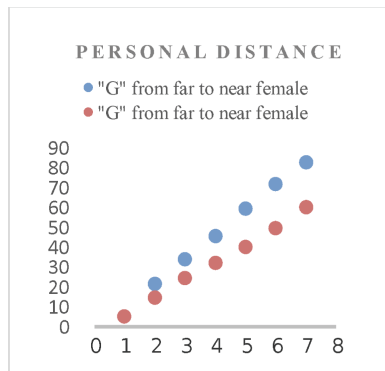
Fig. 7. E personal distance record.

Table 6. Surrounding perception distance reference.

DIS/perception	P7	P6	P5	P4	P3	P2	P1
Average distance reference	4.22	14.27	24.78	33.89	43.60	52.53	63.47

Unit: M.

space, dynamic activity space, transition space, meditation space, solemn space, retreat space, waiting space, experience space, etc. The goal of this paper is to provide design distance reference to the designer as a consideration for planning public space with different functions.

4   Conclusion

The results of the study showed that each person's body height with different spatial cognition did not affect the perception of distance. Spatial cognition changes over time and familiarity with the environment in a given spatial venue, indicating that people have a certain amount of adaptability and judgment in familiar environments. And that the idea of changing cognition according to the level of familiarity will make multiple self-corrections. However, the factor of comfortable distance is often overlooked by designers during the design of the building. Therefore, in the designer's mind, it is necessary to have the appropriate distance standards in the planning of the transition space, such as the public area or private regional venue design, or the residence activity for a longer period of time. Raising the standard of height comfort, especially in similar settings such as hospitals or nursing homes requires the standard of appropriate distance as a reference for spatial design distance. After all, the relationship between distance scale and people should be added and become an important reference value for thinking about environmental design planning. In conclusion, in the unfamiliar design environment and large-scale design planning, spatial awareness and cognitive considerations of the design are the main key elements. The existential feeling of surrounding perception is the consideration of the design space to the content of the activity, and the appropriate distance is a necessary decision that determines the success of the whole building design.

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Satisfaction of the Immersive Virtual Reality in Upper Limb Rehabilitation

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Abstract. The Immersive Virtual Reality system has been used by occupational therapists in upper limb rehabilitation treatments and has proven to improve treatment satisfaction and effectiveness. The purpose of this research was to evaluate the usage satisfaction of immersive virtual reality in rehabilitation. All subjects were required to complete a questionnaire after using the HTC Vive system. The results after recruiting a total of nineteen stroke patients in this research are as follows: (1) after using the HTC Vive system, 89% of patients agreed that their motivation to receive treatment can be improved. (2) 79% of patients think that the HTC Vive system is effective for improving upper limb functions. (3) Regarding ease of use, 42% of patients think that the HTC Vive system is not easy to operate. (5) 95% of patients were satisfied with the HTC Vive system used in upper limb rehabilitation. The research results offer design reference for future rehabilitation therapy and virtual reality game development.

Keywords: Satisfaction · Immersive virtual reality · Upper limb rehabilitation

1 Introduction

Cerebrovascular disease is one of the causes of death in the world. Upper limb motor deficit is the main symptoms of stroke patients. Most patients need to perform rehabilitation activities to restore their ability to live independently. The clinical rehabilitation equipment is very old and no feedback can be provided to the user (patient or therapist). Users do not know their rehabilitation progress, nor can they motivate their treatment [1]. Most of these commonly used clinical rehabilitation equipment are made of wood, and there is no adjustment to the function of patients with different rehabilitation stages of upper limb rehabilitation.

With the development of digital technology, clinical occupational therapists have used virtual reality (VR) game systems for rehabilitation treatment in stroke cases. The results found that virtual reality game assisted rehabilitation can indeed help improve the efficacy of upper limb rehabilitation and improve the motivation of patients to receive treatment [2]. VR presents patients with an immersive experience, and aims to accomplish the goal to improve performance [3].

Immersive virtual reality (IVR) systems create an environment that surrounds the user. When the user in the virtual environment, he/she will fully immersed into the system and completely isolated from the outside world. IVR has become an increasingly popular technology that is applied in occupation therapy to improve the motivation for, and effectiveness of treatment. VR headsets that deliver high quality immersive experiences are becoming more available and affordable [4]. IVR offers a new possible way to perform treatments in an ecological and interactive environment with multimodal online feedback [5].

The IVR system that was identified from the literature review are as follows: HTC Vive [6, 7], The GRAIL System [6], Oculus Rift DK2 and Intel® RealSense™ [2]. Lee et al. [5] showed that a complete IVR rehabilitation program using a head-mount display (HMD) for rehabilitation is feasible. There are few studies done on the satisfaction of using the IVR system in the upper limb rehabilitation, and further trials are still needed to confirm the satisfaction. Therefore, the purpose of this research was to evaluate the usage satisfaction of the IVR system used in upper limb rehabilitation therapy.

2   Methods

In this study, a questionnaire survey was used to assess satisfaction. Before completing the questionnaire, the study conducted two stages recruitment of subjects, as follows: (1) pilot trial (pilot group), and (2) clinical trial (clinical group). Subjects in the pilot group completed three training sessions in one week. Clinical group, subjects completed twenty training sessions in seven weeks, with three training sessions per week.

2.1   Subjects

Stroke patients were recruited from the occupational therapy department of Chung Shan Medical University Hospital in Taiwan. All subjects were needed to meet the criteria: (a) hemiparesis with upper limb dysfunction; (b) a need for upper limb rehabilitation to recover from Brunnstrom stages IV; (c) ability to communicate; (d) able to follow instructions; (e) participates in other rehabilitation studies. Each patient gave informed consent.

2.2   Devices

HTC Vive has high-fidelity hardware and an ecosystem of innovation. These systems make a superlative experience [8]. The system requires a few meters of space for a complete system set up. Participants wore a head-mounted display that has a 90-Hz virtual picture update frequency and scene sound effects, and each hand held an interactive controller that allows the subject to interact with the virtual script. Two sensors were set up in that space to track the subject's position, and construct a corresponding virtual environment as the subject's visual experience.

A questionnaire was designed by this study, and used to evaluate the usage satisfaction of the IVR. This questionnaire includes two parts: (1) Characteristics of stroke

patients, and (2) the usage satisfaction, includes five parts as follows: motivation, effectiveness, ease of use, fun, and satisfaction. 7-point Likert scale was used in each questions. 1 was "strongly disagree", and 7 indicating "strongly agree".

Therapists Select Virtual Reality Games for Rehabilitation Therapy. Researchers invited three occupational therapists to select games according to actions of training for upper limb, and operation difficulty. Four games were selected, they are as follows: Slapping the balloon away, Archery, Fried muffins, and Tennis (see in Table 1).

Table 1. Four IVR games are selected by the therapists.

Name of IVR games (Operation difficulty)	
1. Slapping the balloon away (Difficulty: Easy)	2. Archery (Difficulty: Easy Medium)
3. Fried muffins (Difficulty: Medium to Hard)	4.Tennis (Difficulty: Hard)

Slapping the balloon away: to hit the balloon, the user grabs the controller and flaps the balloon. Training upper limb stretching and bending movements. Archery: Shoot the red target that appeared on the building. Mainly train the stability of upper limb lifting movements. Fried muffins: According to the instructions for frying muffins, the user is required to complete each step. Mainly training upper limb stretching and bending, wrist external and internal rotation, and lifting movements. Tennis: Swing according to the position of the tennis ball. Mainly training arm extension and bending movements, external and internal rotation of the wrist, and the flexibility of the movement.

2.3   Trial Process

First, therapists helped to select stroke patients who meet the criteria in subjects. Researcher asked patients willingness to participate. Researcher arranged the trial time for stroke patients, according to patients therapy schedule. This study arranged three training sessions per week. Each session lasts thirty minutes. Before the training sessions, subjects also received occupational therapy or physical therapy about 1 h.

After all training sessions, each patient need to fill in the questionnaire. For patients who cannot stand for a long time, it is recommended to play in a sitting position. Some patients have poor stability of upper limb movements, it is recommended to use the healthy hand to drive the affected hand to hold the controller for game tasks. The use situation of patients, see in Fig. 1.

Fig. 1. Stroke patients used the HTC Vive in trial.

Data Analyses. All data were analyzed with SPSS 22.0. The characteristics of the two groups were analyzed with descriptive statistics. The Mann-Whitney U Test was used for between-group analyses. Differences were considered significant when $p < 0.05$.

3   Results

3.1   Characteristics of Stroke Patients

Nineteen patients participated in this study. The characteristics of the patients are shown in Table 2. There are no significant differences between two groups.

Table 2. Characteristics of stroke patients.

Groups	Pilot group			Clinical group			
	N	Mean	SD	N	Mean	SD	p-value[a]
Number of subjects	10			9			
Gender, male/female (n)	6/4			8/1			
Paretic side, left/right (n)	2/8			4/4			
Age in years		52.6	11.4		59.5	15.0	0.219
Time from stroke, months		15.4	7.5		9.7	3.6	0.052

[a]p for differences between two groups.

3.2 Satisfaction of Immersive Virtual Reality Used in Rehabilitation Therapy

Nine questions were investigated in the questionnaire. The results shown in Table 3. The survey results are described as follows:

Motivation. Motivation (Q1) in the clinical group was better than in the pilot group ($Z = 2.453$, $p < 0.05$). After using the HTC Vive system for twenty sessions, 89% ($n = 8$) patients in the clinical group strongly agreed that motivation for treatment can be improved. IVR games could increase motivation result from the following: (1) IVR games make patients focus on playing the game, distracting their attention from the fact that they are in rehabilitation. (2) Patients are interesting in the games which provide vary tasks, (3) play games make them felt happy and they were voluntary, (4) compare with conventional rehabilitation devices, the games have challenge. It is important to increase motivation, because of active participation in rehabilitation will program increases the effectiveness. Base on this results, VR is necessary and feasible to integrate into rehabilitation devices.

Effectiveness. The therapeutic effect (Q2) of the clinical group is significantly higher than that of the pilot group ($Z = 2.389$, $p < 0.05$). 79% of patients in the two groups ($n = 15$) think that the HTC Vive system is effective for them to improve upper limb functions.

Table 3. The results of the questionnaire.

No	Questions	Pilot group	Clinical group	
		Mean (SD)	Mean (SD)	p-value[a]
Q1	Using the HTC Vive system will increase treatment motivation	4.7 (1.7)	6.2 (1.1)	0.014*
Q2	HTC Vive system is effective for restoring upper limb motor function	4.4 (2.4)	6.2 (1.0)	0.017*
Q3	The information provided by the HTC Vive system can help understand the recovery of my upper limb motor function	5.3 (0.7)	5.9 (1.2)	0.122
Q4	The HTC Vive system is easy to use it	4.6 (1.6)	4.8 (2.1)	0.585
Q5	The sound effects of the game make me feel energetic	5.7 (0.5)	6.2 (1.0)	0.054
Q6	The HTC Vive system is fun	5.1 (2.0)	6.6 (0.5)	0.005**
Q7.	The HTC Vive system is more interactive	5.3 (1.9)	6.4 (0.5)	0.013*
Q8	I am satisfied with the use of the HTC Vive system for rehabilitation	5.1 (1.9)	6.3 (0.7)	0.023*
Q9	I am willing to continue to use the HTC Vive system for rehabilitation	5.5 (0.7)	6.4 (0.7)	0.013*

[a]p for differences between two groups.
*Significant at ≦0.05 level.
**Significant at ≦0.01 level.

Easy to Use. There were two questions (Q3 and Q4) asked. For the easy to use (Q4), there was no significant between-group differences. 42% (n = 8) of patients think that the HTC Vive system is not operated easily. About the functions of the HTC Vive games, 58% (n = 11) of patients think that the information (for example: grades, operating time) can help them to know the recovery ranges of motor functions.

Enjoyment. Three questions (Q5 to Q7) were asked. It (Q5) was no significantly greater in the clinical group than in the pilot group (Z = 1.923, p > 0.05). Patients in both groups think that the feedback sound effects of the game made him/her feel energetic. For the fun (Q6), clinical group was better than pilot group (Z = 2.800, p < 0.01). All patients in the clinical group agreed that the HTC Vive system was fun. Interactive (Q7) was also significantly greater in the clinical group than in pilot group (Z = 2.490, p < 0.05). All patients in the clinical group agreed that the HTC Vive system was interactive.

Satisfaction (Q8 and Q9). Clinical group was more satisfied than pilot group (Z = 2.275, p < 0.05). Most patients in clinical group were satisfied with the HTC Vive system for upper limb rehabilitation. With regards to willingness to continue to use (Q9), clinical group better than in the pilot group (Z = 2.497, p < 0.05). Most patients in the clinical group hope to continue using the HTC Vive games for rehabilitation.

4   Conclusion

This research aims to evaluate the satisfaction of using the IVR system in upper limb rehabilitation. The results were as follows: (1) the motivation of patients in the clinical group was better than the pilot group. After using the HTC Vive system, 89% of patients agreed that motivation for treatment can be improved. (2) For effectiveness, 79% of patients think that the HTC Vive games are effective for improving upper limb functions. (3) For satisfaction, 95% of patients were satisfied with the HTC Vive system used in upper limb rehabilitation. (4) For easy to use, 42% of patients think that the HTC Vive system is not easy to operate. Future research will investigate how to design immersive virtual reality that is easy for patients to operate.

One limitation in this trial is sample size. It is difficult to find patients who meet all the criteria of this study from one hospital, therefore, the sample size is small.

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Research on the Consumer Needs for Emotional Attributes of Lucky Commodity Design

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Abstract. This research focuses on discussing and analyzing the needs and preferences of Taiwanese consumers regarding the emotional attributes of lucky commodity design to determine the important attractiveness factors for the design of lucky commodities. This research takes its creative work and good luck available on the market as analysis objects, adopts qualitative research methods, conducts in-depth interviews with experts, scholars and consumers highly involved in lucky commodities, and works out the Attractiveness Factor Construction Evaluation Grid Diagram with the aforementioned lucky commodity. By doing so, we determine a total of three primary attractiveness factors (modeling design, symbolic message, and traditional belief), 16 specific attractiveness factors, and 17 abstract attractiveness factors and then analyzed them to provide a reference for the subsequent design and improvement of lucky commodities.

Keywords: Lucky commodities · Miryoku engineering · Evaluation grid method

1 Introduction

Lucky commodities, combined with needs related to traditional cultures, beliefs, emotions, and spirit, play an important role in Taiwan's consumption market. Although general lucky commodities can meet the spiritual needs of consumers for good luck, consumers' feelings toward the usage and aesthetic aspects have not been simultaneously considered. The purpose of this research was to analyze and discuss its creative work and good luck available on the market as research samples by making use of the evaluation grid method of Miryoku engineering, summarizing the characteristics of attractiveness factors of the lucky commodities, as well as the requirements and preferences for emotional attributes. We then summarized the characteristics of attractiveness factors of the Lucky commodity using the evaluation grid method to provide a reference for the subsequent design and improvement of lucky commodities.

2 Literature Review

2.1 Lucky Commodities and Emotional Bond

Many design elements of commercially available lucky commodities are acquired from image elements that are visible, audible, touchable, edible, and unique in meaning and are derived from Feng Shui, beliefs, or folk customs. They are presented in a way that is easy to understand after being visualized and patterned through allegorical and symbolic techniques. For example, the shape of the God of Wealth symbolizes the arrival of wealth, while the shape of the orange symbolizes "big fortune and great profit". The 12 Symbolic Animals correspond to the lucky commodity; for instance, Rat belongs to water, Ox belongs to earth, etc. The intensity of symbolic meanings of lucky commodities needs to be shown so that consumers can easily develop an association and imagination to stimulate purchasing motivation. Therefore, before pursuing a sense of beauty and a sense of design, consumers' needs for spiritual aspects like Feng Shui and faith must first be satisfied. Although commodities can directly convey symbolic meanings to consumers, they are also prone to copying patterns. Very little creative thinking, aesthetic design, and design technique can be seen in lucky commodities; as a result, many commodities are prone to copying and are highly homogeneous.

For any commodities that are in circulation in the consumption market, the purchase intention of consumers' needs to be considered, and the motivation of consumption comes from the needs or desires of consumers [1]. In this era of emotional consumption, the research results of Maslow [2], Jordan [3], and Norman [4] found that consumers' top needs are emotional and psychological satisfaction. Emotion is the expression of inner feelings after experiencing external stimuli and is a basic element of human nature. Through emotional expression, likes and dislikes and their values can be judged. Consumers should not only see commodities and then have feelings, but also comprehend something from them, so as to be moved [5]. The aforementioned research suggests that when consumers purchase commodities, their emotional bonds will emerge in their hearts towards such commodities through product information, such as color, pattern, function, price, past usage experience, etc.

2.2 Miryoku Engineering and Evaluation Grid Method

Attractiveness represents the subjective preferences of consumers, which mainly comes from their value judgment system. This judgment system comes from the sensory reception, psychological decision-making, and sociological and artistic evaluation of consumers [6]. Sanui [7] divided the research method of Miryoku engineering into two steps. The first step is that the evaluation of the target object needs to answer the with like or dislike of the object; the second step is to clarify the meaning of the answer through additional questions and to integrate respondents' answers; the charm elements of the product to consumers are then analyzed, and the relevant structure grid diagram is worked out. This research method is called the evaluation grid method (EGM). Chen Chun-Chih and Su Minqi [8] thought that in terms of EGM, interviews must be conducted mainly with highly involved groups, and true and credible evaluations and

opinions are collated through paired comparison of various features from the users' actual behavior cases. Even the corresponding relationship of abstract feelings, which has been difficult to capture in the past, and specific conditions can be integrated using this method.

3   Research Methods

In order to clarify the different needs of consumers to lucky commodities and identify the attractiveness quality factors that affect the design of lucky commodities, this research used EGM of Miryoku engineering, conducted in-depth interviews with persons highly involved in lucky commodities, and analyzed attractiveness factors of lucky commodities to provide the results to academic and practical circles for reference.

Lin Hung Lung [9] divided the lucky Feng Shui wares available on the market into six categories: Wealth Class, Zhisha Class, Peach Blossom Class, Good Luck Class, Blessing Class, and Wisdom Class. Based on this classification, a total of 30 samples were preliminarily collected in this research after reconsideration of the acceptability of the consumption market. Afterward, five designers or scholars with at least 10 years' experience in commodity design practice were invited to have discussions through the Focus Group.

The participating experts and scholars selected six representative samples (as shown in Table 1) through further grouping according to the similarity of cultural and creative information or cultural and emotional attributes of the lucky commodities, and then through examination of the five major senses of quality, namely, attractiveness

Table 1. Samples of lucky commodities [10–13].

Chinese Zodiac Lucky Bag

Wudiqian Gourd Pendant

Gourd Treasure Pendant

God of Wealth Figurine-Gold

Agathis Alba Wenchang Brush Pen Pendant

Agate-Gold Bead Pi Xiu Wealth Bracelet

feeling, aesthetic feeling, creative moving, exquisite sense of quality, and engineering perception inspection. In terms of EGM, in-depth interviews were adopted to interview our nine subjects (six with design-related academic background and three consumers). The following four questions were asked in the interview according to the spirit and method of EGM.

4   Analysis and Discussion

4.1   Attractiveness Factors Evaluation Grid of Lucky Commodities

Through the interview content, this research collects specific matters, original reasons, and abstract reasons of more than half of the interviewees (mentioned at least five times) to construct the following Attractiveness Evaluation Grid Diagram of God of Wealth Figurine Commodities with lucky commodity (Fig. 1).
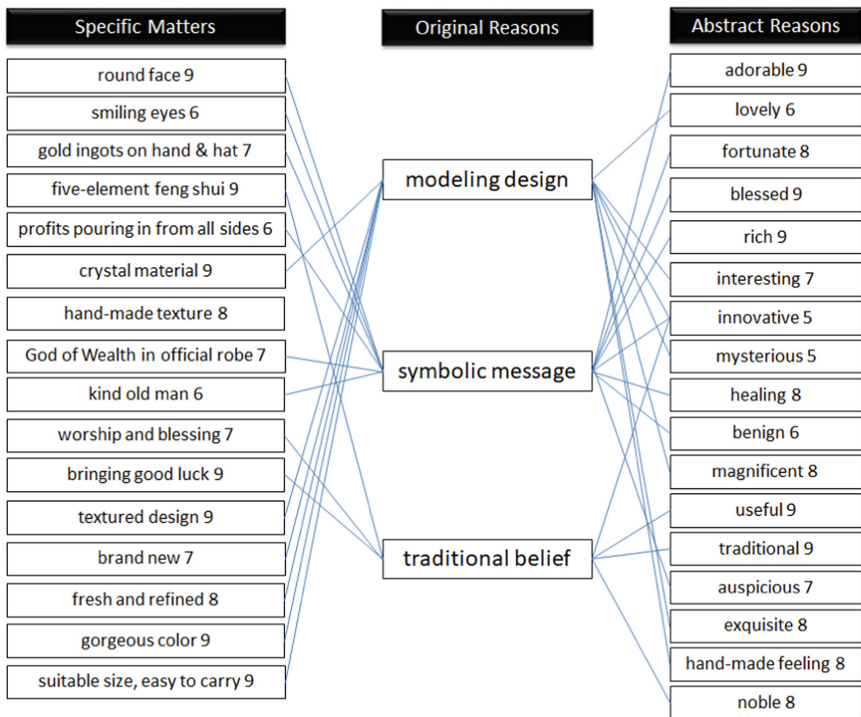

Fig. 1. Attractiveness evaluation grid diagram of lucky commodities.

4.2   Analysis of Results

According to the Attractiveness Evaluation Grid Diagram of Lucky Commodities in Fig. 1, the analysis of original reasons demonstrates that the factors attracting consumers' preferences are: "modeling design", "symbolic message" and "traditional belief"; simple and clear transmission of messages can meet the emotional needs of consumers, which can easily stimulate, either directly or indirectly, consumers' purchase motivation. The analysis of abstract reasons shows that the abstract feeling elements of attracting consumers to God of Wealth Figurine Commodities with lucky commodity and Good Luck are all positive, among which "adorable", "useful", "traditional", "blessed", and "rich" are mentioned by each interviewee. Therefore, the abstract feelings for attracting consumers need to create traditional characters with blessed, rich, and useful feelings. The analysis of specific matters indicate that the most important specific matters attracting consumers' preferences are: "round face", "five-element feng shui", "crystal material", "bringing good luck", "gorgeous color", "suitable size, easy to carry", and "textured design", which are mentioned by each of the respondents, showing that while the emotional level of consumers for lucky commodities (five-element feng shui, bringing good luck) must be met, both bright exterior design (round face, crystal material, gorgeous color, and textured design) and practicality (suitable size, easy to carry) also need to be satisfied.

5   Conclusion

The visual modeling of lucky commodities requires the simple and clear transmission of lucky messages to meet the emotional level of consumers, which can easily stimulate consumers' purchase motivation, either directly or indirectly. Abstract feeling elements are all positive, showing that commodities can evoke pleasant feelings. Linking with experience in Feng Shui, beliefs, or folk customs is a key design element, which can induce consumers' emotional cognition at a deep emotional level to acknowledge lucky commodities. The specific matters of consumers' preferences in design show that while the emotional level of consumers for lucky commodities must be met, both a bright exterior design and practicality also need to be satisfied.

In order to meet the needs of consumers for lucky commodities, clarify the attractiveness preferences of consumers, and draw more complete research conclusions, future research should subsequently increase the number of EGM interviewees, expand the age stages of EGM interviewees, and use the evaluation grid diagram of the attractiveness factors of lucky commodities to provide a reference for subsequent questionnaire designs. In the later stage, the effectiveness of the AHP questionnaire and the weight of various attractiveness factors can be adopted to determine quantitative values of attractiveness factors and provide a reference for the design and improvement of lucky commodities in the later stage.

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Research on Attractiveness Factors by the Application of the Evaluation Grid Method on Leather Technology Expression Techniques

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Abstract. In the current era of perceptual consumption, it is difficult for commodities with popular design to meet the needs of consumers' diversification and popular trends. Therefore, design personnel should consider how to meet needs and preferences of consumers at the stage of commodity design and business planning. With the development of science and technology, and diversified leather decorative texture types, appearance evaluation has become one of the factors affecting the perceptual characteristics of consumer decision-making to meet preferences of individual consumers. This research adopts qualitative research methods, conducts in-depth interviews with experts highly involved in leather technology expression techniques, works out attractiveness factors of leather technology technique expression, makes the evaluation grid diagram and analyze it to provide a reference basis for subsequent leather texture design.

Keywords: Leather technology · Evaluation grid method · Miryoku engineering

1 Introduction

The creation of commodities is driven by demand, and therefrom esthetic economy develops gradually. In recent years, the customized consumption trend has gradually improved qualia commodities highlighting the lifestyle and moves towards personalized design consumption. The value adding of design arouses consumers' cognition and moving. The demand for vogue or other characteristics is not only reflected in the design features of personalized commodities, but also in the transformation of consumer psychology, that is, consumers use personalized commodities to show their own style. Leather is one of common materials in daily life. It is gradually valued in the era of customization. The expression of leather technology techniques is to design according to personal preferences concurrently with practical and aesthetic art of life to meet more diverse needs by making use of leather lasting charm features, good texture and distinctive pattern feature presentation rendered by expression techniques to leather. Therefore, this research discusses the hand feeling in the creation of leather

technology expression techniques and the touch and overall attractiveness of leather, and expects to find out attractiveness factors of design to be used as the basis of leather pattern design in the future through interviews and discussions by using the evaluation grid method and focus group.

2 Layout Instruction

2.1 Analysis of Leather Technology and Leather Products Design Market

As early as in the 15th century, China had gorgeous and complicated leather technology. In recent years, the rising leather technology has gradually attached importance to necessities of life and aesthetic life process. In the basic elements of technology, such as modeling, decoration and color, the rationality and aesthetics of patterns are re-evaluated according to the viewpoint of design principles [1]. Leather technology is characterized by individuality. Creation with practical life art by making use of technique characteristics and materials has achieved the key in the presentation of commodity styles.

With economic development, technological progress and change of consumption ability of leather commodities, consumers have personalized and more intense design needs for leather commodities. According to Hakuhodo Institute of Life and Living, a well-known research institute in Japan, it is shown in the survey report about the five-sense structure that "consumers' evaluation benchmarks are changing", with the arrival of the five-sense age, consumers' pleasurable perceptual consumption experience and sensory perception satisfaction confer commodities with new perceptual ways to create the attractiveness of commodities, the concept of commodity has been redefined [2].

In modern life, not only practicality is required, but also it is hoped that emotional artistic feelings [3] can be acquired, the unique texture is presented by factors, such as color, luster and pattern [4]. Therefore, for designers, the promotion of product value has injected new connotations into material selection, making methods and modeling style.

Therefore, process decoration is either plane pattern or 3D pattern. In this research, natural ox leather is used in the sample design. Ox leather is mostly used among leather materials of leather products. The texture of cattlehide has the characteristics of tight fiber, so it is very tough [5]. In this research, six common expression techniques are mainly applied, as shown in Table 1 Sample Legends of Leather Technology Expression Techniques.

2.2 Miryoku Engineering and Evaluation Grid Method

'Miryoku engineering' was initiated in 1991 by a group of scholars led by Masato Ujigawa. It is aimed at creating attractive products, spaces, and services. Miryoku engineering focuses on the consumer's inner subtle feelings. Attractiveness can arouse consumers' potential sensory pleasures and satisfy their desire for dreams [6]. The influence can be found by Miryoku engineering. It can be extended to explore the sustainability of the charm. The main system of Miryoku engineering is composed of

three areas; basic theories, modeling (techniques for research and analysis), and design. In a part of the system, there is the 'evaluation grid method', modified from the repertory grid method or repertory grid technique [7].

The evaluation grid method (EGM) is an important research method in Miryoku engineering. The evaluation grid method research was often used as a design aid in architecture as well as the industrial field. Ujigawa and several scholars initiated Miryoku engineering and proposed the evaluation grid method. The primary purpose of the evaluation grid method is to thoroughly explore users' inner feelings to extract details of consumers' cognitive structures and to convert them into real factors of assessment as a basis of design [6]. The evaluation grid method can obtain customers' product preferences and emotions relating to products through in-depth structural interviews, which are conducted hierarchically. First, the interviewee is invited to assess the merits and attraction of the product by recognizing similarities and differences to other products and replying to additional questions from the interviewer. The interviewer categorizes the answers and opinions for further compiling of a hierarchic structure of the interviewee's descriptive attractiveness factors [4].

Table 1. Sample legend of leather craftsmanship.

Carving technique   Cauterization Technique   Hank Dyeing Technique

Relief Technique   PasteDyeingTechnique   BatikTechnique

3   Research Methods

Through data collection and analysis, including leather technology techniques, leather commodity market analysis and expression technique definition. In-depth interviews are held according to the evaluation grid method (hereinafter referred to as EGM) to find out the evaluation elements of attractiveness (median). Then according to the reason meaning of abstraction (upper) and conditions and characteristics specifically formed (lower) from interviews on evaluation elements, upper, median and lower

elements are drawn into the grid diagram. Through focus groups, attractiveness evaluation elements of EGM are converted into attractiveness evaluation issues of "leather technology expression techniques" according to the three topics of expression technique composition, tactile expression and overall image.

4   Analysis and Discussion
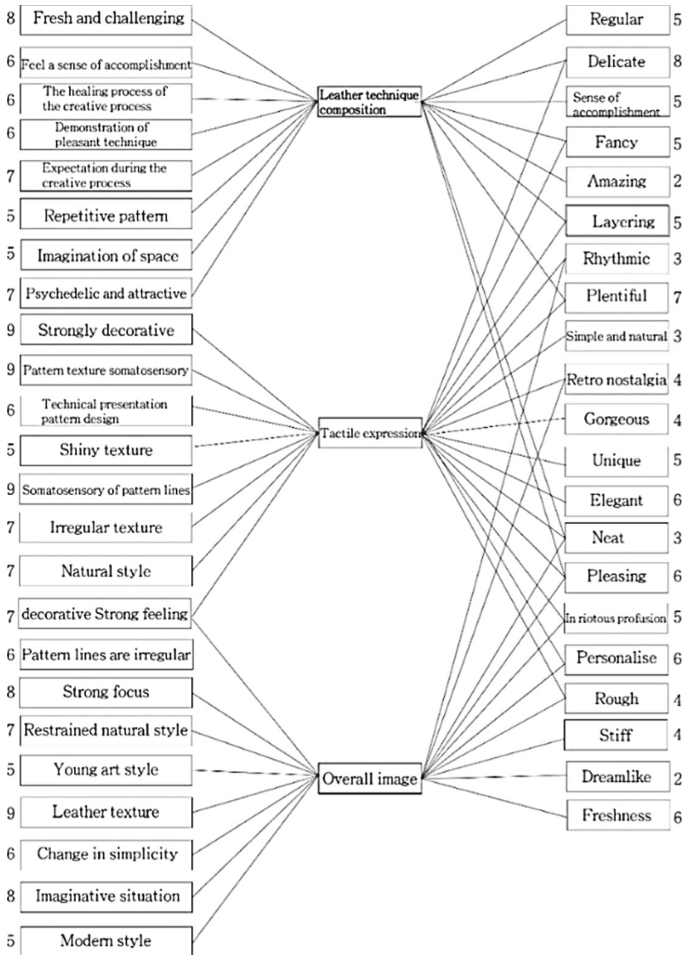
4.1   Attractiveness Factor Survey

Fig. 1. Grid of attractiveness assessment of leather craftsmanship.

The main purpose of this research is to explore the attractiveness factors of "leather technology expression techniques", so that leather technology expression techniques

can be truly presented in front of the interviewees. Therefore, actual samples are provided to the interviewees to reflect their true feelings in in-depth interviews in this research. In this research, persons who are familiar with leather techniques and have more than 5 years of practical creation experience in leather technology expression techniques are selected as interviewees. Therefore, only 10 interviewees are selected according to the condition. In the in-depth interviews, interviews and discussions on six practical samples are held one by one in an open manner from the three aspects of expression technique composition, tactile expression and overall modeling image. Finally, six samples are tested simultaneously to investigate the attractiveness factors and to construct EGM, as shown in Fig. 1.

4.2 Statistics of Conversion from EGM to Attractiveness Factors

Statistics of attractiveness factors is to sort out EGMs of all the persons, then most frequently appeared specific descriptions are taken out, in coordination with median names and attractiveness factor sentences converted from abstract descriptions, the three aspects discussed in the research are arranged in order according to the occurrence number, and descriptions with the occurrence number being less than three are deleted, as shown in Table 2, there are a total of thirteen.

Table 2. Statistics table of attractiveness factors.

Occ.#	Specific description (attractiveness factors)	Attractiveness aspects
6	1 The creation process of the carving technique is exquisite, fresh and challenging	Technique composition
4	2 The creation process of the cauterization technique is full of gradation and accomplishment	
5	3 The creation process of the hank dyeing technique is surprising and full of expectations	
5	4 The creation process of the paste dyeing technique makes one feel healed	
4	5 The creation process of the batik technique is attractive	
6	6 The tactile expression of the pattern of the carving technique is exquisite and well-bedded	Tactile expression
4	7 The tactile expression of the pattern of the cauterization technique is delicate	
6	8 The tactile expression of the pattern lines of the hank dyeing technique is regular and orderly	
5	9 The pattern texture of the relief technique is rough and rigid	
5	10 The overall modeling of the carving technique is pleasing and fresh	Modelling image
6	11 The overall modeling of the relief technique retains the roughness and individuation of leather texture	
4	12 The simple change in the overall modeling of the paste dyeing technique is rhythmic	
6	13 The overall modeling design of the batik technique is dreamy and mysterious	

5 Conclusions and Recommendations

The expression of leather technology techniques can indirectly induce the buying motive of consumers in buying leather commodities, and the pattern expression of commodities can evoke the feeling of pleasure. To meet the needs of leather product designers for leather commodity texture design, attractiveness preferences of consumers are clarified, and more complete research conclusions are drawn, it is expected that subsequently the number of EGM interviewees can be increased, the age levels of EGM interviewees can be enlarged, and EGM of attractiveness factors of leather commodities can be used to provide a reference basis for the subsequent questionnaire design. In the later stage, AHP can be used to check the validity of the questionnaire and the weight of various attractiveness factors and to find out the quantitative value of the attractiveness factors to provide a reference basis for the design and improvement of leather commodities in the later stage.

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NuanNuan: An Interactive Lamp for Pregnant Women to Regulate Emotions

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Abstract. Women face significantly more psychological pressure during pregnancy, resulting in a dramatic decrease in a sense of emotion regulation control. They lack the relevant knowledge due to stress, and they are afraid to seek mental treatment. This study aims to use design methodology to help them regulate their emotions conveniently. Through an in-depth understanding of the daily behavior and emotional needs of pregnant women, the study interprets mental processes and insights into three processes: synesthesia, psychological experience, and the volition process. Within several iterations based on user research, the study proposes the use of an interactive emotion regulation lamp for pregnant women who lack emotions of acknowledgment, ease, and autonomy. It utilizes multi-layered interactions between products and users. There are three main features: lighting feedback, thoracic contraction breathing simulation, and "smile therapy" guide. These features cater to the three layers of user needs, while interactions trigger positive emotions in them. Lighting feedback and the simulation of the thoracic contraction that guides users to adjust breathing allows the lamp to achieve the effect of regulating negative emotions. In the volition process of pregnant women, the "smile therapy" is used for interpreting user needs into positive emotion regulation. Through this case, there is a conclusion that the design based on users' needs combined with mental processes can create prototypes that both benefit the users' wishes and simulate positive emotion for them.

Keywords: Interactive prototype design · Emotional design · Pregnant women · Regulate emotions

1 Introduction

Pregnant women are under higher pressure than usual. During this vulnerable period, most women and their families pay less attention to mental health, even though the data shows that a substantial number of women screened in obstetrics settings have significant symptoms of depression [1]. Woods et al. found that 78% of pregnant women experienced low to moderate stress during their pregnancy [2], and the stress response is always accompanied by emotional, physical, and psychological problems [3], leading to the emergence of diseases. In developed countries, 10%–13% of pregnant women have a prevalence of pregnancy anxiety and depression [4]. After a mental health diagnostic evaluation, they are more willing to seek treatment when they suffer from depression [5]. As a result, pregnant women attract the attention of many

researchers. Kim studied the way pregnant women manage their diet plan [6]. Asplin investigated their needs by ultrasound scan [7]. Some researchers found that motivations from family and friends help them recover from depressions [8]. However, researchers focus more on the physical health of women instead of mental health.

In other words, there is a gap in research that helps regulate emotions before they fall into depression. Many pieces of research indicated that different cultural origins might result in various findings [9]. Some studies proved that emotional designs that attract customers' attention and elicit positive emotional feedback [10, 11], not only worked in product design but also worked in service design. This study aims to understand pregnant women's emotions, needs, and motivations. In China, they experience different challenges with regards to the companion of the family. However, most Chinese lack awareness of mental health, and they prefer to avoid visiting the hospital alone. This study uses qualitative research methods combined with hardware prototypes development and focuses on applying psychological expertise to interactive product design towards pregnant women in a Chinese context. Based on these findings, the study finds that regulating emotion is a helpful method to keep them away from depression. Taking deep breaths is an effective way to gain emotion regulation skills, including emotional awareness [12, 13] and managing distress and negative emotions. So, the study selects breathing as a method to regulate emotions. Furthermore, the design focuses on the emotional experience of pregnant women to control emotions.

2   Methodology

The UX Studio course is a three-month-long project-based design course and has been operating continuously for four years. Fifty-six applied psychology masters students signed up for the course in 2019. First, each group defined a target user group based on desktop research. Then, each group defined characteristics of the target users and analyzed users' needs since it is essential to focus on quality engineering that incorporates users' needs into the development process. Mental processes of users include three mental processes: cognition, emotion, and volition, which govern human behaviors. The team translates users' actions and processes into users' mental processes, such as behavior and cognitive processes. They analyze needs, concerns, and especially emotions of so-called Kaisei needs behind these actions as inputs of the product design process [14, 15], which will contribute to the product experience and conveniently generate ideas for user-centered opportunities [16, 17]. To create excellent design, designers should fulfill and consider the whole experience process. Every design idea should satisfy one or more fundamental needs of users. An essential component of the experience, such as an emotional experience that is elicited by individual appraisals, it will appraise beneficial for the users' concerns [18]. The next step is to consider the framework of product experience, and designers arrange ideas that involve three levels of experience: the aesthetic level, the meaningful, and the emotional level [19]. Some studies proved that inducing positive emotions enhances performance and can endure the personal resources of participants, such as learners' perceptions of multimedia [20, 21]. Designing an interactive product is about creating behaviors in user-product interaction [22]. Based on the framework, the study ideates

interactions between users and product and prioritizes ideas by desirability, whether elicit positive emotions and fulfill pregnant women's needs.

Furthermore, every interaction should create at least one of twenty-five positive emotions, according to Desmet's research [23]. These interactive behaviors are modeled by CAD software, RP (Rapid prototyping) tools, and open-source hardware. This study demonstrates a case of the UX Studio course, an interactive emotion regulation lamp for pregnant women as an example.

3   User Research Result on Pregnant Women

3.1   Pregnant Women Mental Processes Analysis

Based on desktop research results, the target users are defined as ordinary pregnant women between twenty to thirty years of age. Through observation and interviews, this study lists their mental processes. It refers to the process of occurrence, development, and disappearance of psychological phenomena. It has the time continuity, consisting of the cognition process, the emotion process, and the consciousness process [24]. Moreover, the study finds that these women often lack emotions of acknowledgment, ease, and autonomy. In other words, they need attention, mental comfort, and freedom of decision. For example, Chinese pregnant women also want to get care and support from others instead of quarreling. They want to live in a relaxing life, not a stressful life. They also want to decide matters for themselves, not dictated by parents. After brainstorming and prioritizing ideas, the team proposes an interactive lamp to regulate emotions to fulfill these needs. See Table 1.

Table 1. Mapping mental processes, needs, and main features.

Mental process	Sub mental process	Fundamental needs	Sub needs	Main features
Cognitive process	Synesthesia	Acknowledgment	Attention	Get lighting feedback
Emotional process	Psychological experience	Ease	Mental comfort	Regulate emotions
Consciousness process	Volition	Autonomy	Freedom of decision	Adhere to the self

According to user research results, this study discovers pregnant women's mental processes, needs, and maps these needs to the design. First, pregnant women need feedback when they face mood swings. The second process is the need to control emotion. When it comes to the emotion process, users need to adjust their emotions. The last process is consciousness, and they need to adhere to themselves and control their life.

3.2   User Scenario

This study presents an interactive lamp to help pregnant women to regulate emotions and keep a good mood. Xiao Li, a young pregnant woman, is living with parents. She often suffers from anxious emotions, especially when there is a conflict between her and her parents due to their lifestyle or parenting philosophy. One day, she plans to drink cold water to keep calm; her mother saw it and tried to stop her. Her mother told her that it is harmful to the baby. She feels more anxious and sits down besides the lamp. When she places her hand on the touching switch, the light turns on and shows the specific hand shape area on the lampshade, which instructs her to put two hands on the lampshade. With the guidance of the lamp, Xiao Li takes several deep breaths and feels better. While the screen shows a smiling face to lead her smiling, she keeps the positive emotion in mind and walks back to the bedroom.

# 4   Development of NuanNuan

4.1   Interaction and Emotion Design

After proposing the concept and features of NuanNuan, the research team analyzes and maps actions, interactions, and emotions in detail by dividing user behavior into activities. Each user action belongs to one of three mental processes. According to the specific feature of the lamp, this study develops interactions between the user and the lamp, which will trigger two of positive emotions.

Table 2. Mapping user research results with interaction and emotion design.

Sub mental process	Main features	User actions	Interaction	Emotion
Synesthesia	Get lighting feedback	Activate	Put a hand on the switch, and the light turns on	Kindness hope
		Breath preparation	Follow the light guide and put hands on the lampshade	Anticipation enchantment
Psychological experience	Regulate emotions	Under guidance	Breathing with lampshade contraction	Energized relaxation
		End of guidance	Hands off the lampshade, the light will be dimmer	Relief satisfaction
Volition	Adhere to the self	Emotional reinforcement	Leads user to smile	Confidence inspiration

As Table 2 shows, there are five stages of using the lamp. The first stage is activating NuanNuan. When the user feels negative emotion, she can put her hand on a hemispherical touch switch. Then she will see the light, feedback from the lamp. She

will feel kindness and hope due to receiving feedback from the lamp quickly. Then she waits for the next instruction and sees a handshape on the lamp. Following this clue, she put her hands on the lampshade. The whole light ball will light up when it detects two hands while she is in anticipation and enchanted. It is a magical moment that her hands can light the small world. Next, the lampshade contracts slightly, with white noise background sound, and leads her to breathe in and breathe out. After several times, she feels energized and relaxed and moves the hands of the lampshade. The light will dim; she feels relief and satisfies with the therapy. At the last stage, she wants to keep the good feelings and follows the smile instruction. Watching the smiling faces on the screen, she finds that she gains confidence again and gets inspiration from the therapy.
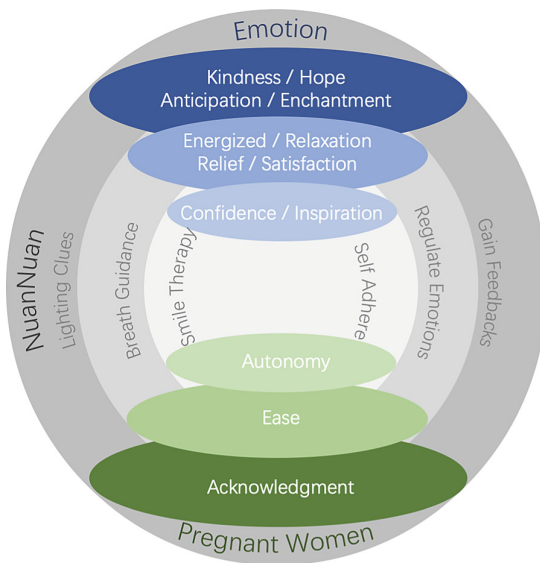
Fig. 1. The framework among users, the product, and emotion.

The framework among users, the product, and the emotion shown in Fig. 1. There are three layers of pregnant women's needs that map to different features of an interactive lamp. It will help to create positive emotions and cater to their needs. The primary need is acknowledgement that is obtained by feedback since the pregnant woman is sensitive; and they feel ignored by the family. NuanNuan has several lighting clues to show empathy to the user and create a context full of kindness, hope, anticipation, and enchantment. The second need is the ease that regulates emotions through breathing guidance. After taking deep breaths, she feels energized, relaxes, relieved, and satisfied. Autonomy is the last, as well as the highest layer of needs of a pregnant woman. It is fulfilled by keeping positive emotions longer by smile therapy while she gains confidence and inspiration back.

4.2   Implementation

According to the analysis of the mental process including the cognitive process, emotional process, and consciousness process, this study concludes the user's operable behaviors that interactively interpret the product features of a prototype. Furthermore, this study uses the agile developing method with several user tests. There are five iterations of concept and prototype development. The first two iterations focus on exploring the combination of mental process analysis and user needs to cluster the psychological process of pregnant women. The third iteration aims to translate interaction behavior and to build conceptual possibilities. The fourth iteration aims to crack technological problems while the last iteration targets on integrating user comments to finalize the prototypes.

**Table 3.** Interaction behavior translation of emotion regulation lamp for pregnant women.

Sub mental process	User actions	Interactive translation	Prototype implementation
Synesthesia	See, hear, touch	Light, white noise	Intelligent color lights, audio modules, touch sensors
Psychological experience	Breathe	Contraction, expansion	Rocker mechanism, blowfish appearance
Volition	Smile	Facial recognition	Face++ system

As Table 3 shows, NuanNuan translates processes of seeing, hearing, and touching into features of lamps, using Grove-GSR sensor, skin resistance sensor, and HK-1606 reflective infrared heart rate sensor as inputs of emotion detection. These sensors will detect the user's emotion and turn on the light when the user places a hand on the sensor window for a short duration. The lamp wick adopts Yeelight LED smart bulb as a visual feedback, and it is placed inside the lamp body (in the deformation ball). The LED bulb connects to smartphones via WIFI. Generally, the light is soft white. The bottom of the lamp is equipped with a Bluetooth speaker for auditory feedback. When it detects negative emotions, the lamp will also play white noise to regulate emotions.

In the psychological experience process, the lamp uses a breathing guide with the interaction of touch. The main body of the lamp adopts the bionic design of blowfish because of shrink characteristics, which is shown in Fig. 2 (b). Breathing in and breathing out is the same as a blowfish's systolic and diastolic features. Inside the lamp is a crank and rocker mechanism connected to the motor. Several collapsible structures are connected around the crank and rocker mechanism and constructed as spheres. As Fig. 2 (a) shows that when the user puts her hands on the two sides of the lampshade, the touch sensor will give the signal. Next, the lampshade structure will shrink to guide the user to adjust her breathing by stimulating the contraction of the chest, thus achieving the effect of regulating negative emotions.

(a)   (b)
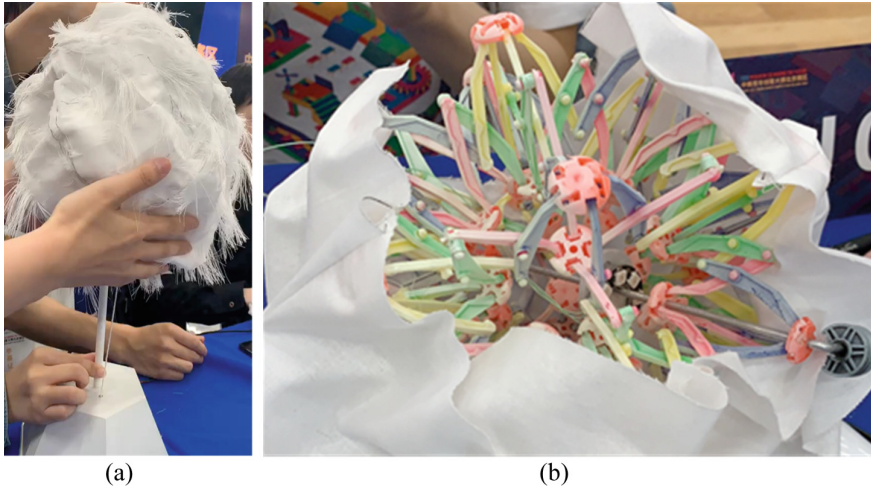
Fig. 2. (a) When the user puts her hands on the two sides of the lampshade. (b) Crank and rocker mechanism connected to the motor.
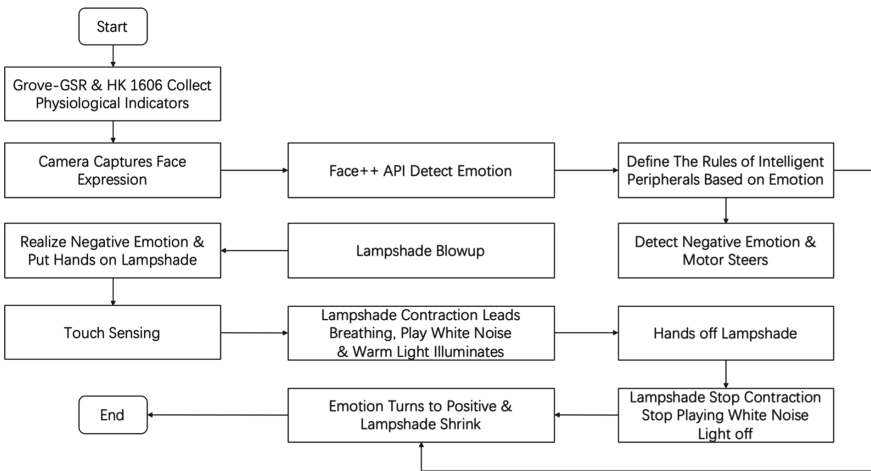
Fig. 3. Interaction workflow of an interactive lamp.

In the volition process, the needs of pregnant women are keeping emotional regulation and self-adherence. The team interprets needs in "smile therapy" [25] by placing a small display near the lamp, which is integrated with the Face++ system for face recognition. When the system recognizes an expression as a negative emotion, it will prompt for smile training to release the pregnant woman's stress.

Based on the above design, the interaction flow is shown in Fig. 3. When the lamp detects the negative emotion of the user, it will link to intelligent peripherals. Then the lampshade will expand. The user will realize she is experiencing negative emotions.

The lampshade will contract, play white noise, change to warm light illumination, while she puts her hands on it. She can follow the contraction to take a deep breath. When she feels better, she will stop interacting with the lamp, and it will change to the original state.

5   Discussion

This study understands pregnant women's needs and living scenarios in China. Based on the Chinese context, pregnant women are not willing to visit hospitals unless their body shows signs of physical discomfort. The interactive lamp will help them get relief from negative feelings. Furthermore, it also prevents their mental health from getting worse. Although the lamp needs further longitudinal evaluation to prove the effectiveness and whether the stimulus is joyful or painful. From a design methodology perspective, the study finds that the prototype is designed after the interaction translation of mental processes, which can trigger a more profound emotional interaction experience between users and products. The analysis of the mental process illustrates user behaviors in detail, leading to a successful final interactive product that supports wellbeing. Interaction is a bridge between subjective reality and objective reality. This bridge will activate a specific emotional experience. So, it is necessary to incorporate psychological research into design. Through this research model, product functions will better fit individual behaviors, enhancing the usability of interaction and individual initiative. As interaction designers or UX designers, especially novice designers who always omit detailed interactions of users, through following these analyzed steps, these designers will list every single action of users. It is easier for designers to promote constant interactions between users and products. Emotional design can attract customers' attention and elicit positive emotional feedback. So, the process inspires designers to create product concepts with a deep understanding of user interactions, emotional experience, and mental processes, which keeps designers involved in an emotional relationship between user and product. This research and methodology also have some implications for other designs of physical interaction products.

6   Conclusion

This study demonstrates that the research team interprets mental processes and applies interaction design to a wellbeing product. In user research sessions, the user's fundamental needs including acknowledgment, ease, and autonomy, mental processes such as the synesthesia processes, psychological experience processes, and will process. This study aims to regulate pregnant women's emotions by the interactive lamp and conclude the user's operable actions. Then the research team interactively interprets these actions in product features of the interactive lamp. Three main features cater to the three layers of user needs, while interactions trigger ten positive emotions of pregnant women. Moreover, the proposed design process approach enables designers to understand the user's needs that are combined with mental processes and create

prototypes that both benefit the users' wishes and, at the same time, is stimulating positive emotion for them.

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The Influence of Virtual Reality Learning System on the Learning Attitudes of Design History

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Abstract. Virtual reality technology has huge potential, it can improve traditional teaching models, inject fresh ideas into traditional teaching, and enhance students' understanding of content and learning motivation. Design history courses are facing a situation where students' interest in learning is not high. In order to solve this problem, this study integrates virtual reality technology into the teaching process of design history courses, and explores the impact of virtual reality learning systems on student's learning attitudes. In this study, 70 students from the design department of a university in Southeast China were selected for experimental design. The students in the experimental group studied the virtual reality learning system, while the students in the control group studied in the traditional way. Experimental results show that compared with traditional teaching, virtual reality learning system significantly improves students' learning attitudes.

Keywords: Virtual reality · Design history · Learning attitudes

1 Introduction

The history of design course is one of the most important courses in design education. However, due to its strong theory, the teaching method has been relatively simple and outdated for a long time. There are more teacher-based teaching modes and less use of technology to integrate into classroom teaching. Students' learning interest is generally not high [1, 2]. Recently, technologies such as virtual augmentation technology and virtual reality have achieved rapid development, and the combination of new information technology and teaching has been welcomed by students [3–5]. The study of design history course involves the appreciation of many design works and art relics. Therefore, context is an important factor in the study of design history, that is, to provide students with a close contact with design works or art remains [6]. However, the situations provided by general classroom activities are limited [6].

The emergence of virtual reality technology has brought great changes to the teaching and learning of many disciplines. Some situational effects that are usually difficult to present in the classroom have been well solved by virtual reality technology, such as medical simulated surgical operations. [7], and insect learning in natural

science. Virtual reality technology has huge potential. It can improve traditional teaching models, inject fresh ideas into traditional teaching, and enhance students' understanding of content and learning motivations [8].

In order to improve this situation, this research attempts to integrate virtual reality technology into the curriculum teaching of design history, to provide students with a virtual reality learning environment, so that students can conduct situational learning in it, in order to stimulate students to learn design history. The learning motivation of the course enhances personal self-efficacy, and then attempts to understand the knowledge of design history learned and enhances the learning ability. To this end, this research will use the Bauhaus design unit of the University Design History course for experimental application and analysis. As the Bauhaus covers a variety of styles in different periods, the design styles are also slightly different, and the better way for students to understand Bauhaus design, understand the concept of Bauhaus, and explore the Bauhaus grid in different periods is to be physically present Go watch them in person. Therefore, in this unit, through virtual reality technology, students will have the opportunity to experience different forms of Bauhaus design products in an immersive context and experience the charm of artistic design in this way. At the same time, in addition to hoping that students can get up close and personal with these art products, they also hope that students can build a better motivation for learning, thereby improving the learning effectiveness of their art history courses.

Therefore, the purpose of this study is to understand whether students using virtual reality learning models exhibit better learning attitudes than students using traditional learning models?

2 Literature Review

2.1 Design History Course

The history of design as a basic course for design students, its importance has been proven by many experts [9–12]. With the rapid development of educational technology, teachers are required to continuously innovate their teaching methods in order to meet the increasing demands of students on classroom learning technology and the environment [13]. Situation is an important factor in the study of design history [6]. In the course of the design history course, how to make students more integrated and experience the charm of design works, feel the evolution of design history, is a problem that many teachers are concerned about [11]. However, in the history of design, there is relatively little research on technology and teaching [6]. When it comes to updating the design history curriculum, you can consider incorporating virtual reality or augmented reality technology into design history teaching. Unfortunately, though, many design history museums have succeeded in using virtual and augmented reality technologies. But this did not motivate scholars to incorporate these technologies into the classroom, and the learning process of design history courses is still a teacher-centered teaching method.

2.2   Virtual Reality Technology

The rapid development of virtual reality technology has had a profound impact on classroom teaching [14]. The virtual reality learning mode is a new teaching method by introducing virtual reality technology into the classroom teaching process [15–17].

Virtual reality technology is a three-dimensional virtual world simulated by a computer or a new media technology that brings a real presence through a computer and other devices. It has a 360-degree panoramic immersion, making people feel like they are in a real environment [18–20]. Now, more and more 360-degree spherical video-based virtual reality (SVVR) technology has been developed [21, 22]. Take 360-degree panoramic photos or videos with a panoramic camera, such as insta360. With human visual focus as the center, users can use head-mounted devices to view SVVR for an immersive contextual experience [20]. The VR environment can not only provide realistic multi-sensory stimulation, but also provide users with a high degree of interactivity [23]. The convenience, interactivity, and contextual experience of SVVR show people its great potential in education [24].

In order to enable VR technology to develop further in the education field, the [20] team from the Chinese University of Hong Kong developed a system platform called EduVenture VR. The platform has low production costs, simple system operation, and good interactive functions. Through the introduction of the panoramic camera shooting sample introduction platform, a low-cost Interactive spherical video-based virtual reality can be produced. Combined with a head-mounted VR device, students can obtain a good realistic immersive interactive experience. The VR learning mode system discussed in this article is built using this platform. So far, there are few related researches on EduVenture VR. This research has played a role of attracting attention, which is consistent with the purpose of developing EduVenture VR. The original intention of the platform is to improve the learning motivation and participation of learners [20].

3   Virtual Reality Learning System

In order to make the design history curriculum in virtual reality more effective and enhance students' learning interest, this virtual reality learning system was developed to support the development of learning activities. This research used the EduVenture VR platform developed by a university in Hong Kong as a development tool [20]. As shown in Fig. 1. The editing interface of VR learning system.

Figure 2 shows the interface of the VR learning system, scenes and works involved in this unit.

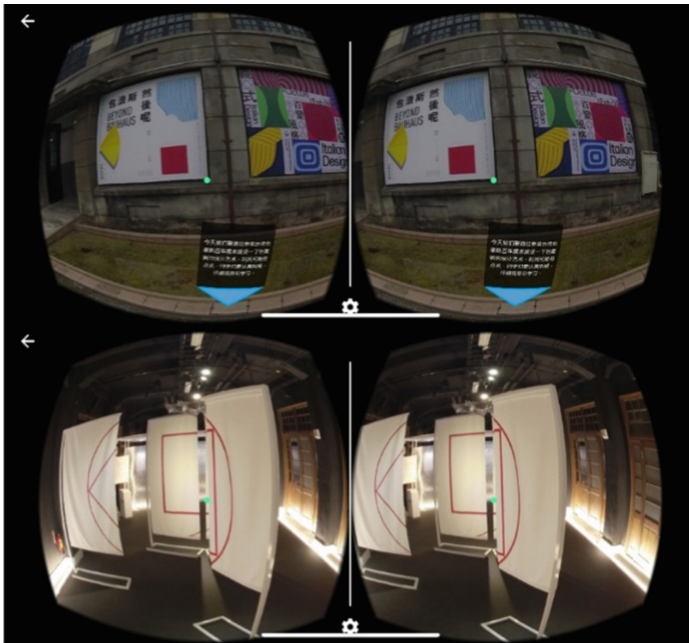**Fig. 1.** The editing interface of VR learning system.

Fig. 2. Interface of the VR learning system.

4   Experiment Design

In order to evaluate the performance of the proposed virtual reality learning model in the history of design, experiments were conducted on the "Bauhaus Design" module of the history of design in the university. This module has been in the history of design history syllabus for selected universities for over two decades and has been identified as a more important part of the history of design. We aimed to investigate the impact of virtual reality learning models on student learning attitudes.

4.1   Participant

The experimental subjects of this study were selected from two class students of the first-year design department of a university in the southeast coast of China. All students have initially studied the "Bauhaus design" unit, and have the same prior knowledge of design history. One class is the experimental group and the other is the control group. A total of 36 students in the experimental group accepted the "VR learning system" learning activity during the learning process; while 34 students in the control group accepted the traditional learning model. All students are taught by the same professor who has more than eight years of experience in teaching art history.

4.2   Measuring Tools

The research tools for this study include pre-test and post-test, as well as questionnaires to measure students' learning attitudes. The learning attitude scale was modified based on measurement methods developed as in [5]. It consisted of seven items based on a five-point Likert scale, as shown in The Cronbach's alpha value of this questionnaire was 0.83.

4.3   Experimental Process

The experimental process is shown in Fig. 3. Before the learning activities, the participating students first conducted a pre-learning questionnaire. Then began the learning activities. After the teacher introduced the learning content and overall activities designed by the Bauhaus design history course, the experimental group students accepted the virtual reality learning mode; the control group students accepted the traditional learning mode, and both groups had 45 min. Time to complete learning tasks. After the learning activity, all students need to complete a questionnaire.
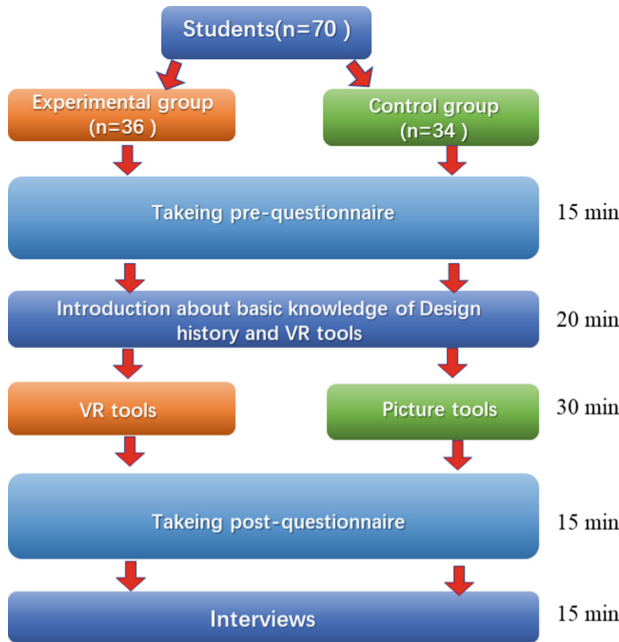
Fig. 3. The experimental process.

5   Experimental Results

5.1   Analysis of Learning Attitudes

In order to evaluate the effectiveness of the VR system from different dimensions, the students' learning attitudes were examined through ANCOVA (Analysis of Covariance), to exclude the impacts of the pre-questionnaire ratings.

The Levene's test of determining homogeneity of variance was not violated (F = 9.16, p > .05), indicating the null hypothesis is tenable and the variance is equal across groups. In addition, the homogeneity of regression slopes was confirmed, indicating that it was appropriate to employ the analysis of covariance (F = 0.025, p = 0.87 > .05). Therefore, the one-way ANCOVA was conducted.

The adjusted means and standard error were 4.23 and 0.10 for the experimental group, and 3.83 and 0.11 for the control group as shown in the Table 1. It was found that the post-test scores of the two groups were significantly different (F = 6.79, p < .05).

Table 1. The ANCOVA result of learning attitudes.

Group	N	Mean	SD	Adjusted mean	SE	F	η2
Experimental group	36	4.24	0.68	4.23	0.10	6.79*	0.73
Control group	34	3.83	0.53	3.83	0.11		

*p < .0.05.

6   Discussion and Conclusions

From this study, we can find that virtual reality learning systems can significantly improve students' learning attitudes, which is also the same as the findings as in [21]. The emergence of virtual reality technology has provided a new method for teacher teaching. It has been experimentally proven to stimulate students 'interest in learning, enhance students' motivation for learning, and improve their academic performance [21] At the same time, virtual reality technology has great potential. It can improve traditional teaching models, inject fresh ideas into traditional teaching, and enhance students' understanding of content and learning motivation [8].

According to the research results, there are the following suggestions for future research. First, the sample size can be expanded, second, the experiment time can be extended, and long-term experimental observations are considered. Furthermore, VR experimental equipment may cause dizziness and distress for some people. Consider upgrading equipment. Finally, there can be more experimental units.

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Kansei Engineering as a Tool to Design Tool Kit for White-Collar Family

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Abstract. The purpose of this study is to explore the application of Kansei Engineering for designing kit products. This study precisely described the design processes of kit products based on the theory and method of Kansei Engineering. A tool kit for the white-collar family was selected as the implementation target. The target users' perceptual needs and aesthetic tastes for tool kit were obtained via user survey and statistical analysis. The six Kansei words and fifteen representative samples of tools design were obtained through questionnaires, interviews, statistical analysis, and other methods. The semantic differential method was used to collect users' evaluation data of typical samples. The tool kit design elements that meet the target customer's perceptual needs were obtained by the analysis of evaluation data and the breakdown of representative samples. Finally, two kits were developed according to the design clue and verification test was performed and provided proof for the feasibility and effectiveness of this study. The result of this research can be used as a reference for future research or future design related to hardware products.

Keywords: Kansei Engineering · Tool kit · Perceptual needs · Design elements · White-collar workers

1 Introduction

The user-centered method is always the primary principle of product design and development. Hardware tool products are indispensable tools for every family, the success of product design depends on whether the design could satisfy the perceptual needs of customers. The Kansei Engineering method could assist the product design by transforming the customer's perceptual needs into design solutions and concrete design parameters [1]. Hu Weifeng [2, 3], Luo Shijian [4], Su Jianning [5], and Tan Hao [6] used Kansei Engineering to design automobiles, mobile phones, mechanical equipment, and other products, and all study achieved excellent results. All of the above took design practices to verify the feasibility of the Kansei Engineering method. Joana Vieira et al. [7] described the use of the Kansei Engineering method as a tool to evaluate the subjective perception of rubber keypads, and the study has proven that the Kansei Engineering method is a useful tool to establish robust relations between the customer's perceptual needs and all physical properties. However, the related design

research of the tool kit based on the Kansei Engineering method is still absent at present. Hence, based on the Kansei Engineering, this study aims to translate the Chinese white-collar customers' perceptual needs into design elements of the tool kit, and then use it as a guide for the design of a tools kit. This study has particular practical and theoretical value for subsequent design and Kansei Engineering research.

2 Design Procedure and Process

2.1 User Research

White-collar workers mainly refer to non-physical workers, such as civil servants, teachers, and designers. They have different lifestyles, consumption ability, and aesthetic tastes from the blue-collar workers. To determine the tool types and storage methods that meet the target user's perceptual needs, we need to investigate the behaviors and habits of white-collar workers.

Field interviews and questionnaire methods were used to survey white-collar users. The questionnaire consists of two parts; the first part has questions about some necessary personal information, including gender, age, occupation, and living environment; the second part has questions about the storage habits and purpose of use. Based on the answers, the size, storage method, and tool types of a tool kit were initially defined.

The survey results showed that white-collar workers use hardware tools mainly to repair things, and five tools were frequently used, including a screwdriver, a hammer, a tape measure, a wrench, and pliers. They thought that the length of tools should be limited to 20–25 cm to save space. Compared to other storage methods such as flipping, drawers, and zippers, they prefer the clamshell storage container.

2.2 Domain and Semantic Space

A total of 200 original words and expressions describing hardware tools were collected via product promotional materials, group brainstorming, consumers' reviews, and interviews with relevant sellers.

Firstly, a focus group consisting of domain-related professors and target users, was invited to categorize these collected words. Thirty-six words were obtained by removing unnecessary and inappropriate words, and by organizing the low-level Kansei words into high-level Kansei words. The KJ method was used to classify these words into four clusters, namely material, function, style, and form.

Secondly, the statistical analysis method was used for further selection. Thirty target users were invited to participate in the survey. The questionnaire is listed in Table 1. Each participant was required to select more than one word from each cluster, and only 6 Kansei words could be selected. Then, each participant was asked to opt for three favorite Kansei words among the words they have selected. Finally, we obtained six Kansei words that were simple, humanized, durable, superior, safe, and creative. Furthermore, the participants' preferred Kansei words were simple, superior, and safe. Then, they found the antonyms corresponding to the six Kansei words and matched

them. The six pairs of words are as follows: simple-complex, humanized-dehumanized, durable-non-durable, superior-inferior, safe-dangerous, and creative-non-creative.

Table 1. Kansei words questionnaire.

Material	Function	Form	Style	
1. Shiny	1. Safe	1. Sharp	1. Superior	11. Feminine
2. Textured	2. Durable	2. Smooth	2. Delicate	12. Individual
	3. Lightweight	3. Small	3. Professional	13. Elegant
	4. Humanized	4. Straight	4. Kind	14. Technological
		5. Regular	5. Simple	15. Traditional
		6. Detailed	6. Public	16. Modern
		7. Irregular	7. Interesting	17. Gorgeous
		8. Thin	8. Creative	18. Cool
		9. Round	9. Colorful	19. Lovely
		10. Heavy	10. Tough	20. Active

Q1: Please choose six words that could be best representing the hardware tools from the above four categories; at least one word should be selected from each category.

1. ( ) 2. ( ) 3. ( ) 4. ( ) 5. ( ) 6. ( )

Q2: Please select three favorite Kansei words from the six words that you have selected.

1. ( ) 2. ( ) 3. ( )

2.3   Space of Properties and Samples

A large number of hardware tool sample pictures were collected via e-commerce platforms, designing websites, and field surveys. These hardware tool pictures can be roughly classified into eight types of styles.

According to the results of prior user surveys, the most commonly used tools for white-collar consumers were screwdrivers, hammers, tape measures, wrenches, and pliers. Based on the user's requirements for the tools kit, a total of 15 typical sample images were acquired through professional analysis and discussion. The 15 representative sample images are represented in Fig. 1.

An expert group, consisting of students and teachers majoring in design, analyzed and broke down the product properties by using the method of morphological analysis. The overall composition of the target tools is relatively simple. It generally consists of the handle and the head. The handles could be broken down into three items: form, material, and detail. The form of the handles can further be broken down into geometric shapes and streamlined shapes. Furthermore, the handles are made from a wide variety of materials, including plastic, rubber, and wood. Similarly, the design elements of the heads could be obtained by this method, as shown in Table 2.

Fig. 1. The 15 representative sample images.

Table 2. The design elements deconstruction.

Handle			Head	
Form	Material	Detail	Function	Form
Geometric Streamline	Metal Plastic Rubber Wood	Details Details	Wrapped Naked Removable Un-removable	Geometric Streamline

2.4   Kansei Evaluation and Data Analysis

In this phase, we invited 30 target users to evaluate all representative samples by presenting them with a seven-scale semantic differential schema, according to the six Kansei words separately. The seven-scale semantic differential schema is shown in Table 3. The evaluation data were averaged, and the samples with the highest and lowest average score corresponding to each Kansei word were listed in Table 4.

Table 3. Seven-scale semantic differential schema.

Negative word	Scales	Positive word
Complex	−3 −2 −1 0 1 2 3	Simple
Dehumanized	−3 −2 −1 0 1 2 3	Humanized
Non-durable	−3 −2 −1 0 1 2 3	Durable
Inferior	−3 −2 −1 0 1 2 3	Superior
Non-creative	−3 −2 −1 0 1 2 3	Creative
Dangerous	−3 −2 −1 0 1 2 3	Safe

Table 4. Samples with the highest and lowest mean value.

Kansei words	Samples with highest mean value			Samples with lowest mean value		
Simple	4(2.48)	5(2.33)	1(2.30)	13(1.49)	11(1.09)	7(0.70)
Humanized	13(2.3)	8(2.16)	9(2.05)	3(1.64)	10(1.58)	5(1.52)
Durable	9(2.30)	1(2.28)	12(2.22)	13(1.70)	5(1.69)	7(1.18)
Superior	12(2.25)	11(2.12)	8(2.10)	13(1.58)	8(1.53)	3(1.42)
Creative	7(2.38)	4(2.15)	11(1.95)	2(0.65)	1(0.28)	3(0.12)
Safe	7(2.09)	11(2.02)	4(1.99)	14(1.58)	10(1.55)	5(1.40)

2.5 Establishing the Relations Between Kansei Words and Physical Properties

As shown in Table 4, sample 4, sample 5, and sample 1 brought users a sensation of simplicity, and sample 7 took users an intense impression of complexity.

The mapping relations between the six Kansei words and the design elements could be established by qualitative analysis. As presented in Table 5, the participants were more sensitive to the shape of the handle. The geometric handle gave users an impression of simple and durable, and the streamlined handle brought users a sensation of humanity, safety, and quality. As shown in Table 5, the Kansei word "simple" could be translated into concrete design elements, including metal or wooden material handle with geometric form, and a non-replaceable head with a streamlined shape. In the same way, if the design elements of handles are geometric in form and are made of rubber, with little details, exposed, and have non-replaceable heads with a geometric shape, that would bring customers a sensation of "durable".

Table 5. The mapping relations of Kansei words and design elements.

Design elements			Simple	Humanized	Durable	Superior	Creative	Safe
Handle	Form	Geometric	●		●			
		Streamline		●		●	●	●
	Material	Metal	●					
		Plastic-cement		●		●	●	●
		Rubber		●	●			
		Wooden	●			●	●	●
	Details	Details	●	●	●	●	●	●
		Non-details						
Head	Function	wrapped						
		Naked	●	●	●	●	●	●
		Removable		●		●		
		Non-removable	●		●		●	●
	Form	Geometric			●			
		Streamline	●	●		●	●	●

2.6 Product Design and Verification

According to the analysis results of prior user surveys and Kansei analysis, some design direction of the tools kit can be determined. The tools kit consists of five products, including a screwdriver, a tape measure, a hammer, a wrench, and pliers, and the storage container uses clamshell packaging. Since the preferred Kansei words of white-collar workers are simple, superior, and safe, hardware tools can be broken down into some concrete design elements, which are geometric or streamlined handles made of plastic-rubber, or wooden materials with a few design details. Meanwhile, the head of the hardware tools can be designed with a streamlined shape and non-removable. We designed two design solutions, as presented in Fig. 2.
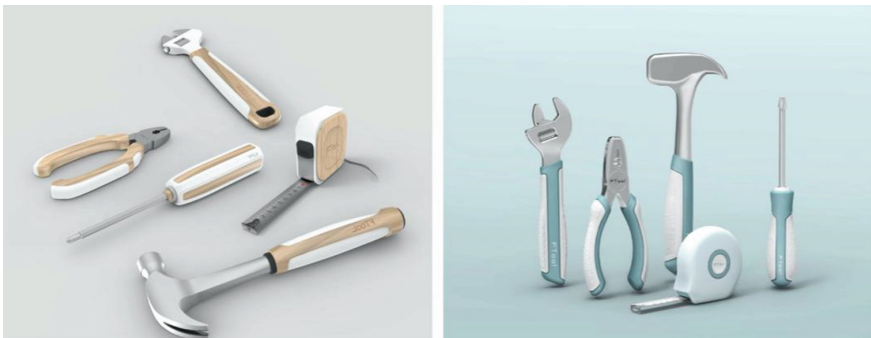
Fig. 2. Design No.1 on the left, and Design No. 2 on the right (Design by Yuting Fan, Huanyun Wang, Yue Wang, Wen Xu).

Table 6. Evaluation result and the average value.

	Simple	Humanized	Durable	Superior	Creative	Safe
Design No. 1	2.09	1.84	1.91	1.86	1.58	1.83
Design No. 2	1.90	1.82	1.84	1.84	1.61	2.05

Finally, we took a verification of the design results. Fifteen white-collar users were invited to evaluate their Kansei perception towards the two design solutions. The seven-scale semantic differential scheme in Table 3 was used to collect their evaluation data, and the average scores were calculated in Table 6. As shown in Table 6, the two design schemes both performed well in terms of simplicity, superiority, and safety. However, the first design with wooden material and geological handles brought users a stronger sensation of simplicity. The streamlined shape of the handle in the second design solution gave users an intensive impression of safety. The verification results proved the validity of prior research conclusions that the geometric handle would give users an impression of simplicity, while the handle with streamlined shape could bring a sensation of safety to users.

3   Conclusions

This study analyzed the application of the Kansei method about hardware tool product design. The study on the practical use of the tool kit for white-collar families confirmed the effectiveness of Kansei Engineering regarding the design of hardware tool products. However, there are still some shortcomings. The user's Kansei evaluation of samples mainly surveyed by subjective evaluation, and there were certain limitations. Subsequent research could consider a combination of physiological and psychological measurement methods.

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On the Influence of "Bauhaus Centenary" in China from Online Public Opinion of 2018–2019

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Abstract. Taking "Bauhaus centenary" as the research object, this paper aims to look at the influence of Bauhaus and the public attitude towards Bauhaus in today's China. Taking the "YQT" as the research tool for the Internet information capture and AI analysis, the relevant network data of the past two years and the whole network analysis reports are obtained. The research mainly consists of two parts, the first is reanalysis of the AI analysis reports including the information amount, regional distribution, key words, hot information; and the second is the content analyzed manually of "2019 Bauhaus 100". Combining the data of the two parts the research reaches the conclusions. It is found that Bauhaus has a limited influence on the Chinese public, with focus on the professional design group and high-end brands in household products. While in other areas, it mostly appears as props or background. The discussion of Bauhaus in the academic circle of design is limited to outdated topics, lacking in the expansion of breadth and the excavation of depth, which has the tendency of ossifying Bauhaus. Another tendency brought is alienating of Bauhaus in business, due to preference to show brands' high-level and nobility in the name of Bauhaus.

Keywords: Bauhaus · Online public opinion · Content analysis · AI analysis · Public attitude

1 Research Background and Methods

As an academy, a spirit or an ideal, Bauhaus is irreplaceable for the development of modern design. In China, the 100 years old Bauhaus is still in operation and present in the field of design and design education. However, Bauhaus is a word with a familiar name and rich connotation, yet vague in meaning. Even so, Bauhaus is almost unknown outside the design field. To study what repercussions the "Bauhaus centenary" caused in China and to further discuss the influence of Bauhaus together with the public attitude to Bauhaus in today's China, an exploratory study is conducted basing on the network big data: "Bauhaus centenary" is the event, the network public opinion monitoring and analysis tools are used for data capture and intelligent analysis, and content analysis of the main information is made after manual review.

This study focuses on qualitative research with quantitative data as the basis. Firstly, Using "YQT"[1] as the research tool, the network public opinion in 2018 and 2019 with two group of keywords "(包豪斯|Bauhaus + 百年|100年)" and "包豪斯| Bauhaus"[2] respectively, with the monitoring periods: 2018/01/01/00:00– 2018/12/31/23:59, 2019/01/01/00:00–2018/12/31/23:59, is monitored and four whole network event analysis reports[3] are produced intelligently. Secondly, comparative re-analysis is conducted for the four analysis reports, and "2019 Bauhaus 100" is determined as the further content analysis object. Then, all the "2019 Bauhaus 100" information data collected are classified and content analyzed on the basis of item by item review.

2 On Whole Network Event Analysis Reports of 2018 and 2019

2.1 Amount of Information

To see Table 1, the information volume of "Bauhaus 100" and "Bauhaus" is 8.88 times and 1.92 times more in 2019 than in 2018 respectively. However, it is found that in the "2018 Bauhaus" there are three pieces of Weibo in August that far exceeds other items, which are "forwarded and delivered" of a famous brand pen, accounting for 60% of the whole year's amount. If that part is removed, 2019 is 4.78 times more than 2018.

Table 1. Comparison of information volume between 2018 and 2019.

Group	2018 amount	2019 amount	Proportion of 2018: 2019
Bauhaus	134351[a]	257387[b]	1: 1.92
	53802[c]	257387	1: 4.78
Bauhaus 100年	4502[d]	39976[e]	1: 8.88

[a]YQT: Network Event Analysis 1 (year 2018, "Bauhaus"), 2020/01/14.
[b]YQT: Bauhaus Network Communication Analysis report (year 2019), 2020/01/17.
[c]the number of copied 3 pieces of Weibo (about "forwarded and delivered" of a famous brand pen) is removed from 2018 amount.
[d]YQT: Network Event Analysis 2 (year 2018, "Bauhaus 100"), 2020/01/14.
[e] YQT: 100 years of Bauhaus (year 2019), 2019/12/31.

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[1] YQT is a big data service platform from Sina for public opinion gathering and analyzing, which is based on Chinese internet big data and exclusive official Sina Weibo.

[2] "包豪斯|Bauhaus" means "包豪斯 or Bauhaus"; "(包豪斯|Bauhaus + 百年|100年)" means "(包豪斯 or Bauhaus) and (百年 or 100年)"; 包豪斯 is the Chinese word for Bauhaus, 100年 is 100 years.

[3] Four whole network event analysis reports are named in abbreviation respectively: "2018 Bauhaus", "2018 Bauhaus 100", "2019 Bauhaus", "2019 Bauhaus 100". Moreover, "Bauhaus" represents "2018 Bauhaus" and "2019 Bauhaus", "Bauhaus 100" represents "2018 Bauhaus 100" and "2019 Bauhaus 100", "Analysis Reports" represents all the four analysis reports.

2.2   Information Peak

The information peak of "2018 Bauhaus" is in August, which is caused by the marketing activity of the pen brand. In addition, the amount of information is relatively stable. The information peak of "2019 Bauhaus" appears between April and May, which is consistent with the centennial anniversary of Bauhaus. The information peak of "2018 Bauhaus 100" appeared in December, and then rose all the way to the annual peak in May of 2019. It can be seen that Bauhaus centenary, as an event, has a great pull for online public opinion (see Fig. 1 and Fig. 2).
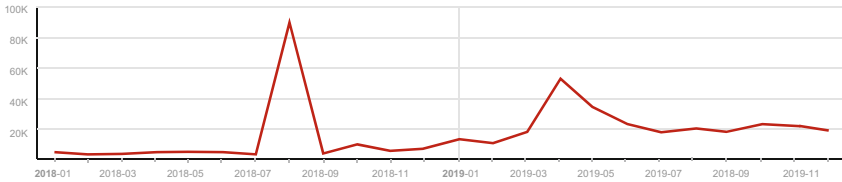
Fig. 1. "Bauhaus" Network information trend chart of 2018–2019 (YQT: Bauhaus Network Communication Analysis report (year 2019), 2020/01/17. YQT: Network Event Analysis 1 (year 2018, "Bauhaus"), 2020/01/14.).
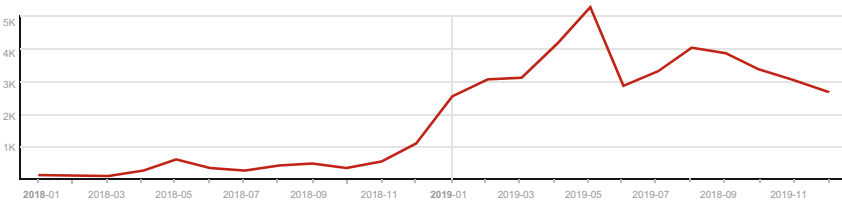
Fig. 2. "Bauhaus 100" Network information trend chart of 2018–2019 (YQT: Network Event Analysis 2 (year 2018, "Bauhaus 100"), 2020/01/14. YQT: 100 years of Bauhaus (year 2019), 2019/12/31.).

2.3   Regional Distribution of Information

From the perspective of the region of information release, Beijing and Guangdong are the top two in China and far ahead in terms of quantity. Shanghai, Jiangsu and Zhejiang basically occupy third to fifth places, with little differences in number and slightly different orders in two years. Qinghai and Tibet always rank in the last two. In general, the amount of information about Bauhaus is consistent with the local cultural and economic development.

2.4   Keywords Cloud

Keywords cloud is the aggregation of hot words with the highest frequency, which is presented in different sizes and positions in the words cloud chart. The larger the font and the more centered the words are, the higher the heat (see Fig. 3). In the chart of the

"2018 Bauhaus", almost all the words relate to the marketing activities of that famous pen brand like "feedback, China, only, extract, pen, 10th anniversary", but not related to Bauhaus. There also are some unrelated words in the chart of "2018 Bauhaus 100" and "2019 Bauhaus", such as "try, chart, pitiful", but not in the chart of "2019 Bauhaus 100". "2019 Bauhaus 100" group is the most consistent with the theme of Bauhaus, indicating that its information is most closely related to Bauhaus.
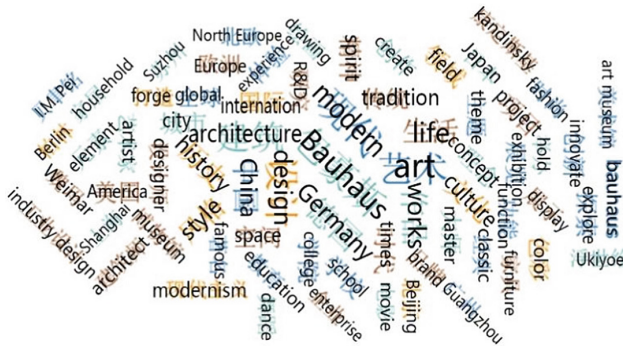

Fig. 3. "2019 Bauhaus 100" Keywords cloud chart (YQT: 100 years of Bauhaus (year 2019), 2019/12/31.).

2.5   Hot Information

Hot information is determined by the number of forwards. The top five items of Sina Weibo and the top five items of other media platforms except Sina Weibo are listed. There is a big difference in quantity between the first and the tenth in each group. The top three with small differences in quantity are all from Sina Weibo.

The top three of "2018 Bauhaus" are all about the marketing activities of that famous brand pen. Two of the top three "2018 Bauhaus 100" are the sharing of Bauhaus documentary. The other is about the flat style of design, which links to Bauhaus by the original text "Bauhaus's design concept has influenced flat style".

Topping the list of "2019 Bauhaus" was a blogger who "discovered a cool rock bar BAUHAUS" and @ a pop star. The following two hot items are about an installation art exhibition by a star singer in Bauhaus square, 798 Art District, Beijing. In "2019 Bauhaus 100", two of the top three are Bauhaus books sharing, and the other is an Ukiyoe exhibition in Bauhaus square as well.

Thus, a significant phenomenon has been formed. The hot information of "Bauhaus 100" is almost the sharing of Bauhaus videos and books, while that of "Bauhaus" is not directly related to Bauhaus itself. Bauhaus, as an advertising spokesman, has emerged from the brand's promotion events, or as a background of entertainment activities. To some extent, this also shows the expansion and influence of Bauhaus.

2.6   Summary

Comparing data between 2018 and 2019, the "Bauhaus Centenary" event has improved Bauhaus' dissemination and influence in China. However, the total amount of information is so small that the quantity of forwarding a hotspot can change the data structure. The topic of #Bauhaus centenary# on Sina Weibo is read only over 7 million times. Compared with other hot topics[4], which are easily over 100 million, it is not a social hot topic at all. In addition, the regional heat distribution is uneven, and the heat is concentrated in the provinces and cities with developed culture and economy. In terms of content, the relevance between the hot information and Bauhaus ontology is not high. While "Bauhaus 100" is relatively higher than "Bauhaus", and "2019" is higher than "2018".

2.7   Re-analysis on "2019 Bauhaus 100" Whole Network Event

According to the above comparative analysis, the content of "2019 Bauhaus 100" is most consistent with Bauhaus itself, so the next step is selecting the data of "2019 Bauhaus 100" for further analysis as a complement to the previous section.

2.8   Related Words

As the related words chart, the word with the highest frequency is extracted as the core word firstly, and then the high-frequency words associated with the core word are found. The higher the frequency of these words and the core word appear together, the closer they are to the core word in the related words chart, meaning the higher the relevance (see Fig. 4).

Fig. 4. "2019 Bauhaus 100" related words chart (YQT: 100 years of Bauhaus (year 2019), 2019/12/31.).

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[4] For example, the Weibo topic about the installation art exhibition of that star is 360 million in reading volume, which is far more than the topic "Bauhaus centenary". Meanwhile, since that exhibition began in Bauhaus square, the curve of "2019 Bauhaus" has increased sharply.

In "2019 Bauhaus 100", "design" is taken as the core word, "work, China, master" as the first circle close to the core with the highest relevance, the second circle is "designer, I.M. Pei, brand", and the third circle is "exhibition, space, museum, Germany, architecture, art, Bauhaus, life, furniture, Shanghai". It can be interpreted that Bauhaus takes design as the core. When Chinese people talk about Bauhaus design, "design masters, design works, design brands, and China related" are more popular, and I.M. Pei is related to it. As a famous Chinese architect and a design master, with many excellent works and high brand reputation, Pei once studied with Gropius in the United States, which is also directly related to Bauhaus. Therefore, I.M. Pei has become more important with the related words compared to the other masters of Bauhaus.

2.9   Hot Information Except Sina

As to the whole network hot information except Sina Weibo, two items are about the current popular styles: Chinese "Nordic style" and Chinese "ins style"; the other two are about design trends like the digital future of architecture and cross-border integration of design and artificial intelligence. The last is about an international architecture forum. All information is related to design. However, Bauhaus is not the subject but merely a side reference.

2.10   Viewpoint Analysis

Viewpoint analysis[5] consists of three parts: news, forum and Weibo[6]. "Bauhaus centenary" is a special event with a long period and wide contents, not just a hot point in news. The aggregation of viewpoints can be regarded as the aggregation of contents, which also reflects the hot spots from another viewpoint.

News Viewpoints. There are eight hot news articles about exhibitions, forums and other event activities, which are carried out by enterprises or governments. Although the activities involve "Bauhaus centenary" a bit, Bauhaus is not the theme at all. The other two are about design style and design trend. None of the ten items take Bauhaus as the subject.

Forum Viewpoints. The top view, accounting for 33%, is the speech of Prof. Liu Guanzhong, known as the father of China's industrial design, who studied in Germany in the early 1980's. Others are diversified in different topics and in similar proportions, making it altogether there are two items about Bauhaus itself.

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[5] The method of viewpoint analysis: First, the information data is merged by keywords, and the items with the same or similar views are clustered. Then, the first 10,000 items are selected and re-clustered, thus the core views are extracted and the first ten items are listed as "viewpoints".

[6] News viewpoint comes from professional media, also known as media viewpoint. Forum viewpoint comes from we- media except Sina Weibo, also called netizens viewpoint. Weibo viewpoint comes from Sina Weibo messages.

Weibo Viewpoints. Three of the ten items are about Bauhaus theme exhibitions. Six items share Bauhaus' videos and albums, with another item being about Japanese Matchbox design influenced by the Bauhaus style. A big V named "German films and contemporary art" provides most of the resources. Therefore, most of Bauhaus' introduction sharing is closer to art than design, such as painting, drama and dance.

2.11   Summary

When Bauhaus is discussed, it is more about things related to Bauhaus, especially by the professional media. Bauhaus is not well understood by the public. We-media do better than professional media in spreading information about Bauhaus. As a representative of "we-media", the information published by Sina Weibo has a higher correlation with Bauhaus.

3   Content Analysis on "2019 Bauhaus 100"

The intelligent *Analysis Report of Whole Network Event* aggregates hot information and does not fully display the network contents. Thus, all information captured in the "2019 Bauhaus 100" are downloaded in 2172 items total after merging similar articles from the total of 13311 items. Every item is read, and the messages with unclear meaning are reviewed by clicking the website one by one, since only the text can be downloaded. From the content point of view, the information is classified as follows.

3.1   Introductions About Bauhaus

As to the introduction data, the heat is followed in turn by books, documentaries, characters, video materials of drama and dance, architecture and products, font and photography. The volume of books and documentaries is about 10% respectively. Documentaries are all from abroad, and most of the books translated are mainly about the classical works. The character introduction covers almost all the masters of Bauhaus, and Kandinsky is the most frequent one. The whole theater and the dance created by Oskar Schlemmer also received a high volume of forwarding, which was not paid much attention by the design circle before. The introductions of architectures and products are few and comprehensively and systematically lacking compared to its numerous works and great influence.

The introduction of Bauhaus has triggered some hot topics, reflecting the influence of Bauhaus on the present life, which has attracted more attention in three aspects: Nordic style decoration dating back to Bauhaus and now flooding in China, Tube-shaped apartment from Bauhaus once accommodated the life and work of many Chinese people, and feminism issues caused by the books and films of *Bauhaus girls*.

The other influences discussed are, such as modernism is still booming in Germany, the origin relationship between Jobs, his Apple and Bauhaus, and the connection of IKEA and Bauhaus design. There are few discussions on the connection of Bauhaus and Chinese contemporary design.

3.2   Brand Marketing by the Name of "Bauhaus Centenary"

In terms of the activities' number and popularity, the business community shows more enthusiasm for Bauhaus than the academic community. There are more than 40 international brands using the name of "Bauhaus centenary" for brand marketing, more than a half of which are from Germany. The most is household products, such as furniture, bathroom products, decorative materials, and home appliances. The second most brand product is watches, while other products include cameras, glasses, pens, notebooks and dining ceramics. All the Germany brands are from traditional manufacturing industries while other international brands are all from Europe, consisting of Italian household products and Swiss watches, Dutch glasses, Swedish clothing, French bags and so on. Most of these brands adopt the method of launching Bauhaus memorial or limited products. The second way of brand promotion is advertising and soft writing, with almost no exhibition and other events.

For Chinese brands, there are more than 20 of them. Most of them are from Guangdong, and are related to residences from architecture to household supplies, including real estate, interior decoration design, shopping mall for house decoration, furniture, decoration materials, kitchen and bathroom products, central air conditioning, and almost everything needed for dwelling. There are also some brands related to fashions, including clothing, men's shoes and vocational training for making clothing. As for the promotion, the most popular is soft advertisement, and the second is the conventional events like forums and exhibitions, though there are not any Chinese brand launches of the Bauhaus Memorial products. In addition to the obvious use of the Bauhaus name in advertisements and soft articles, Bauhaus is also casually mentioned as a shiny prop on other stages, which are dominated by architectural design, interior decoration style, industrial product marketing and tourism promotion.

Although Chinese and European branding methods are different, there is a common feature in advertising: they all focus on high-end and quality. Chinese brands further emphasize the concept of nobility (and high prices undoubtedly) above the concept of high-end, as seen in the slogan of a real estate that reads "apart from nobility, there are no defects".

3.3   Academic Event on Bauhaus

More than 20 Bauhaus themed academic events such as forums, salons and exhibitions have been held by well-known universities and museums in some first and second tier cities such as Beijing, Shanghai, Guangzhou, Qingdao, Xiamen and Kunming, as well as Taipei and Hong Kong. The topics can be divided into three categories:

- the origin and development of modern design from the perspective of Bauhaus.
- whether Bauhaus is an academic, college, style or spiritual.
- the value and significance of education (design education).

All the topics in China are more classic or conservative than new and exploratory. However, there is a forum topic with solicited contributions in Germany on the theme of "Bauhaus's reflection and criticism in the past hundred years".

3.4   Bauhaus Theme Tour Promotion

In early 2019, a variety of study tours and travel promotions became popular. The study mainly focuses on design or architecture. Besides Bauhaus places, the design tours are packaged with Milan design week and some design colleges. The architecture tours are packaged with some contemporary famous masters, such as Tadao Ando, I.M. Pei, Zaha and so on. For different target groups, the types of study tours are also diverse, including summer study, master class, cultural tourism, parent-child trip, Youth Art Troupe. Most of these projects work with German institutions, including the Bauhaus Institute of design.

As a world heritage site on its 100th anniversary, Bauhaus places have been listed as a global tourist destination in 2019 by authoritative travel media such as National Geographic and Lonely Planet. Tel Aviv and Shanghai and other cities also showcase the Bauhaus' architectural heritage in their own tourism promotions. In some Chinese cities like Qingdao, Nanjing, Beijing, Hong Kong, Ganzhou and Jingdezhen, the Bauhaus-style industrial buildings left behind have also become major tour attractions.

3.5   Personal Thoughts on Bauhaus

With more activities around the world taking place the personal reflections on Bauhaus became popular among the Bauhaus fanbase. They pay homage and express love to Bauhaus by sharing some classic pictures and topics after visiting exhibitions, participate in activities, watch films, read books and visit Bauhaus places. The fans also share their favorite things of the Bauhaus memorial edition, represented by the famous pen mentioned above. Meanwhile, there are more netizens who uttered "can't afford".

3.6   Summary

Putting the heat aside, this part focuses on content analysis. All these contents can be divided into two categories. One category is for the commercial service by Bauhaus name, including brand marketing and theme tour promotion, which accounts for just a half of the total. The service targets are mainly household industry and tourism, and the most of brands and activities are high-end. The other category is about Bauhaus itself with more or less academic contents. The main content can be summarized as a homage and worship. In general, going to the high-end in business and looking back to history in academia is likely the present existence of Bauhaus in China, which is far from Bauhaus's concept.

4   Conclusions

Starting from *the whole network event analysis report*, this study gradually focuses on the content analysis of "2019 Bauhaus 100". The response of "Bauhaus centenary" in China is summarized as follows:

- From the perspective of the information heat, according to the data comparison between 2018 and 2019, "Bauhaus centenary" has greatly improved the dissemination and influence of Bauhaus in China. However, the total amount of information is very small compared with the other hot spots, thus, the "Bauhaus centenary" has not been a social hot spot really.
- From the perspective of the regional heat, Beijing and Guangdong are much higher with different heat sources. Beijing is rooted in deep culture, while Guangdong is more rooted in the commercial promotion activities brought by the booming manufacturing industry.
- From the perspective of the information content, the most popular messages exist in commercial and entertainment events, in which Bauhaus appears as a prop or the background. "Bauhaus" group has lower correlation with Bauhaus itself than "Bauhaus 100"; "2018" group is lower than "2019" group; "2019 Bauhaus 100" has the highest correlation with Bauhaus.
- According to the content analysis of "2019 Bauhaus 100", although introduction content accounts for one quarter of the total information, the contents focus on history fragmentation, lack of system and a high-value perspective.
- In terms of events related to Bauhaus in China, the enthusiasm of the business community is higher than that of the academic community. The events in the academic field are relatively conservative with the limited depth and breadth of the discussion topic and without the concept of forward-looking for the future especially.
- As to marketing events in the name of "Bauhaus centenary", Chinese brands prefer exhibitions and forums, focusing on real estate, interior designs and household products, which all are high and expensive brands.
- Compared with professional media, we-media has done better in the popularization of Bauhaus knowledge. Netizens are keen to share Bauhaus' pictures, videos, text materials and the impressions of the exhibitions, and they also like to share small and beautiful Bauhaus commemorative products. However, there is almost no intersection between netizens' concerns and the "noble" brands that are vigorously promoted in marketing events.

Through the network data, it can be seen that "Bauhaus centenary" improves the influence of Bauhaus in China, however it is still limited, mainly in the academic field of design and the business brands of high-end household supplies. The public's attitude towards Bauhaus reflected by these influences is not optimistic. The academic discussion of Bauhaus is confined to outdated topics, which has the tendency of ossification of Bauhaus. Meanwhile, the business community prefers to use the name of Bauhaus to promote high-end and noble brands, which goes against the original spirit of Bauhaus, bringing the danger of alienation of Bauhaus.

A Study of Design Based on Negative Emotions of Modern People

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Abstract. People often had been accompanied by negative emotions using all kinds of products. In this study, our aim was to test what the new method of design through negative emotions could be accepted. It was considered that one of the challenges for designers to transform the negative feelings of consumers into the positive experience. We applied Principal Component Analysis and Cluster Analysis to extract with 10 samples of 5 design concepts turned from 5 Clusters. It concludes that the number of Kansei words using Factor Analysis was reduced and also categorized to 2 factors labeled Form Factor and Affective Value Factor, represent 82.065% of data. A semantic-spatial distribution performed to identify factors and determine specimen's Kansei, displayed an extreme variance of two categories. It was showed that about a quarter of the proposals were clearly accepted by the people, while the rest were ambiguous or rejected. Our research conceptualized the relationship between Kansei evaluation and form characteristics both more qualitatively and more objectively. Each cluster in Kansei space derived from negative emotions of modern people analysis was tabbed with an identified discrimination. The expected results and findings can provide a contribution to make decisions on the creation of developing new design product.

Keywords: Smartphone · Negative emotions · Coping

1 Introduction

As Nagamachi has done in the past forty years, the contemporary designers are used to develop the more "beauty" design through the positive emotions. However, as people feel more and more negative emotions in the use of smartphone, it is increasingly possible to discover new design methods. In this study, it is considered that one of the challenges for designers to transform the negative feelings of consumers into the positive experience.

We aim to test the feasibility of the new method through negative emotions. In this study, an experiment recruiting graduate students of Institute of Design Science the map of phone was conducted to explore the possibility. Works of design were measured via Kansei scale and analyzed in terms of principal component analysis, cluster

analysis and stepwise regression analysis to examine the effect of maps using different design concepts of negative emotions. The results may be attributed to new consumer-oriented products.

2 Literature Review

2.1 Caring and Design

The concept of Sorge (translated to care or caring in English), is used by Heidegger to characterize the basic principle of humans' 'being'. This being is constituted as a being-in-the-world and as a being-together-with-others [1]. Hence, our being presupposes the being of others. Our existence is communion: Our foundational characteristic is that we are living because of and for others for our own sake [2]. For Watson [3, 4], her concern is the human dimensions of nursing care, thus emphasizing the human-to-human relationship, characterized as a caring and healing relationship [3, 4]. In Nodding's explication of an ethic of caring, caring appears as a relational value, "as a mark of a valuable kind of relation . . . [and] a characteristic way of being in the world" [5]. It would be believed that interactivity plays a role in the field of design [6]. Emotional design can enhance the vitality and value of products [7, 8]. Kansei Engineering technology enables his or her image and feeling to be used in the new product. Kansei Engineering is defined as translating technology of a consumer's feeling of the product to the design elements [9].

2.2 Emotion and Emotion Coping

Lazarus [10] distinguishes 15 basic emotions. Nine of these are negative (anger, fright, anxiety, guilt, shame, sadness, envy, jealousy, and disgust), whereas four are positive (happiness, pride, relief, and love) [10]. The theme of anxiety, for example, is the confrontation with uncertainty and existential threat. The core relational theme of relief, however, is a distressing goal-incongruent condition that has changed for the better or gone away [10]. Coping is intimately related to the concept of cognitive appraisal and, hence, to the stress relevant person-environment transactions. Most approaches in coping research follow Folkman and Lazarus, who define coping as the cognitive and behavioral efforts made to master, tolerate, or reduce external and internal demands and conflicts among them. Coping actions can be distinguished by their focus on different elements of a stressful encounter [11]. They can attempt to change the person–environment realities behind negative emotions or stress (problem-focused coping). They can also relate to internal elements and try to reduce a negative emotional state or change the appraisal of the demanding situation (emotion-focused coping) [11].

3   Research Design

3.1   Method

There were four steps in this experiment. Firstly, the researchers collected 20 negative examples using smartphones. Secondly, the researchers extracted the main structures, and analyzed the responses. Thirdly, 7 researchers developed five methods of design on map, showing a total of 10 cases. In the last, 10 groups of students were tested the acceptability of the design by a Kansei scale.

3.2   Selecting the Representative Examples

A pilot trial was conducted to choose the qualified participants. From Institute of Design Science, 20 researchers (Age 18–45, 10 males and 10 females) from different backgrounds and having taken the product design course were recruited. Carried out in the design image course, they collected 63 examples of negative emotions associated with smartphone.

A focus group consisting of 6 senior designers (4 males and 2 females) with an average design experience of more than 6 years was organized and recruited. Through semantic analysis, total examples were discussed and interpreted by the focus group. Furthermore, 20 examples were treated as stimuli for following evaluation in Table 1. Get the similarity matrix in Table 2.

Table 1. The examples of negative emotions.

NO.	Description
1	Stay up all night
2	Choice difficulties
3	Post-holiday phobia
4	Aphasia
5	Cheat picture
6	Social phobia
7	Face blindness
8	Selfie
9	Phone dependence
10	Senile
11	Phobia of overtime
12	Autism
13	Procrastination
14	Follow-up
15	Night snack
16	Shopping bonanza
17	Obsessive compulsive disorder
18	Speech phobia
19	Pre-meal photo syndrome
20	Anxiety

Table 2. Similar matrix.

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16	Sample 17	Sample 18	Sample 19	Sample 20
S1	10.0	8.3	8.4	8.0	10.0	7.6	5.4	5.6	3.7	5.86	7.3	3.4	5.9	7.9	2.9	7.1	6.6	8.6	9.1	6.1
S2	8.3	10.0	6.3	3.7	9.0	2.9	8.3	8.9	8.7	5.6	5.1	4.4	2.7	5.3	8.4	8.6	2.0	7.9	8.6	2.9
S3	8.4	6.3	10.0	8.9	9.3	3.1	6.3	7.3	5.3	8.3	3.3	3.9	8.1	8.3	9.4	9.4	9.4	7.9	7.9	4.3
S4	8.0	3.7	8.9	10.0	6.9	3.4	6.9	7.7	7.6	8.0	8.0	6.9	7.3	3.7	8.1	8.1	8.1	3.9	8.1	4.6
S5	10.0	9.0	9.3	6.9	10.0	4.6	7.4	3.4	5.1	4.4	8.6	8.3	8.4	10.0	9.6	8.0	7.3	9.0	7.1	8.9
S6	7.6	2.9	3.1	3.4	4.6	10.0	3.6	6.3	4.7	3.6	5.7	8.0	6.3	5.3	7.0	9.1	8.3	9.0	9.9	8.0
S7	5.4	8.3	6.3	6.9	7.4	3.6	10.0	4.3	5.0	4.4	7.9	5.4	6.3	7.4	9.1	9.0	8.9	9.1	10.0	6.9
S8	5.6	8.9	7.3	7.7	3.4	3.6	4.3	10.0	6.3	2.0	7.1	7.3	8.0	8.0	8.1	7.1	9.9	7.3	6.4	6.4
S9	3.7	8.7	5.3	7.6	5.1	4.7	5.0	6.3	10.0	6.3	7.3	3.7	6.4	8.3	8.0	9.0	3.6	7.3	9.0	8.0
S10	5.9	5.6	8.3	8.0	4.4	3.6	4.4	2.0	6.3	10.0	3.9	3.1	2.0	4.3	8.3	3.9	9.1	4.7	2.0	8.1
S11	7.3	5.1	3.3	8.0	8.6	5.7	7.9	7.1	7.3	3.9	10.0	5.4	3.4	6.6	7.9	9.1	2.0	7.1	10.0	7.4
S12	3.4	4.4	3.9	6.9	8.3	8.0	5.4	7.3	3.7	3.1	5.4	10.0	9.1	6.6	10.0	9.1	8.9	7.6	5.6	6.4
S13	5.9	2.7	8.1	7.3	8.4	6.3	6.3	8.0	6.4	2.0	3.4	9.1	10.0	3.9	10.0	6.9	7.4	8.3	4.3	6.7
S14	7.9	5.3	8.3	3.7	10.0	5.3	7.4	8.0	8.3	4.3	6.6	6.6	3.9	10.0	9.1	3.7	8.3	9.1	4.3	6.7
S15	2.9	8.4	9.4	8.1	9.6	7.0	9.1	8.1	8.0	8.3	7.9	8.7	4.7	9.1	10.0	5.4	7.4	8.3	7.1	8.4
S16	7.1	8.6	9.4	8.1	8.0	9.1	9.0	7.1	9.0	3.9	9.1	9.1	6.9	3.7	5.4	10.0	5.6	9.1	7.6	5.6
S17	6.6	2.0	9.4	8.1	7.3	8.3	8.9	9.9	3.6	9.1	2.0	8.9	7.4	8.3	7.4	5.6	10.0	6.9	8.3	3.3
S18	8.6	7.9	7.9	3.9	9.0	9.0	9.1	7.3	7.3	4.7	7.1	7.6	8.3	9.1	8.3	6.9	6.9	10.0	9.1	3.9
S19	9.1	8.6	7.9	8.1	7.1	9.9	10.0	6.4	9.0	2.0	10.0	5.6	8.1	4.3	7.1	7.6	8.3	9.1	10.0	7.1
S20	6.1	2.9	4.3	4.6	8.9	8.0	6.9	6.4	8.0	8.1	7.4	6.4	3.7	6.7	8.4	5.6	3.3	3.9	7.1	10.0

Analyzed in terms of principal component analysis and cluster analysis, 5 Clusters were further extracted (Fig. 1 and Fig. 2).
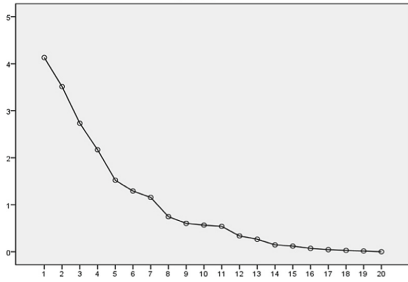
Fig. 1. Result of principal component analysis.
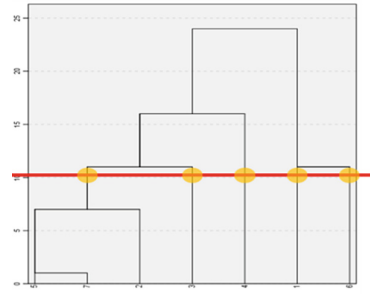
Fig. 2. Result of cluster analysis.

Cluster 1: This group are composed of Sample1 and Sample 15. Coping strategies can be summarized as "Coping of staying up late" because the common is attributed to night work or life. "Coping of staying up late" is named CP1.

Cluster 2: This group are composed of Sample 2, 6, 7, 9, and 2. Coping strategies can be attributed to "coping alone" because the common is a fear of social living. "Coping alone" is named CP2.

Cluster 3: This group are composed of Sample 5, 8, 10, and 19. Coping strategies can be attributed to "narcissistic coping" because of thinking too much of themselves. "Coping narcissistic" is named CP3.

Table 3. Coping of design.

Coping (1-5)	Transforming	Visual design	Examples of design
	• Designed with maps which are developed by researchers. • Negative emotions turn into positive reminders. • The form of painting must be modern and implicit.	Reading in blue light	

Cluster 4: This group are composed of Sample 17, 20, 11 and 13. Coping strategies can be attributed to "twisted coping" because the common is t indecision. "Coping twisted" is named CP4.

Cluster 5: This group are composed of Sample 14, 16 and 18. Coping strategies can be attributed to "Coping of following" because their common is a lack of independent personality. "Coping of following" is named CP5. For example, Table 3, 10 proposals of map are designed by the coping strategies.

3.3   Selecting the Representative Kansei Vocabularies

In Institute of Design Science, 10 samples of design were tested by 10 teams (Age 18–45.3 per team), from different backgrounds and having taken the product design course.

A focus group consisting of 6 senior researchers (4 males and 2 females) with an average design experience of more than 6 years collected 9 pairs of kansei vocabularies (k1 Comfortable-uncomfortable, k2 confident-unconfident, k3 Low key-high key, k4 happy-unhappy, k5 natural-unnatural, k6 active-unactive, k7 humor-inhumor, k8 embarrassed-unembarrassed, k9 accepted-unaccepted), and 10 examples were treated as stimuli for following evaluation in Table 4.

Table 4. Measure of Kansei.

Measure of Kansei vocabularies		Example of design
positive ■ ■ ■ ■ ■ ■ ■ ■	negative	
comfortable	uncomfortable	
confident	unconfident	
low key	high key	
happy	unhappy	
natural	unnatural	
active	unactive	
humor	inhumor,	
embarrassed	unembarrassed	
accepted	unaccepted	(1-10)

4   Results and Discussions

This approach builds a link between 10 samples of design and 9 pairs of vocabularies for demonstrating all differences statistically through perception-cognition-evaluation phase by factor analysis and Kansei Space, as shown in Table 5 and Fig. 3.

Table 5. Results of Kansei vocabularies.

Kansei	k1	k2	k3	k4	k5	k6	k7	k8	k9
sam1	4.3	4.6	3.8	4.3	4.2	4	4.3	3.2	4.3
sam2	4.3	5.1	3.7	4.8	4.3	4.1	3.9	3.3	3.9
sam3	3.4	2.6	5.1	2.9	4.2	2.7	3.2	3.2	2.9
sam4	3.8	2.5	5.4	3.9	5.2	3.4	3.7	3.5	3.7
sam5	2.4	3.1	3.8	3	3.1	3.7	3.5	4.8	2.5
sam6	2.8	3.4	4.3	2.3	2.9	2.5	2.6	4.5	2.3
sam7	2.5	2.9	4.7	2.7	2.8	2.8	3.0	4.3	2.9
sam8	4.6	4.0	4.4	4.2	4.8	3.5	4.0	3.6	3.3
sam9	3	2.4	3.8	3.1	3.4	4.3	3.8	3.8	2.3
sam10	3.3	2.9	4.1	3.2	3.1	3.6	4.1	3.5	2.9
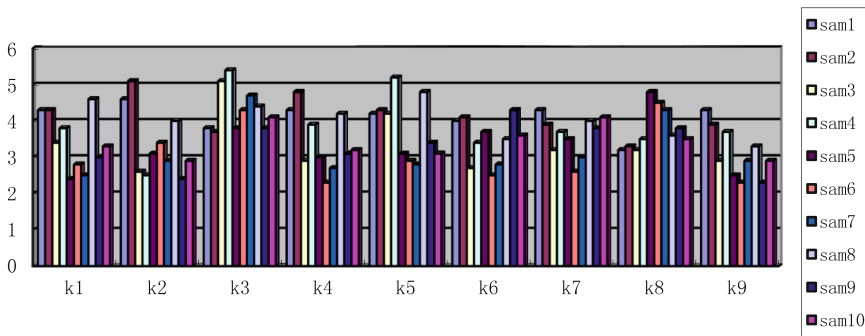
Fig. 3. The occurrence points of 10 samples.

4.1   Factor Labels for the Extracted Factors

This analysis method in Table 6 is a statistical data reduction technique employed to explain variability among observed random variables, in terms of fewer unobserved random variables named factors. Factor analysis has the advantage that all the involved variables could play the same role. It is used to define important individual factors as the vocabularies are too many or have complicated correlations.

We named and labeled the two constructs as 'Form Factor'(F), 'Affective Value Factor'(A). F is the art feeling of appearance of the shape, A is a subjective feeling of overall appearance.

Table 6. Results of component

	Component	
	1	2
k5	.944	
k1	.909	.309
k8	−.859	−.104
k4	.793	.552
k3	.331	−.924
k6	.247	.844
k7	.580	.668
k2	.348	.650
Total:	4.614	1.951
% of Variance:	46.436	35.629
Cumulative %:	46.436	**82.065**
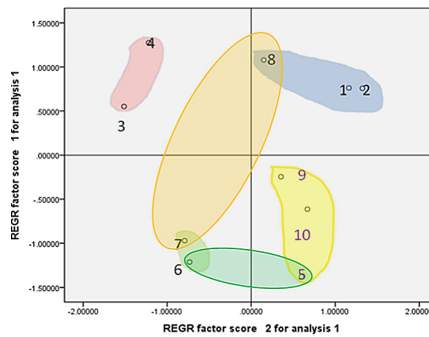
Fig. 4. Kansei space between M and A.

4.2 Distribution of Kansei Space

We have listed S1–S10 according to the above-mentioned as 2 factors to build 2 axes. This helps us to see how items (variables) are organized in Kansei Space. The CP1 is located within the first quadrants. The CP2 is located within the second quadrants. The CP5 is located within the fourth quadrants. The CP3 is located within the third and fourth quadrants. The CP4 is located within the first and third quadrants in Fig. 4.

4.3 Relationship Between Kansei Vocabularies and Acceptability

Stepwise regression analysis was performed to examine the relationship between Kansei vocabularies and acceptability, the results of which are shown in Table 7. K4 could explain up to 70.9% of the occurrence of K9, indicating that K1–K3, K5–K8 play little in determining the Acceptability.

Table 7. Results of stepwise regression analysis.

Kansei acceptability	Model	R	R-Square	Adjusted R-Square	F change	Sig. F change	Predictable variable: Kansei vocabularies
K9	1	.861	.741	.709	22.904	.001***	K4

* $p < .05$; ** $p < ..01$; *** $p < .001$

5   Conclusion

Our research conceptualized the relationship between Kansei evaluation and form characteristics both more qualitatively and more objectively. Each cluster in Kansei space derived from negative emotions of modern people analysis was tabbed with an identified discrimination. The Kansei Engineering approach can be conscientiously visualized the customers' feelings toward concepts of design with high validity and reliability. Furthermore, it can be combined with expert systems and emotions targeted decisions aimed at customers' preferences. To the end, the following conclusions are drawn from current study's findings: (1) The present study applied Principal Component Analysis and Cluster Analysis to extract with 10 samples of 5 design concepts turned from 5 Clusters. (2) It concluded that firstly, using Factor Analysis the number of Kansei words was reduced and also categorized to 2 factors labeled Form Factor and Affective Value Factor, represent 82.065% of data. A semantic-spatial distribution performed to identify factors and determine specimen's Kansei. It was showed that about a quarter of the proposals were clearly accepted by the people, while the rest were ambiguous or rejected. (3) In 8 variables, *happy and unhappy* was the most predictive factor. To sum up, there is a complicated psychological process for the public to accept the method of negative emotions. Being the goodwill design, people need to develop more accurate design techniques. The expected results and findings can provide a contribution to make decisions on the creation of developing new design product.

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Research on Guidance Design in Elderly Medical Products Based on Kansei Engineering

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Abstract. To study the perceptual needs of the elderly on the guidance of medical product interface, and to put forward effective suggestions for the guidance design in medical products for the elderly. In this paper, the perceptual engineering method is used to analyze the physiological characteristics and psychological characteristics of the elderly such as vision, hearing, perception, and then use questionnaires and interviews to obtain the elderly's perceptual preference for medical product interfaces. Through quantitative analysis, emotional preferences are transformed into design elements. In the design, the perceptual needs of the elderly were emphasized, and a quantitative model was established for the guidance design of the medical interface for the elderly based on the perceptual evaluation system. Further research has led to guidance design methods that focus on the perceptual needs of elderly users, which can improve the medical experience of the elderly and promote the development of the elderly medical industry.

Keywords: Guidance design · Medical interface · Kansei engineering · Perceptual needs

1 Introduction

With the emergence and development of the Internet and mobile digital devices, smart medical care is slowly integrating into people's lives. Some audiences with limited ability to adapt to new things, especially the elderly, are caught off guard when facing these kinds of emerging medical approaches. Guidance is indispensable in the life of the elderly. The development of information technology has brought opportunities to the guidance design in modern elderly medical product. The rise of interface guidance design is not only to make users understand relevant information more convenient and quickly, but also to lead the elderly to accurately find the target information and implement related operations. This saves time and effort, is safe, and environmentally friendly.

Facing the scourge of pneumonia, it is foreseeable that in the future, people's medical habits will gradually be transferred from the physical environment to a more convenient and safe online environment. In particular, the elderly have relatively low immunity and this increases susceptibility to diseases, and the demand for elderly

medical services will increase accordingly. Online medical care for the elderly has already attracted attention. However, due to the lack of investigation and research on the perceptual needs of elderly medical care in the market, there are very few medical product interfaces specifically designed for the elderly. Therefore, targeted design to effectively solve the guidance problem of elderly medical interface has become necessary.

Due to the special physiological and psychological characteristics of the elderly, the medical product interface based on the universal design cannot really meet their needs that are different from the general population [1]. Relatively speaking, the medical needs of the elderly are more direct and frequent, but the interaction interface with many functional levels, complex operations and high intelligence often makes the elderly feel discouraged by the interface of medical products. Therefore, it is imminent to design a more humane, emotional, and aging-friendly medical interface centered on the perceptual needs of the elderly using forward-looking Kansei engineering methods [2].

2 Research on the Needs of Elderly Medical Guidance

2.1 Analysis of the Physiological and Psychological Characteristics of the Elderly in the Medical Environment

The psychological characteristics of the elderly are manifested in a decline in their sense of psychological security, weakening of their ability to adapt to a new environment, and a tendency to feel lost, inferior, lonely, and even a sense of crisis and fearful of new things. Secondly, due to the limitation of physiological conditions, such as vision loss, the perception of brightness, significantly reduced perception of brightness, space, and color [3]; decreased hearing and selective attention; slower actions; short-term memory loss and deteriorating thinking, etc. [4] These factors have increased the complexity and difficulty in designing targeted guidance for the elderly to varying degrees, as shown in Table 1.

2.2 Research Status of Medical Guidance Products for the Elderly

At present, the research on guidance design of medical products in China is generally based on the universal design, and a few research on medical guidance design for the elderly. Research on the design of medical product interface guidance for the elderly is lacking theoretical support and systematic and complete practice. Comparatively speaking, the research results of medical product guidance designs in developed countries such as Japan, Europe, and the United States are at a relatively advanced level. They have realized the particularity of vision-oriented design in geriatric hospitals earlier, and have made some significant achievements in practice.

Compared with domestic designs, it highlights the characteristics of elderly patients, and uses colors more freely and in place. It is more systematic to take into account the deep psychological needs of the elderly in the design, such as investigation of changes in vision, hearing and human perceptions [5]. The minimum recognizable

Table 1. The effect of changes in physical functions on guidance for the elderly.

Sensory type	Impact on guidance
Vision	①Vision: vision loss, font and image size of the guidance interface directly affect the guidance effect; ②Brightness perception: The sensitivity and adaptability to brightness will be reduced to varying degrees, and the guidance interface brightness and color brightness are moderate; ③Color perception: As the lens becomes yellow and turbid, the ability of the elderly to recognize blue is more obvious than the ability to identify red and green, so try not to use blue for interface colors.; ④Spatial Vision: Due to the decline of surrounding vision and visual field, the elderly usually cannot see the objects in front of them, and cannot accurately distinguish the distance and height of the objects
Hearing	①Sound frequency: not sensitive to high-frequency sound waves, high-pitched sounds; ②Sound size: It is more difficult to hear smaller sounds. Pay attention to the loudness of the audio guide design; ③Auditory Attention: As you age, your selective focus on hearing begins to decline
Response capability	①Response speed: Due to physiological reasons, the elderly's response becomes sluggish
Cognitive ability	①Information reception: The ability to receive information decreases, and sensory analysis becomes slow
Memory capacity	①Memorization method: The elderly's memory ability is weakened, and it is difficult to learn new knowledge. In the interaction method, a familiar natural interaction method should be used
Thinking ability	①Judgment and Reasoning Ability: Concept, logical reasoning and solving ability are gradually lost, and the guidance needs to be accurately and intuitively displayed to users

character size for different age groups is also indicated in the Japanese JIS specification, as shown in Fig. 1. In Min Shi's Research on Kansei Engineering System Establishment for Elderly Product Design, the minimum viewing angle that the elderly can accept is 0.75°, the viewing distance is 43 cm, and the character height after conversion is equivalent to 5.62 mm [4].

3 Interface Guide Design of Elderly Medical Products Based on Kansei Engineering

3.1 Sensitive Image Analysis of the Elderly

According to Maslow's Hierarchy of Needs theory, the needs of seniors for medical product interface guidance design are divided into instinct, behavior, and reflection layers. The design elements of existing medical product interfaces are analyzed and subdivided to obtain accurate users' perceptual needs. When the basic functions are satisfied, more emphasis is placed on the principles of rationality, ease of use, safety, interactivity, and emotional factors. The perceptual factors are integrated into the

Fig. 1. Minimum recognizable character size for different age groups.

guidance design of the medical product interface, and the semantic difference method [6, 7] is used to explore the interactive relationship between people and the environment, which assists the design by constructing a correlation model between users' perceptual intention and guidance design elements to help bring better medical experiences to the elderly, and provide new ideas for the design and research of interface guidance in elderly medical products [8].

3.2 Product Samples and Perceptual Image Vocabulary Determination

The collection and screening of perceptual image vocabulary represents the subjective impression of elderly users on the interface of medical products, and it can more intuitively reflect product availability and users' psychological experience. Therefore, this article first establishes a database of perceptual vocabulary related to the medical product interface of the elderly. We collect 80 related perceptual vocabulary through relevant literature, network data, user interviews, etc. and select the most directly related and most relevant words of medical product interface from the elderly. Ten groups of high-frequency words were chosen to represent user impressions, which were: Concise ——Complicated; Intuitive——Abstract; Comfortable——Awkward; Regular—— Messy; Generous——Restrained; Clear——Fuzzy; Streamed——Angular; Technological——Traditional; Delicate——Pool made; Beautiful——Tacky. As shown in Table 2 [6, 9].

3.3 Extraction of Modeling Design Elements

The semantic difference method was used to establish a 5-level scale for the 10 groups of perceptual image words that were finally selected. The levels are −2, −1, 0, 1, 2, respectively, where "2" indicates that the expectations for the guidance design of

Table 2. List of 10 typical perceptual image vocabulary.

Number	Perceptual image vocabulary
1	Concise——Complicated
2	Intuitive——Abstract
3	Comfortable——Awkward
4	Regular——Messy
5	Generous——Restrained
6	Clear——Fuzzy
7	Streamed——Angular
8	Technological——Traditional
9	Delicate——Pool made
10	Beautiful——Tacky

medical product interfaces are more inclined towards the adjectives on the left (such as the adjective "Concise" on the left side of the first line), while "−2" refers more towards the adjectives on the right (such as the "Complicated" adjective on the right side of the first line), as shown in Fig. 2. A total of 30 elderly with medical interface guidance needs were invited to participate in this questionnaire. Participants all had experience using medical product interfaces. Its variables include participant age, gender, education level, and physical fitness. Among them, there are 12 males and 18 females, and the age range is between 60–75 years [10].
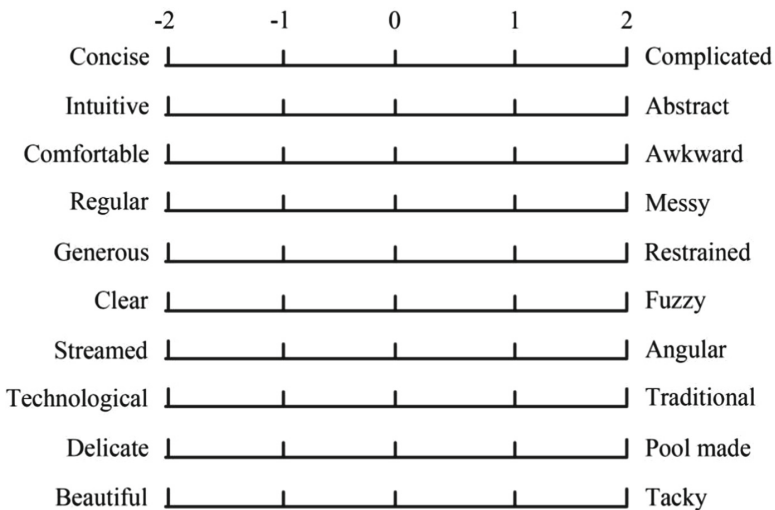
Fig. 2. Questionnaire scale.

30 valid questionnaires were collected, and each group of adjectives with relative meanings was quantitatively analyzed. The evaluation consisted of five grades: very good, good, general, poor, and bad, and allowed the interviewees to evaluate each evaluation factor according to their subjective view. Taking the "Concise" factor as an example, there are 28 people that think it is "very good", 9 people think it is "good", 1 person thinks it is "general", and none thinks it is "poor" or "bad". Finally, the questionnaire generates the evaluation results, as shown in Table 3.

Table 3. Questionnaire evaluation results data.

Perceptual vocabulary	Subjective evaluation				
	Very Good	Good	General	Pool	Bad
Concise	28	9	1	0	0
Intuitive	24	6	0	0	0
Comfortable	17	11	2	0	0
Regular	19	9	2	0	0
Generous	15	8	7	0	0
Clear	27	3	0	0	0
Streamed	13	5	12	0	0
Technological	8	5	17	0	0
Delicate	14	6	10	0	0
Beautiful	14	3	13	0	0

According to the subjective evaluation of the users by the questionnaire evaluation results, the ISD scale was used to weigh the average of the scores of each option of each questionnaire, and the expected analysis curve chart of the medical guidance was drawn to determine the interface guidance of the elderly medical products. See Fig. 3 for the design elements of perceptual intention design.

3.4   Extracting Design Elements from Perceptual Intention Evaluation

According to the expected analysis curve chart, the perceptual vocabulary with a higher average score is established as a design element for positioning the medical guidance interface for the elderly. According to the survey results, it was concluded that the testees hoped that the medical guidance interface for the elderly was intuitive, clear and comfortable [1].

1) The intention is intuitive and clear. Intuitive intention is the first characteristic of Kansei needs, that is, the role and function of the product can be clearly identified when using the interface. The primary purpose of the elderly group when using the interface of the guidance product is to find the target information content. Subjective judgment is a very important part, allowing elderly users to quickly make correct judgments, making their psychological state easier during use, and avoiding unnecessary negative emotions.
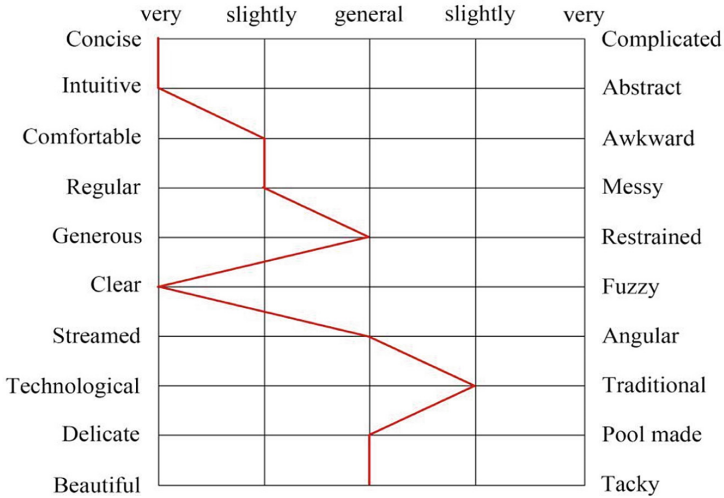
Fig. 3. Sensual expectation style curves for interface guidance design of elderly medical products.

2) The guidance function is clear. Clarity is mainly expressed by design details, such as setting icons, fonts, character sizes, and character colors on the interface according to the reading habits of the elderly, such as easy-to-understand icon images.

3) The interface is visually comfortable. This sense of comfort is reflected in the entire process of the product interface, including the sense of stability for the elderly in different colors [11], the softness of fonts, and reasonable human-computer interaction methods.

   This helps understand the problems and expectations encountered by elderly users in the daily use of digital medical product interfaces. Then, through forward qualitative reasoning and hierarchical recursion to get the perceptual intention characteristics into the elderly medical product interface guidance design perceptual demand design points, the following design model tree diagram is obtained, as shown in Fig. 4.

   According to the tree diagram of the questionnaire results and the design model, the interview method was used to conduct one-on-one in-depth interviews with the interviewees. Through literature review and analysis, and referring to the user experience honeycomb model [12], it allowed for further construction of the influencing factors of the guidance design scheme for elderly medical products. The 6 dimensions and 15 impact factors of the quantitative model were extracted, and the design elements for the guidance design of the elderly medical product interface were obtained, as shown in Table 4.
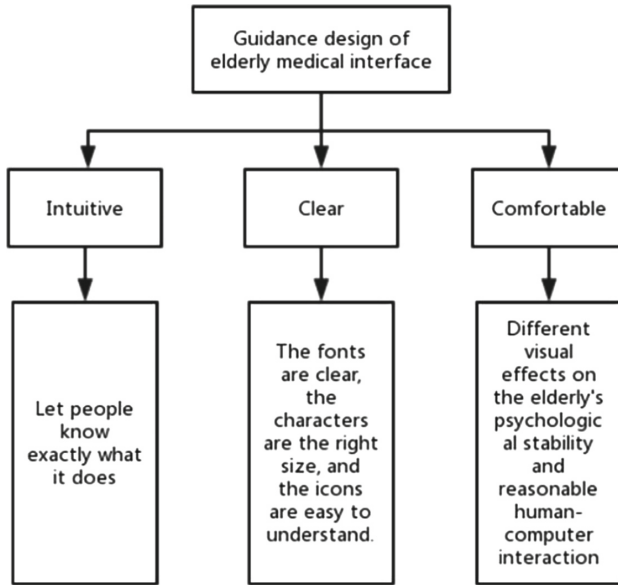
Fig. 4. Interface design model of geriatric medical guidance.

Table 4. Design elements of interface guidance design for geriatric medical products.

Dimensions	Impact factors
Usability dimension	①Clear functions and simple operation procedures can help users solve practical problems such as basic navigation ②The guidance service system is designed reasonably and meets the design standards ③Contains outpatient information of each department of the hospital, user navigation and service requirements
Easy-to use dimension	①The guidance service platform has a clear and clear design, with clear functions such as area navigation and destination information services ②The service guidance system has reasonable guidance and reflects the speed and efficiency ③Service guidance facility interface is convenient and easy to operate
Practical dimension	①Can accurately provide service information such as clinics and location information ②Can provide other relevant information
Reliability dimension	①User's personal positioning and demand orientation are accurate, without deviation ②Guide the stability and real-time nature of information services, and inform users of changes in information in a timely manner ③Users can promptly remind and correct when they make or produce wrong operations
Legibility dimension	①Service guidance interface can be designed based on shape, size, icon, color, etc.
Interactive dimension	①Guidance system can generate good interaction with users ②Give users a good interactive experience, and strive to reach the level of natural human-computer interaction ③It can expand more novel interaction methods, taking into account factors such as multi-sensory channels and personalized matching, such as tactile interaction, auditory interaction, and olfactory interaction

4   Conclusion

Based on the analysis of the above studies, it is found that in the design of interface guidance for elderly medical products, it is necessary to incorporate the perceptual needs of intuitiveness, clarity and comfort suitable for the elderly. In addition to the basic considerations such as large font size, softer font lines, and more vivid colors, human-computer interaction should adopt a more guided interaction method to allow the elderly to obtain target information more quickly and accurately. Together with making correct behavioral operations, you can better understand the humanistic care of the design while treating the disease.

At present, the guidance design of elderly medical products in China is still in the exploratory stage, and there are very few targeted studies on people with special needs. To make a breakthrough in this regard, it is necessary to start from the users' perceptual needs, mine the users' potential perceptual preferences, and develop a targeted design strategy by combining quantitative models. With this study as a reference, we will provide new possibilities for the guidance design and research of elderly medical products in the future.

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Impact of Internet Use on Subjective Well-Being Among Future Elderly in China: The Mediation Role of Loneliness

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Abstract. With the rapid popularity and promotion of Internet in China, the age of people using Internet has been gradually spreading from young group to middle-aged and elderly, and the Internet use has become an integral part of their lives. In order to explore the potential of Internet for the elderly service industry in the future and its impact on the subjective well-being of the future older adults, this study selected 459 Chinese people aged 45–60 as the research object, and adopted the UCLA Loneliness Scale, Subjective Well-Being Scale and Internet use questionnaire to explore the impact of Internet use on subjective well-being of the future elderly in China, using loneliness as a mediation variable. The result shows that: First, the Internet use of future elderly people in China will mainly focus on five aspects including social interaction, entertainment, life service, information acquisition, and personal development. Second, the ability of Internet use degree of elderly people will be significantly affected by some demographic variables include age, occupation, income, and education level while other variables like gender, marital status and housing way do not have significant influences. Last but not least, Internet use will have a significant positive impact on the subjective well-being of future elderly in China, and among them, loneliness will have a complete mediation effect. To sum up, it is concluded that Internet use can significantly promote the subjective well-being of future elderly in China by reducing their loneliness level.

Keywords: Internet use · Subjective well-being · Loneliness · Future elderly · Chinese · Mediation effect · Empirical research

1 Introduction

As the most populous country in the world, the aging population in China will reach 235 million in 2030 and 333 million in 2050 [1]. China will become the country with the largest number of aging populations in the world and will encounter with serious aging challenges in the coming decades. Facing the severe problem of aging, Internet and Intelligent technology will become one of the most important approaches for China to cope with the aging society dilemma in the future [2]. On one hand, the rapidly growing population of elderly people will bring tremendous pressure to the whole

Chinese society, but on the other hand, large number base of aging population in China means tremendous aging industry market opportunities [3]. This study will explore the impact of Internet use on subjective well-being for future elderly, taking loneliness as the mediating variable, to analyze its mediation mechanism between Internet use and subjective well-being. The reason why the author focus on loneliness is because it is one of the most serious psychological problems of the elderly and is the culprit of many mental and physical diseases for them [4]. If the research could find that the Internet use could positively affects the subjective well-being of future elderly and could reduce the loneliness level to improve the quality of life for older adults, then it will provide the evidence of Internet technology will affect the happiness of Chinese elderly, at the same time, means there is huge and prosperous elderly market of Internet in China and it will have great potential in dealing with the aging society challenges in the future.

2   Literature Review

Subjective well-being (SWB), as one of the important research fields of Positive Psychology [5], has received extensive attention from researchers. It is an individual's overall evaluation of his own quality of life, and it is one of the important indicators of the individual's mental health level [6]. It has two main components: life satisfaction and emotion experience, including positive and negative emotion [7]. Since the concept of subjective well-being was proposed, related scholars have paid close attention to the standardized measurement of subjective well-being and proposed a series of measurement indicators. Diener has developed a subjective well-being scale, which includes two parts, namely the positive and negative affect scale (PANAS) and the Satisfaction with life scale (SWLS), has been widely adopted [8]. Other scales, like the Index of Well-Being (IWB) compiled by Campbell includes two parts which are the satisfaction of life and perceived stress [9]. Memorial University of Newfoundland Scale of Happiness (MUNSH), which is applicable to the elderly and has been widely used [10].

Loneliness refers to the subjective experience of an individual who feels isolated or lacks interpersonal contact resulting in unpleasantness or pain [11]. It is also one of the most serious psychological problems of the elderly, and is the culprit of many mental and physical diseases [4]. Regarding the measurement of loneliness, different researchers have proposed different measurement scales. The commonly used one is the third edition of UCLA (University of California at Los Angeles) revised by Russell in 1988 [12]. Wittenberg compiled an Emotional versus Social Loneliness Scale based on the theory of social needs proposed by Weiss in 1973. This scale was widely used in the measurement of adult loneliness [13].

According to the Law of the People's Republic of China on Protection of the Rights and Interests of the Elderly, people over the age of 60 are positioned as the elderly, while those aged 45–60 are defined as the middle-aged [14]. There are many studies on the physical and psychological health field of the elderly, but few studies focusing on how the Internet use could affect them, no mention to focus on Chinese future elderly group. Some international researchers put forward internet could improve the

psychological well-being of people, but the majority of them are focused on young group and adolescence [15–17], few of them focus on elderly group and they have not explored the mechanism and conduct empirical research [18–20], no mention taking the Chinese future elderly group as research object.

3 Method

This study compiled a questionnaire based on the literature review and the characteristics of Chinese future elderly people, along with the characteristics of the Chinese Internet industry. Using the UCLA loneliness scale compiled by Russell and the Subjective Well-being Scale proposed by Diener as the measurement of the loneliness and subjective well-being level of future elderly in China. The Internet use part refers to the questionnaire of young people's, combined with the questionnaire for the elderly compiled by Lagana in 2008 [21]. We randomly distributed questionnaires on Chinese Internet platforms, and received a total of 482 responses, of which 459 were valid questionnaires, with a recovery rate of 95.23%. According to the reliability and validity analysis, the Cronbach's α coefficient of the scale is 0.930, which is close to 1, and the KMO value is $0.972 > 0.9$, which shows that the research scale has good reliability and validity.

The paper uses path analysis and Structural Equation Modeling (SEM) to conduct data analysis and was performed by IBM SPSS25.0 and AMOS24.0. The following is the main assumptions having been proposed:

H1: Internet use will positively affect the subjective well-being of future elderly.
H2: Internet use will negatively affect the loneliness of future elderly.
H3: Loneliness will negatively affect the subjective well-being of future elderly.
H4: There is mediation effect of Loneliness between Internet use and the subjective well-being of future elderly.
H5a: The age variable could significantly affect the Internet use.
H5b: The gender variable could significantly affect the Internet use.
H5c: The marital status variable could significantly affect the Internet use.
H5d: The housing way variable could significantly affect the Internet use.
H5e: The education level variable could significantly affect the Internet use.
H5f: The occupation variable could significantly affect the Internet use.
H5g: The monthly income variable could significantly affect the Internet use.

4 Result and Analysis

4.1 Internet Use Characteristics of Future Elderly and the Influencing Factors

The demographics information statistics of these 459 respondents are shown in Table 1. In order to analyze the potential of Internet technology in the elderly industry in the coming decades, the researcher has picked up the people whose age are between

45–60 years, which will enter the aging stage in 15 years. They are the group wit-
nessing the development and prosperity of Internet industry in China and staying very
suitable for research subject.

Table 1. Sample demographics information statistics.

	Gender		Age			Marital status			
Type	Male	Female	45–50	51–55	56–60	Single	Married	Divorced	Widowed
N	183	276	377	60	22	62	382	13	2
Percentage	39.9	60.1	82.1	13.1	4.8	13.5	83.2	2.8	.4
	Way of living								
Type	Alone	With spouse		With children		With spouse and children			With others
N	57	211		52		123			16
Percentage	12.4	46.0		11.3		26.8			3.5
	Education level								
Type	<High school		High school		Associate		Bachelor	Master	Doctor
N	36		57		103		235	23	5
Percentage	7.8		12.4		22.4		51.2	5.0	1.1
	Monthly income (RMB) *1k = 1000RMB								
Type	<1k	1k–3k	3k–5k		5k–7k		7k–10k		>10k
N	21	62	138		122		59		57
Percentage	4.6	13.5	30.1		26.6		12.9		12.4

Table 2. Basic internet use features.

	Internet use experience		Internet use age (Year)				
Type	Yes	No	<1 year	1–3 years	4–5 years	6–10 years	>10 years
N	448	11	19	61	99	130	139
Percentage	97.6	2.4	4.1	13.3	21.6	28.3	30.3
	Internet use frequency						
Type	One time/week	1 time/several days		1 time/day		Many times/day	
N	1	25		46		376	
Percentage	.2	5.4		10.0		81.9	
	Duration of a single use						
Type	0–30 min	30–60 min	1–2 h		2–4 h		>4 h
N	44	127	129		72		76
Percentage	9.6	27.7	28.1		15.7		16.6

Table 2 shows a descriptive analysis of the middle-aged Internet use situation. We can see that the majority of Chinese future elderly already have Internet use experience, and more than 80% of them have been internet citizen longer than 4 years and has the behavior of using Internet many times a day, and a single use of more than half an hour has accounted for more than 90% of the surveyed people.

As can be seen from Table 3, most of the future elderly in China have already reached and beyond the general Internet use level, can benefit from many Internet functions. The most frequently used are chat & social, then, online shopping, information acquisition, leisure & entertainment, and current affairs news.

Table 3. The usage frequency of different Internet function.

Internet function	Frequency of usage					Ave.
	1 never	2 rarely	3 general	4 often	5 always	
Affair news	2(0.43%)	41(8.74%)	135(28.78%)	223(47.55%)	68(14.5%)	3.67
Chat & Social	1(0.21%)	28(5.97%)	98(20.9%)	183(39.02%)	159(33.9%)	4.00
Leisure & amusement	4(0.85%)	34(7.25%)	119(25.37%)	199(42.43%)	113(24.09%)	3.82
Online games	42(8.96%)	125(26.65%)	130(27.72%)	117(24.95%)	55(11.73%)	3.04
Office work	17(3.62%)	61(13.01%)	115(24.52%)	199(42.43%)	77(16.42%)	3.55
Online education	28(5.97%)	95(20.26%)	170(36.25%)	128(27.29%)	48(10.23%)	3.16
Information acquisition	2(0.43%)	22(4.69%)	95(20.26%)	227(48.4%)	123(26.23%)	3.95
Financial management	46(9.81%)	121(25.8%)	146(31.13%)	110(23.45%)	46(9.81%)	2.98
Travel service	27(5.76%)	117(24.95%)	149(31.77%)	130(27.72%)	46(9.81)	3.11
Health & medicine	30(6.4%)	115(24.52%)	134(28.57%)	146(31.13%)	44(9.38%)	3.13
Online shopping	7(1.49%)	23(4.9%)	87(18.55%)	218(46.48%)	134(28.57%)	3.96
Daily life services	20(4.26%)	56(11.94%)	118(25.16%)	195(41.58%)	80(17.06%)	3.55

Figure 1 reveals the device, place and main applications of Internet use of future elderly in China, we can see that, more than 85% of the current middle-aged population in China already has their own smart phone, 75% has personal computer, nearly half have a pad, and a quarter of them have smart TV (a). Home and bedroom is the most popular place to use internet, followed by leisure places, transportation, workplaces, canteens and restaurants (b). From these two types of information, we can roughly describe the Internet use scenery of the middle-aged people. With regard to the Internet applications, Wechat is the most frequently used one, followed by Taobao online shopping platform and Alipay from Alibaba Group. QQ and Weibo are welcome too. Applications for life services such as Meituan and entertainment applications including

Tencent Video, Iqiyi and Tiktok also receive high attention among middle-aged grous, which shows that the Internet has gradually penetrated into all aspects of life for the future elderly in China.
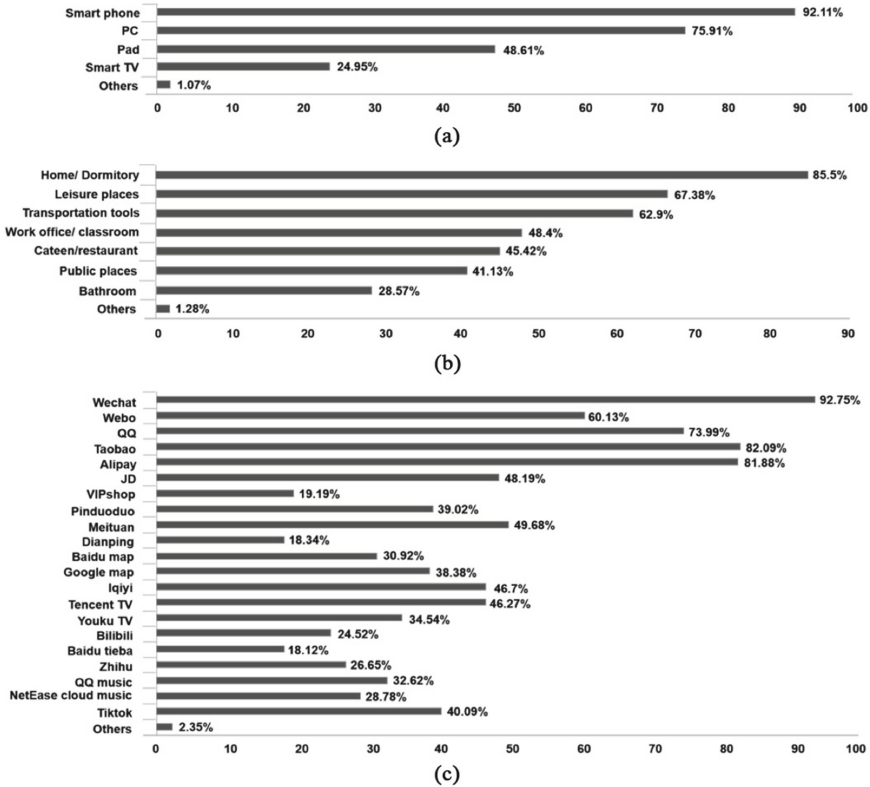
Fig. 1. The device (a), place (b) and application (c) distribution of Internet use.

Besides all the features of the Internet use above, this survey also finds that demographic differences in Internet use among future elderly people are mainly reflected in the following aspects: In the age difference of Internet use level among the research group, young elderly are significantly higher than older elderly, and the difference is significant ($F = 3.434$, $p = 0.000 < 0.05$); When it comes to gender difference, the Internet use level of male is slightly higher than female, but the difference is not significant ($t = 0.629$, $p = 0.858 > 0.05$); For marital status, there is no significant divergence among different marital status ($F = 1.124$, $p = 0.302 > 0.05$), so does the housing way ($F = 0.549$, $p = 0.976 > 0.05$); In terms of the impact of income on Internet use, the higher the monthly income, the higher the level of Internet use, and the difference between low-income people, middle-income and high-income people is obvious ($F = 2.571$, $p = 0.000 < 0.05$); Judging from the impact of education level on

Internet use, the higher the degree, the higher the level of Internet use, showing a linear growth trend, and the level of Internet use of the highly educated population is significantly higher than low education level people (F = 1.652, p = 0.018 < 0.05); Moreover, there is significant differences in Internet use due to the occupation types, the Internet use level of high brain activity occupation is significantly higher than in occupations with low brain activity. such as business management, private enterprise owners, civil servants, teachers, technicians, administrative staff, etc. are higher than drivers, farmers, workers, and domestic service staff (F = 1.467, p = 0.000 < 0.05).

4.2   Model Analysis of Internet Use, Loneliness and Subjective Well-Being

The following will test and analyze the basic fitness, overall fitness, and mediation effect of the hypothetical model.

The Basic Fitness Analysis: 1. e1-e10 error variation value is between 0.050–4.202, all are positive numbers. 2. The CR value of all error variability are between 3.846–13.129, and all reach significant levels above 0.001. 3. The standard error of the parameter is between 0.024 and 0.318, and there is no large standard error. 4. The factor load between the latent variable and its measurement index is between 0.551–0.920, which meets the criteria of bigger than 0.50 and less than 0.95. The above analysis indicates that the model is basically appropriate (Refer Fig. 2).
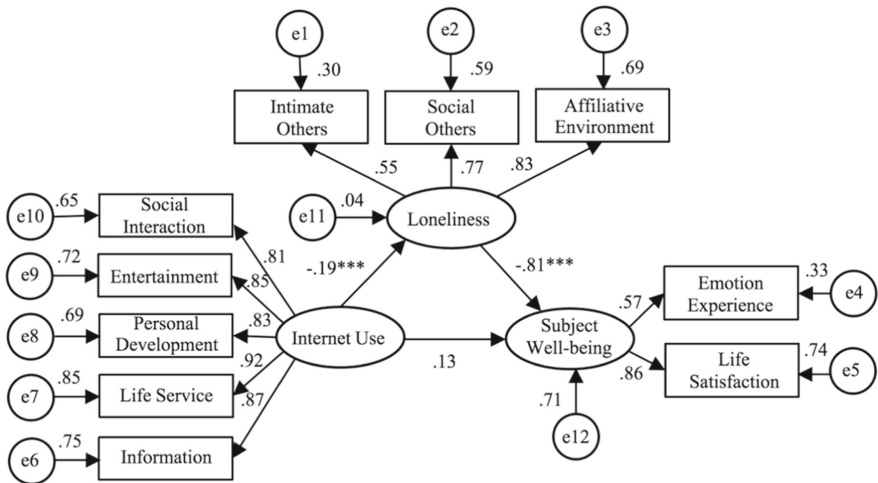
Note: ***path is significant at the 0.001 level, **path is significant at the 0.01 level, *path is significant at the 0.05 level

Fig. 2. Standardized estimates of the default model.

The Model Fit Analysis: As shown in Table 4, the GFI value of this default model is 0.906 > 0.9. The NFI in this study is 0.94 indicates that the hypothetical model in this study has a better proportion of adaptation than the independent model. The CFI of this study is 0.927, which shows that compared with the independent model, the improvement degree is within an acceptable range. The IFI value of this study is 0.927, revealing that the model adaptation degree is good and does not need to be reset. Both PGFI and PNFI in this study are above 0.5, indicating that the hypothetical model in this study is simple. In summary, the analysis of basic fitness and overall fitness shows that the hypothetical model is appropriate, so the intermediary effects are further analyzed.

Table 4. Implied correlations of default model.

Index	GFI	NFI	IFI	CFI	PGFI	PNFI
Default model	.906	.917	.927	.927	.527	.652
Recommended threshold	>.9	>.9	>.9	>.9	>.5	>.5

Verification of the Mediation Effect of Loneliness: As shown in Fig. 3(a), before the mediation effect, the standardized path coefficient for Internet use to subjective well-being is .295 (p < .001), to loneliness is −.186 (p < .001), loneliness to subjective well-being is −.834 (p < .001), they are all significant. After establishing the mediation model, as we can see in Fig. 3(b), the Internet use has significant influence on loneliness, and the path of loneliness on subjective well-being is significant too, but the path of Internet use to subjective well-being has changed from significant to in significant. Moreover, the indirect effect value of Internet use on subjective well-being is (−.20) × (−. 82) = 0.164, which is greater than the direct effect 0.12 (0.164 > 0.12). According to what has been discussed above, it is proved that loneliness has a complete mediation effect between Internet use and subjective well-being of future elderly in China. The total effect of internet on subjective well-being is direct effect plus indirect effect, which is 0.164 + 0.12 = 0.284, that means the total influence of Internet use on subjective well-being is 28.4%. As for whether the intermediary effect has statistical significance, another intermediary effect test is performed. For 95% CI, LL = 0.064 and UL = 0.229, that is, the upper and lower bounds of 95% CI are between 0.064–0.229, excluding 0, The indirect effect two-tailed test result p = 0.005, less than 0.01, reaching a significant level. From the two-tail test results of 95% CI and indirect effects. To sum up, according to all the analysis above, the mediation effect of loneliness is significant and has statistical significance.
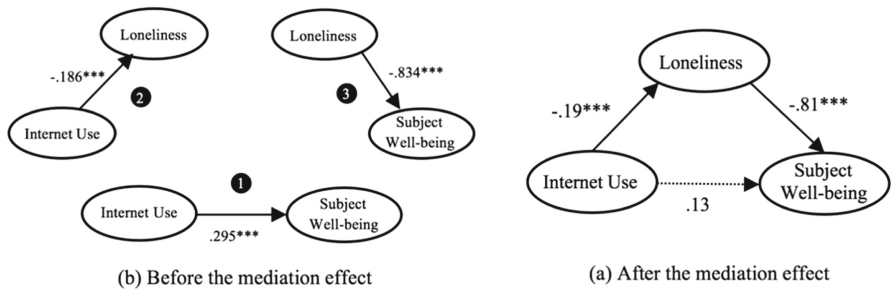
Note: ***path is significant at the 0.001 level, **path is significant at the 0.01 level, *path is significant at the 0.05 level

Fig. 3. The mediation effect test of loneliness.

5   Discussion and Conclusion

With the analysis above, we can get the validation results about our hypothesis, they are showed in Table 5. The internet use of Chinese future elderly is significantly influenced by the demographic variables of education level, occupation, age and monthly incomes, while there is no obvious differences between different gender, marital status and housing way types. Internet use has a significantly positively effect on subjective well-being of future elderly and loneliness plays a complete mediation role.

Table 5. Hypotheses validated results.

Hypothesis	Estimate	T/F test	Result
H1 Internet use → Subjective well-being	.295***		Supported
H2 Internet use → Loneliness	−.186***		Supported
H3 Loneliness → Subjective well-being	−.834***		Supported
H4 Internet use → Loneliness → Subjective well-being	.154***		Supported
H5a Age → Internet use		3.434***	Supported
H5b Gender → Internet use		.629	Rejected
H5c Marital Status → Internet use		1.124	Rejected
H5d Housing Way → Internet use		.549	Rejected
H5e Education Level → Internet use		1.652*	Supported
H5f Occupation → Internet use		1.467*	Supported
H5g Monthly Income → Internet use		2.571***	Supported

Note: ***path is significant at the 0.001 level, **path is significant at the 0.01 level, *path is significant at the 0.05 level

In summary, this study finds that Internet use will significantly positively affect the subjective well-being of future elderly in China, and loneliness plays a complete mediation role among them, which provide the evidence and theory support to use internet technology to deal with the aging society challenges, reduce the loneliness level of future elderly and improve the aging's quality of life and well-being.

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Discussion on the Aesthetic Experience of Artificial Intelligence Creation and Human Art Creation

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Abstract. With the continuous development and progress of science and technology, artificial intelligence (AI) has gradually become a part of the field of literary and artistic creation. In this process, more AI works of art have emerged at key moments. As a result, discussions of the evaluation of AI-produced art have become richer and richer. At present, when discussing whether or not works created by AI are art, the biggest controversy relates to whether AI creations can express emotions, as human art can. No textual research has yet been conducted on this topic. Although a few studies have explored the emotions elicited by AI works of art, most have focused on the identity cognition of AI and human artists. This research proposes a novel approach to artistic aesthetic experience to explore two research questions, as follows: 1) What types of emotional responses do observers have when they encounter works of art created by artificial intelligence? 2) Is there a significant difference in observers' emotional responses to AI works of art and the works of human artists? In this study, the abstract works of art created by human artists and AI are used as the primary image stimulation, and the Geneva Emotion Wheel created by the Swiss Emotional Research Center is used as the basic measuring tool, allowing the study participants to choose from 20 emotion types and 5 intensity levels.

Keywords: Artificial Intelligence (AI) · Artistic creation · Emotional wheel

1 Introduction

Artificial intelligence (AI) works of art are works of art produced by non-human creators [1], either entirely or largely independent of direct interference from human beings [2]. Therefore, art created by computer aided technology does not count. For instance, if somebody uses Photoshop software to assemble picture collages or change color combinations, they are using the computer solely as a tool to facilitate art creation, rather than to produce or create art [3]. AI technology is developing in the realm of art, such as convolutional neural networks [4], creative confrontation networks [5], generative adversarial networks [6, 7], the autonomous artist model [5], and in-depth learning [7], applications. An increasing number of creative, interesting and aesthetically valuable AI

works of art have entered the public field of view. One of the earliest examples in this field is Harold Cohen's work on the interaction between art and artificial intelligence. He created the computer program AARON [8], which can automatically produce works of art. In October 2018, Christie's auction house sold its first batch of pictorial representations by an AI creator named Edmond de Belamy for USD432,500, some of which even passed the so-called Turing art tests. Ordinarily, 75% of human experimental subjects fail to definitively determine whether works of art are created by human artists or manufactured by machines. In the linguistic environment of abstractionism, more than 85% of the experimental subjects classified works of art created by AI as works of human creation. In addition, they described the works as "encouraging" and "visually structured" [5]. Previous studies have found that the types of emotional experience when viewing art fall into two major categories. One kind regards artists as the main source of emotional expression in art; another kind emphasizes the role of the audience in the relationship between works of art and their emotional consequences. Studies have long recorded people's subjective responses to and aesthetic experience of art, and discussed the technology and achievements of AI works of art. However, from the perspective of human subjective emotions, there have been few studies of aesthetic responses to AI artistic creations. Tan indicates that the study of art and the subjective emotions of audiences are surprisingly disjoint [9]. To compensate for this deficiency, this research attempts to address the following research objectives.

- To identify the types of aesthetic experience brought about by AI artistic creations.
- To determine whether there is a significant difference between emotional responses to arts created by AI and by human artists.

2   Literature Review

2.1   Aesthetic Experience

With the increase of people's degree of interest in expression of emotions in works of art Silva, 2010, emotions progressively becomes the most expressed part in works of art [10]. In other words, on some level, artists started to serve emotions as the principal theme of drawing. These emotions are expressed through creation and shared through watching works of art. In the history of art, "aesthetic experience" collectively refers to the shock, moving, sudden enlightenment, exclamation as well as transformation of complex emotions caused by the audience's encounter with art, The discussion of this kind of emotion is mainly divided into two major categories. The first kind of theory emphasizes the arbitrary expression of particular emotion by artists in

The creative process [11]. The other type, which is relative artists, emphasizes the role of viewers in the relationship between artistic works and emotional transmission. For a long time, a large number of researches have been conducted on people's subjective reaction and aesthetic experience to art, and the discussion of the technology and achievements of artificial intelligence artworks. However, there are few pieces of research on sorting out and analyzing the aesthetic feeling of artificial intelligence art creation based on human subjective emotions. This research puts the research emphasis

on the second issue, which addresses the first hypothesis. The artistic creation of artificial intelligence can provide the audience with aesthetic experience in the same way.

2.2   Art Created by Artificial Intelligence

Starting from 2016, artificial intelligence (AI for short) represented by AlphaGo has become a hot spot of ongoing discussion within the academic circle and industry. Artificial intelligence is not a fresh topic. The yielding of unusually brilliant results this time originates from the in-depth learning of convolutional neural network algorithms, and realizing a breakthrough of commercial grade, so as to open up a wide field. This breakthrough is considered as a progress at the level of a scientific and technical revolution. Because the success of this kind of strategy is not limited to the Weiqi field, it can realize the same level of progress and produce a disruptive influence in many fields. Among them, it also includes the realm of art. Through in-depth learning of convolutional neural network algorithms, the vast majority of artificial intelligence systems receive the training of thousands of different styles of drawings created by artists from all over the world for the last few hundred years. Artificial intelligence has access to the drawing language (color selection, form elements, form arrangement on a two-dimensional surface) for image creation, in addition to combining these elements and placing them before the audience's eyes [5] in a similar way to the audience looking upon the drawing. At present, a portion of artificial intelligence artistic creations have obtained significant progress in technology at the present stage. However, it has been noted that the creation of artificial intelligence is excessive, abstract and stiff, and there are a lot of traces of imitation, which makes it hard for the audience to produce a positive aesthetic experience when observing. However, for those works that are already able to produce indistinguishable works from human works in the experience of a third person, some researchers still state that artificial intelligence does not possess true intention and emotional engagement ability. As a result, artificial intelligence fails to carry out real artistic creation.

Another thing to note in the creation field of artificial intelligence is the fact that it is probably not only the works of art themselves that influence the aesthetic experience, but also the identity of the art creator of artificial intelligence which will probably influence the aesthetic experience of the audience [12]. The reason why this identity of artistic creation influences the feelings of aesthetic experience is likely to stem from a useful theoretical framework provided by the schema theory, which is used to understand the audience's opinions on art in the light of the identity of the artist. This mode is "a sort of active processing data structure which can help manage memory and guide perception, performance and thought". Even if the works of art created by artificial intelligence are not significantly different from the works of art created by human beings, the audience may still believe that artificial intelligence is unable to make art, because they believe that art is exactly the works of art created by human beings.

Therefore, this research has studied people's different aesthetic feelings between the works of art marked as artificial intelligence's artistic creation and the works of art marked as human artists' creation. When a work of art is set up by two different entities, the assessment method of its works of art is possibly not only based on the objective differences in composition, but also based on changes in the viewer's

stereotypical and case-hardened concept of the artist. Previous study conducted relating to the works of art of artificial intelligence has found that audiences have a negative bias against works of art produced by artificial intelligence [5, 13]. Therefore, the second hypothesis originates from such an argument, that is to say, if a work of art is a work of art created by artificial intelligence, people are inclined to give more negative aesthetic feelings to a work of art.

2.3 Abstract Art and Aesthetic Experience

Previously, there have been studies that use abstract works of art or some analogous geometric patterns as a stimulation to conduct an experiment. Under this circumstance of using abstract art as a stimulation, people might accurately predict a specific color combination (for instance, color opponents and a more harmonious combination), which might be more arousing/calming or positive/negative, or map to specific emotional categories. For instance, an appreciator can recognize a picture of drawing from Picasso's Blue Period which may portray a sad subject, and an appreciator can experience a sort of relatively happy sense of satisfaction and a sense of joy through identifying and appreciating the works of art [10, 14]. While large numbers of geometrical abstraction artists have created statements connected with their goals, under some circumstances, they express the way that they arouse emotions [15]. From these artistic experiments, it is not hard to find that abstract works of art are more closely related to expression of feelings and aesthetic experience compared to other works of art. Pablo [16], this research will discuss the relationship between artificial intelligence works of art and aesthetic experience by using abstract works of art as experimental stimulation.

3 Research Methods

3.1 Vocabulary Reference for Theme Vocabulary or Intention Adjective

In accordance with the vote sorting and summary of the greatest artists in the 20th century launched in Britain's The Times in 2009, we have enumerated the top 10 artists with the highest public acceptability in the world in 2009. They respectively are Pablo Picasso, Paul Cezanne, Gustav Klimt, Claude Monet, Marcel Duchamp, Henri Matisse, Jackson Pollock, Andy Warhol, Willem De Kooning and Piet Cornelies Mondrian. After confirming the artists, we picked out 20 abstract works of art from their works that ranked highest in Google image search. This method can be considered as a kind of "consensus" approach to defining the abstract art category, in which we are meant to choose those people with certain knowledge at least (but perhaps they are not people with high-class specialized knowledge), classify them into typical abstract works of art, and then screen them. In allusion to document research on related works of art and artists, when the artists' works had painting themes with higher repeatability, reference scholars used subject vocabulary as their research intention. If those artists have no distinct and concentrated drawing themes, they use adjectives that can represent the styles of their works as their research intention. After literature arrangement and discussion and validation by four professionals with more than five years of relevant

experience in art history or art reviews, except that these two groups of vocabulary Klimt - woman and Koonin - woman were repeated, only a group of intention vocabulary of Klimt - woman remains. Besides that, in this research, a total of nine groups of valid topics or intention adjective vocabulary reference were collected: Picasso - three-dimensional, Cezanne - apple, Klimt - woman, Monet - natural scenery, Matisse - cheerful, Pollock - rebellious, Andy Warhol - repeated and Mondrian - color lump.

3.2   Sample Selection

The fundamental purpose of this research is to compare and discuss the transmitted emotion by artificial intelligence works of art and the works of art created by human beings. Therefore, the primary research object is the works of art created by artificial intelligence and human-beings. The research invited professionals with relevant art working experience as representatives of human artists (Table 1).

Table 1. Collection of samples of human creation.

Creator (real)	Number	Material	Vocabulary	Image
Human artists: Hanlin Mi	1	Gouache	Picasso - three dimensional	
Human artists Bingye Guan	2	Watercolor	Cezanne - apple	
Human artists PoLin Huang	3	Acrylic	Klimt - woman	
Human artists Zhigang Fu	4	Acrylic paint	Monet - natural scenery	
Human artists Jane Pan	5	Mark pen	Duchamp - avant-garde	
Human artists Jingchun Lin	6	Composite materials	Matisse - cheerful	
Human artists Hanlin Mi	7	Composite materials	Brock - rebellious	
Human artists Zhigang Fu	8	Acrylic paint	Andy warhol - repeat	
Human artists Zhigang Fu	9	Acrylic paint	Mondrian - color block	

As a representative of artificial intelligence, Microsoft Xiaoice (girl artist Xiaoice procedure) respectively carries out proposition creation in line with the above-mentioned theme vocabulary or vocabulary reference for intention adjectives with regards to works of art. In the research, a total of 18 samples were recycled from the two groups (Table 2).

Table 2. Collection of AI authoring samples.

Creator (real)	Number	Serial number	Vocabulary	Image
(AI) Artist Xiaoice	1	00017692	Picasso- three dimensional	
(AI) Artist Xiaoice	2	75F49875	Cezanne - apple	
(AI) Artist Xiaoice	3	A05BDF54	Klimt - woman	
(AI) Artist Xiaoice	4	221F3802	Monet- natural scenery	
(AI) Artist Xiaoice	5	07E8F7AC	Duchamp- avant-garde	
(AI) Artist Xiaoice	6	710E10F7	Matisse - cheerful	
(AI) Artist Xiaoice	7	4A10CCC6	Brock- rebellious	
(AI) Artist Xiaoice	8	FE106AFC	Andywar hol- repeat	
(AI) Artist Xiaoice	9	340D59B2	Mondrian - color block	

3.3 Testing Program

Before the experiment, the experimental subjects were required to fill in a copy of online written consent as well as relevant individual basic information and material (including age, level of education, and whether they had received professional art training and so forth). Because the test sample involves color, it is also necessary to

affirm that the experimental subject is not colour blind, possesses visual acuity or corrected vision acuity before the experiment, thus guaranteeing the effectiveness of the random selection and the confidence level of the test results. Soon afterwards, the audience were gathered in a capacious space with a projector (a classroom at the university in Fuzhou). In the course of the experiment, in order to exclude the influence of indoor environment, ray of light and other interference factors on the experimental subjects, the experimental subjects would be categorized in accordance with the group and they would carry out the video and image observation in the same classroom at the same time period. The time of each image display lasts about 27 s to 30 s. In the process of the experiment, all the images and videos observed by the experimental subjects were projected into a large screen in the form of a presentation after being connected to the computer (brand: Apple model: Mac Book Pro, Retina, 15-in., Mid 2014, and resolution ratio 2880×1880). (The brand of the projector is EPSON, the model is EB-c2040XN, size 1024×768) The luminance, contrast ratio, as well as resolution ratio of the screen have been adjusted so as to make sure all prime stimulus are in a unitive high-point.

The experiment organized 50 experimental subjects; there were 25 males and 25 females aged between 18 and 30. The experimental subjects observed 9 sample works created by artificial intelligence. Given that the core element of emotion, "sensory component", is subjective in essence, it can only be evaluated through the method of self-report. For instance, through the "Geneva emotional wheel" (GEW) [17]. This research used the third edition (3.0) of the Geneva emotional wheel (GEW for short) founded by the Swiss Emotional Science Research Center [17] in allusion to the purpose of the research: conducting an experiment on account of artificial intelligence artistic creation being able to bring what kind of feeling. Before the experiment began, experimental subjects were informed by the researchers that after they watched the samples, they could freely choose the overriding emotion among the 20 affective groups. The researchers hoped that the experimental subjects would be able to point out the main sentiments generated in their response to the sample.

4   Results Analysis and Discussion

In terms of theory, it is not sufficient to analyze the types of emotion separately from homologous affect intensity. The two concepts are easily confused [17]. To address this problem, the Geneva Emotion Wheel provides two options for each user. During the period of observation of works of art created by AI and works of art created by human artists, we elicited information on the major types of emotions experienced by the experimental subjects and the intensity of the corresponding types of emotions. After the collation and analysis of the data we visualized the data using the Geneva Emotion Wheel, based on which we established an emotional heat map. Similar to a heat map, an emotional heat map is used to present eyeball gaze data in eyeball tracking research; hotter areas signify that there is a greater focus on specific elements of the image. In this research, the more obvious spots represented the feelings of observers in response to works created by AI or works created by human artists. Superimposed Geneva Emotion Wheel color spots represent the emotions reported by the viewers as well as

the intensity of the emotions (such as Fig. 1 and Fig. 2). Larger and more prominent spots (red and yellow) signify that more observers had selected this specific emotional type as their major emotional response.

Fig. 1. Collection of samples of human creation.

Fig. 2. Artificial intelligence creation.

According to the emotional heat map, the major emotional responses of the observers to the creations of human artists (Fig. 1) were pleasure, admiration and joy, along with moderate levels of interest, disappointment, guilt, fear, shame, and contentment. Hate and disgust, anger, compassion, pride and other negative emotions were rarely selected. In comparison, the works created by AI (Fig. 2) elicited high levels of joy, pleasure, love and amusement, along with moderate levels of sadness, relief and admiration. In addition to revealing subtle emotional differences between the experimental subjects in response to works of art created by human artists and works of art created by AI, these datas show that the observers tended to respond to AI creation with a more intense degree of positive emotion. In contrast, when responding to works created by human artists, the observers' intense emotions tended to be more positive than negative, but at moderate levels, positive and negative emotions were more evenly distributed. Comparison of the two suggests that the observers' emotions in response to human-created art were more abundant and diversified than their responses to AI-created art. The data also show that when the observers encountered works of art created by AI and the works of art created by human artists, their emotional responses to serial number 6, serial number 7 and serial number 8 were fairly unanimous. As people's aesthetic experiences of and emotional responses to works of art differ, there are also significant differences in the degree of emotional responses to works of art created by AI and works of art created by human beings, especially in terms of negative emotions. Although the AI artists considered here had fairly high levels of technological expertise, their works were at least superficially similar to the abstract works of art created by human artists. Based on the intense emotional connection between the artistic works and identity of the creator, the results of this research indicate that art created by human beings is generally better able to arouse people's aesthetic experience and elicit more abundant and intense emotional responses. Additionally, the research shows that viewers responded fairly positive to works created by AI and evaluated this art highly. To some extent, AI artists are more likely to be regarded as participants in society than other AI entities.

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Reconstruction of Plant Space in the Urban Park Guided by Visual Experience of Tourists - A Case Study of the Ait Park Afforestation Design in Fuzhou

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Abstract. Plants are an important element in landscape design. They have played various roles in the holistic landscape. Numerous landscape construction projects focus solely on plants' role in the ecological and environmental improvement, thus blindly pursuing the afforestation quantity rather than another key role of space formation in terms of plant arrangement. Through the design of space construction for plant landscape during the renovation of Ait park in Fuzhou City, this paper has studied how to construct the plant space without changing the original ecological environment in the park, thus to achieve the optimal visual experience for tourists.

Keywords: Visual experience · Plant · Space and construction

1 Introduction

People have been pursuing more and more stringent urban ecological environments in the increasingly perfect urban landscape design. In addition to various environmental data, a considerable proportion of afforestation coverage rate is not only an important test standard for whether the ecological environment of a city is ideal and conforms to the requirements of an ecological city, but is also a key indicator to provide a good living environment for people. In recent years, the municipal government of Fuzhou City has made great efforts in promoting urban ecological civilization construction. In order to meet the growing demands of the public for a beautiful ecological environment, the local government has continuously promoted mountain restoration, water treatment and green space system perfection, thus providing more quality ecological products and making significant contributions to the ecology and environment in Fuzhou City. The urban park construction and remodeling plays an important role in the ecological and environmental construction, among which the afforestation design of parks is the most straightforward expression of ecology and environment. Whether the plant landscape design of a park conforms to the requirements of ecological construction is an important criterion to test if the urban ecological park construction in Fuzhou City has been qualified in recent years.

Compared with the newly constructed park, a renovation project focuses more on the plant conservation and the ecology protection on the original site. In combination with the original plant habitat, planning and constructing a landscape that pays more attention to the visual experience of tourists and a plant space with its own characteristics is the key point of urban park reconstruction [1].

2   Type of Plant Landscape Space

The landscape architecture creation based on design materials of plants is unique to landscape design. Plants are the design element of life. Therefore, in terms of the use of plant materials to construct landscapes, while meeting the needs of functionality and art, one should also consider the relationship between the environment needed by plants themselves and those of other plants, so as to properly select the plant species and to rationally plan the plant space. Considering the transparent degree of tourist line of sight, the space built by plants can be divided into the following types. Then, according to the needs of different environments and tourists, different plant landscape space can be constructed, and different plant collocations can be selected [2].

2.1   Open Space

The human line of sight within a certain area is higher than the space of surrounding plants. There are mainly low shrubs and groundcover and are within a transparent and vast field of view but no privacy. This is applicable to open green space, urban park, square, water shore, etc., giving us relaxed, free, and comfortable feelings.

2.2   Half Open Space

One side or some of the space is enclosed by higher plants that limit the penetration of the line of sight so the opening angle is small. The orientation points to the open surface with poor closure, which is applicable to the environment where one side needs privacy while the other side needs landscape for atmosphere. Tall trees and middle-size shrubs are often used to provide a sense of belonging and security.

2.3   Fully Enclosed Space

People are within the area and surrounded by tall, middle-size and small plants which are quite covert. The line of sight is restricted. All plants form a direction-less inward enclosed space. The enhanced appeal of close shot tends to produce a sense of intimacy and tranquility. If the enclosing degree is extremely high, the spatial directivity disappears and will create an extremely strong sense of privacy and segregation. Most of the time, tall shrubs and trees with low branches are matched with each other and planted in small courtyards, leisure areas and solitary spaces.

2.4   Covered Space

Only horizontal elements are restricted while the line of sight and the human action are not restricted in this space. However, the space has a certain sense of privacy and shelter. The top covering blocks the line of sight while the surrounding open line of sight is transparent. Shady trees with high branching points and dense canopy are set up on the avenue, the tranquil rest area, the small tree-array square and other venues to give people a cool and tranquil feeling.

2.5   Vertical Space

Tall and thin plants are adapted to form a vertical and upward outdoor open space. It is applicable to the memorial garden space and gives a solemn atmosphere [3].

3   Landscape Design of Ait Park in Fuzhou City

3.1   General Situation of Ait Park in Fuzhou City

Ait park, formerly known as Sanxian Island, is an island park. It is located in the middle of Minjiang River more than 1000 meters upstream of Jiefang Bridge in Fuzhou City. The park is further north to the Wanglong Terrace on the Cangxia Island and is south to the Wangbei Terrace across the river. The island is an alluvial sandbank that covers an area of 4.83 ha. The park is planted with arrays of trees and with a virescence overlay rate of more than 90%. The elegant environment and the pleasant climate inside the park makes the park a natural summer resort and a well-known "small sunny island" in Fuzhou City. Therefore, the park possesses a great development space. There are more than 50,000 silver birches, metasmuses, willows and other trees in the park, among which six centuries-old banyan trees are included [4].

In the 1980s, the island was developed into a park. Since then, young couples have been fond of dating on the island, so it has also been called the "Isle of Love". In 1995, the CCTV and the Municipal Government of Fuzhou City jointly held the "Lantern Festival Gala" here. The Ait park has become famous ever since. In 1997, the Ait park was closed for the construction material storage yard and the worker residence for the construction of Sanxianzhou Bridge. It has not been opened to the public for 18 years due to the untreated construction debris inside since the completion of the Sanxianzhou Bridge. The island is tree-lined and displays a pristine ecological landscape. With the acceleration of the urbanization process in China, the environmental issue has become increasingly prominent. People who have dwelled in the noisy city for a long time are more eager to get close to nature. Therefore, they need outdoor space for recreation, communication and sports. Urban parks with good green ecological matrix structure have naturally become the key project for renovation and upgrading.

The landscape design and protection of Ait park and the utilization of all valuable artificial and natural elements in the park was to complete and enhance the tour function via the construction of ancillary facilities, including to integrate the original revetment and use the terrain in a reasonable manner in order to achieve the reasonable utilization of original resources.

3.2   Landscape Design Objectives

Ecological Island. Highlight the natural ecological aesthetics. Original dense trees and vegetation on the island have been retained, and more than 40 ornamental plant communities were replanted, such as prunus campanulata, osmanthus fragrans and frangipani.

Humane Island. Display the human scenery. Renovate the performance and art plaza that integrates the art performance, the recreation and the memorial functions. Display the folk culture of Cangshan through Linshui Lady Culture Square and cultural exhibition hall.

Intelligent Island. Create an intelligent park. The scenic spot introduction on the island, the popularization of botany and the park guidance and orientation have all been connected with the WeChat Official Account of "Cangshan Garden" through the form of QR code at the starting end of the suspension bridge outside the park and on the guide map on the island.

Isle of Love. The Ait park is well-known as the "Isle of Love". Therefore, a red steel sculpture was placed in the center of the main entrance square, which symbolizes the "beautiful lingering affection". The theme of "love" in the park has been highlighted by scenic spots as "sunshiny long beach" and "water and cloud".

3.3   Landscape Design Principles

Protect and Utilize all Valuable Elements on the Site. Protect and renovate historic landscapes and nodes; restore the damaged landscape pieces in a manner of "repairing the old as before" (mermaid sculpture, ancient ferry and other scenic spots).

Conform to Local Conditions, Local Materials and the Low-Carbon and Energy-Saving Methods. Adopt materials based on the principle to "conform to local materials". The waste squared stone and the concrete block have been reasonably applied to the site paving, which reduces the transportation and reflects the concept of energy saving and low carbon.

Protect and Improve the Overall Layout of the Park. Protect and continue the original spatial patterns, and reconstruct the building on the basis of the original structure. Avoid causing any damage to the original trees so that no tree shall be moved, and all facilities shall avoid trees and all roads shall wind around trees.

3.4   Visual Experience of Tourist and Plant Space Construction

The design of plant landscape follows the principle of the overall landscape design and preservation, and the utilization of all valuable remains on the site. The original trees shall not be removed at all, and the original spatial pattern shall be protected and continued. The afforestation shall be redesigned for renovation based on the original plant space to ensure a good visual experience for tourists.

Arrangement and Protection of Original Plants. The original vegetation on the ait is plentiful and there are more than 50,000 trees in total (see Fig. 1). The vegetation on the island grows in disorder and most of those plants are in poor condition because the park has been abandoned for long and has been waiting to be managed. Therefore, the primary task for plant landscape design should be a thorough investigation and arrangement of plants on the island in order to protect the original vegetation and sort out plants in poor condition. This way, most plants can be left with growth space and the preparations for the subsequent plant space planning can be made.

Fig. 1. Original mango forest.

The forest floor should be cleared first. There are patches of mango and silver birch in the center of the island and they are excellent covering spaces. To enable a reasonable utilization of that space, the disordered ground cover should be cleared and those ill and dead branches should be pruned. Both measures can get through the line of sight of the forest floor and preserve the original vegetation better, gaining growing space for those plants.

Besides, the forest edge space should be cleared. Most areas in the island center have a high vegetation coverage, which results in more closed space and less open space on the island. To diversify the holistic space on the entire island, it is necessary to sort out the forest edge space on the island. Peripheral plants should be cleared so as to leave ample margin for peripheral forest edge space, which can create a more active open space.

Plant Space Construction for Different Visual Experience. According to the combination between cleared plant space and landscape nodes, the plant landscape on the entire island can be planned to be following spaces for visual experience:

Main Entrance Space. The square at the main entrance has been designed with a bright red steel framework that conforms to the terrain and combines with the waterscape, forming the most prominent place on the whole island. Therefore, to highlight the framework of the main entrance, the half-open space should be a main thought for plant design. Plants should become the background to demonstrate the atmosphere of the

main entrance structure and to make the entrance landscape more prominent. The space on the Guanjiang River side should be opened to give a more transparent view to the main entrance (see Fig. 2).

Fig. 2. Main entrance.

Trestle Space Under the Forest. The forest floor takes the largest area of the whole green design and is also the most important plant space type. During the treatment of the forest floor, most of the original forest has been preserved, weeds and shrubs on the forest floor have been cleaned, and the entire forest floor has become transparent and formed a dense covering space. The trestle surroundings throughout the mango and silver birch forest should be complemented with low vegetation so as to ensure the permeability of the forest floor, which can form a typical covering space to bring about a cool and tranquil sense during walking. Palm bamboo, alocasia, fatsia japonica and other shade-enduring ground cover should be complemented to green up the forest floor. Shade-enduring colorful plants like acalypha reptans should be planted at intervals to brighten the forest floor. Those measures can give tourists walking through the trestle of the forest floor a better landscape experience (see Fig. 3).
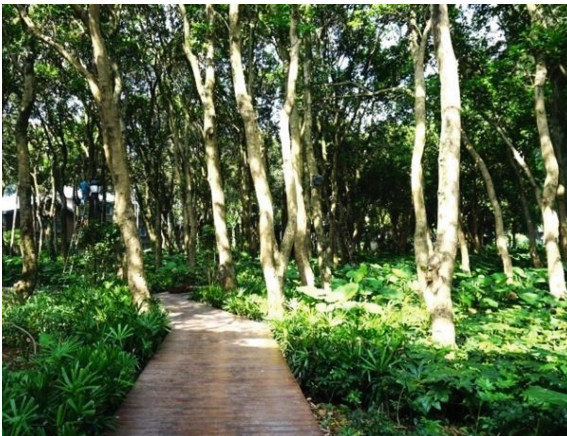
Fig. 3. Trestle in the forest.

Banyan Plaza Space. There have been six large banyan trees that are more than one hundred years old preserved on the island. Banyan trees are the city tree of Fuzhou. Therefore, the tree preservations and the scenic spot development are also the key of plant protection in the whole park. In order to reflect the beauty of the banyan tree, the plant landscape centered on the banyan tree can effectively enclose and make use of the space under the banyan tree. The establishment of Banyan Tree Square makes people connect closer to those banyan trees and appreciate the unique landscape that one banyan tree can grow into in a forest. The plant configuration needs to avoid other disordered ground cover destroying the pure aesthetics of the banyan tree. Accordingly, the low and elegant ground cover should be matched here to demonstrate the dense shade and tall size of the banyan tree, forming a typical half-open space (see Fig. 4).

Fig. 4. Banyan Tree Square.

Main Road Space. In order to ensure a sense of plant hierarchy and an open view, the ground cover on both sides of the main garden road on the island has been pulled back and the curve has been drawn along the forest edge. The roadside has been paved with lawn; trees, shrubs and grasses are in distinct hierarchy and demonstrate a comfortable plant space. They have enhanced the tourist experience to a further step.

Revetment and Trestle Space. The revetment has been reinforced by hydraulic engineering, which ruins the original ecological effect. In order to restore the ecological landscape effect of the whole revetment in a short time period, aquatic plants have been planted along the completed revetment bricks. A variety of plants (ruellia brittoniana, scirpus tabernaemontani, reed, willow herb, thalia dealbata, yellow calamus, etc.) have been selected for experiment. Finally, ruellia brittoniana, scirpus tabernaemontani and thalia dealbata have been selected as main varieties for widespread planting according to the adaptability of plants on the ait. Suitable aquatic plants have been selected to create a beautiful water edge landscape across the island and to provide tourists with the best open coastal visual experience (see Fig. 5).
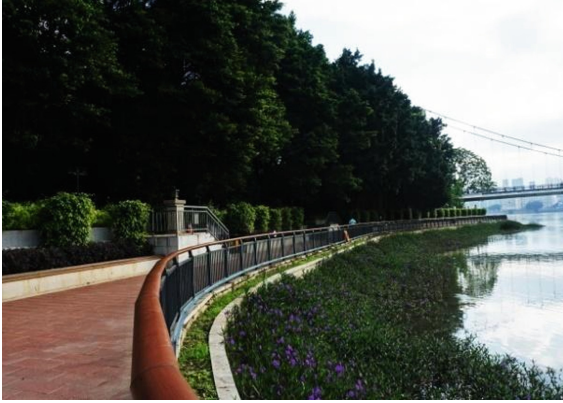
Fig. 5. Revetment trestle.

Building Space. The plant design around buildings is particularly important since the building space is not the only dynamic space in the whole park but also the space exerting the greatest impact upon the original ecology of the park. In order to minimize the destruction of buildings to ecology and to integrate buildings into the entire eco-logical landscape space, great importance has been attached to the concealment of buildings during plant design. The outer space of buildings has been surrounded by thick and large shrubs so that the buildings can hide in plants. The site destroyed by construction has also been complemented by tall trees accordingly to soften the rigid lines of the buildings, making building spaces look more natural and have more hierarchies (see Fig. 6).

Fig. 6. Building space.

Selection of New Plants. Based on the preservation of original vegetation, the selection of plant varieties for complement should be very cautious. New plants not only need to be integrated with the original plant environment but also play the role of the cherry on the cake.

Light up the Color. Plant color needs to be given more consideration during the selection of new plants because the original plants on the island were mainly evergreen plants and their overall color was dim. Ginkgo, liquidambar styraciflua, red maple, acacia podalyriifolia, golden forsythia, acalypha reptans and other plants with colorful leaves, and mountain cherry, camellia japonica, bougainvillea speetabilis, common melastoma herb and other seasonal flower plants have been selected. They have not only enriched the seasonal changes of the park but also brightened the color of the entire park.

Tree Shape Collocation. There are banyan trees, mango trees, silver birch and other original plants in the park. The tree shape has generally been round and oval and the canopy line generally remains unchanged. Therefore, the tree shape should also be considered when new plants are selected. Ginkgo, metasequoia, terminalia mantaly and other steeple-shaped trees have been selected to break through the entire canopy line, forming different ups and down and enriching the line of plants in the entire park.

Control the Number. The total amount of green trees in the park has been in great number since a large number of original trees have been preserved. In addition, the number of new trees should be strictly controlled so as to leave sufficient open space. Therefore, those trees have been mainly planted by dots and distributed in groups of 3 or 5 in each landscape space in the park. The large shade space by newly planted trees has been avoided.

4   Experience and Deficiencies

With its own particularity, the renovation of urban parks is different from the new construction of general urban parks. Based on original plants in the park, this paper has made use of the original elements to transform and innovate a park. It has aimed at creating a comfortable and diversified park plant space for tourists on the basis of respecting nature. This paper is based on the principle to respect the traditional elements and to grasp the historical context in the park. The utilization of modern techniques to shape landscapes as well as the adoption of new technology has made the renovated urban park a paradise for modern citizens.

The principle of adjusting measures to local conditions shall be applied during the renovation and construction of plant space in old urban parks. According to the characteristics of the original park and the area, the theory of urban organic renewal and the plant landscape planning method have been applied to protect traditional culture and landscape characteristics of the park. While meeting the modern functional requirements, the renovation project has created a distinctively new plant landscape as much as possible.

During the plant space reconstruction of Ait park, the principles of preservation and innovation have been well followed. However, there have still been some shortcomings. In particular, the treatment of plant nodes around buildings still looks a little bit simple and displays insufficient characteristics. Thus, the design of plant space should not only consider the effect of large space but also notice the construction of each small space in the urban park renovation project so that the whole park space can be more delicate.

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A Study on Concept Design for Landscape Sketches with the Five Senses

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Abstract. In recent years, besides physical visual expression, people pay more and more attention to their sensory enjoyment, thus the question of how to make better use of our five senses to enable people to obtain a full range of landscape enjoyment has become one of the trends of landscape design research in China. Landscape sketches are an indispensable part of landscape design. At present, there are few researches on the five senses design specifically for landscape sketches, and most of the existing research are just based on theory. Therefore, finding out how to create advanced concept design practice of the five senses in landscape sketches based on the concept of people-oriented has become the current research focus and development direction. Through the combination of the five senses, including sight, sound, smell, taste, and touch, together with the concept design of landscape sketches, this article will introduce new experiences on how landscape sketches achieve the purpose of communication between people and landscape sketches, making a new attempt of landscape sketches designs with the five senses.

Keywords: Five senses · Landscape sketches · Conceptual design · Experience

1 Understanding of Design with Five Senses

1.1 The Concept of Design with the Five Senses

The "Five senses", in a narrow sense, refers to the basic senses of sight, sound, smell, taste, and touch formed by the five basic senses of human beings towards the surrounding environment. Through the combination of human sensory organs to carry out corresponding landscape designs, designs with the five senses aim to fully mobilize people's senses so that people can get the most comfortable sensory perception, and thus get a full range of spatial experience and emotional understanding. As described by John O. Simonds in Landscape Architecture - Site Planning and Design, what people plan is not a place, a space, or a content, but an experience [1].

1.2 The Connection Between Design with Five Senses and Experience

Design with the five senses is reflected in all aspects of our daily life. Different designs bring different experiences to users; good and bad ones, or active and passive ones [2].

For example, the surface of a wooden bench can create a warm and soft feeling, while benches made of stone make people feel cool and rigid; landscape pavilions with human scale give people a comfortable experience, while it is depressing and disturbing in a pavilion that doesn't conform to ergonomics or spatial environment. Experiences can be created everywhere, but to make people have the right sensory experience at the right time and place, it needs to be designed carefully.

1.3   The Connection Among the Five Senses

The five senses work at the same time and are related to each other. Therefore, it is unscientific to carry out experience design on one particular aspect alone, and it can only be said that one certain sense plays a more dominant role in some experience design. In the field of artistic creation and appreciation, the connection of the five senses, namely "synesthesia", has long been studied. Fisher mentioned that senses are characterized by non-independence, and Qian Zhongshu also mentioned the connectivity of the five senses. Therefore, only by strengthening the connection of the five senses and integrating these five senses harmoniously in the design of landscape sketches, can we truly experience integrity, comprehensiveness and stereoscopic of landscape sketches design, and obtain better experience and understanding of the landscape sketches.

2   Research Status of Landscape Design with Five Senses

The concept of "five senses" has evolved from being applied to barrier free design in the first place, benefiting vulnerable groups, to improving the landscape experience for the general population, which has attracted more attention. The requirements of ordinary people for landscape are gradually improving. From the aspects of vision, smell, taste, touch and hearing, the richness and humanity of landscape designs are improved to create a more comprehensive and three-dimensional urban landscape system. For us, the application and practical experience of landscape designs with the five senses in developed countries and the indispensable landscape sketches are worth learning.

At present, the overall domestic attention and research on the related concept of landscape design with the five senses are still in the initial stage, and no mature system has been formed. For example, Yu Kongjian put forward the concept of landscape perception, and focused on the perception and evaluation of landscape, as well as changes in landscape perception needs of people [3]. Although people begin to pay more and more attention to the four senses besides visual sense, they still lack practical experience.

3 Research Significance of Concept Design for Landscape Sketches with Five Senses

3.1 Breaking Standardized Design of Landscape Sketches and Make it More Humanized

At present, domestic research on landscape sketch designs is still in the development stage, and there is still certain conformity psychology issues and blindness in some design methods and ideas, being they are lacking of characteristics. What's more, designers seldom study the landscape sketches in a specific landscape environment, and they also lack thoughts on whether its own functions, scales, forms, colors, etc. are suitable for users. Therefore, based on existing resources, we should make landscape sketches not only more creative in modeling design, greener in material selection, but also pay more attention to the design of landscape sketches with the five senses, so as to create more humanized landscape sketches.

3.2 Concept Design for Landscape Sketches with Five Senses Combined with Science and Technology is the Inevitable Development Result of Landscape Design

Modern design is the combination of science and art, technology and human nature, among which, art and human nature make designs full of beauty, interest and vitality, while science and technology offer design a solid structure and good functions. Considering that the concept design for landscape sketches with the five senses needs to integrate all aspects of human feelings into landscape sketches, the design should be based on rational scientific theory and reasonable functionality. The powerful technical support of modern digital technology and new media provides a broader development space for the concept design with five senses, which enables the design of landscape sketches to break the traditional design mode, and thus provide a distinctive sensory experience.

4 Principles of Concept Design for Landscape Sketches with Five Senses

Landscape sketches have dual characteristics of appreciation and usability. The artistic and ornamental landscape sketches, such as sculptures, waterscape sketches and rockery sketches, always stimulate people's aesthetic interest from the visual sense by showing people their shapes and colors. Functional landscape sketches, such as architectural sketches, facility sketches and plant landscape, are more practical, which mainly attract tourists through vision, sound, touch and smell. Different types of landscape sketches have different sensory appeal to tourists. Therefore, when studying the concept design of landscape sketches with the five senses, we should focus on the types of landscape sketches. In addition, the following principles should also be followed in the conceptual design of landscape sketches.

4.1   Principle Considered from the Integrity of Landscape Design

The forms, colors, materials and other design of landscape sketches should be carried out in the context of respecting the historical and cultural background of a city and region and reflect the theme of landscape design. By integrating the material landscape sketches into the vivid design concept, we can endow the landscape sketches with new vitality and show their unique spiritual significance.

4.2   Principle of Focusing on Human Experience from the Perspective of People-Oriented

The essence and value of modern urban landscape sketches are to meet people's diversified needs in physical structure and spiritual aspects. Therefore, it is of great significance for design with the five senses to start from a people-oriented perspective, and pay attention to people's experience. According to Maslow's analysis of the levels of needs, the need of self-actualization is the highest level of human needs. And everyone's physiological and psychological needs are different. Besides, as experiencers, people have two purposes: to participate and to appreciate. Therefore, in carrying out concept design with the five senses, we should pay attention to the individual differences and characteristics in these aspects, and carry out targeted research on the five senses experience of landscape sketches.

4.3   Principle of Sustainable Development

In 1987, the World Commission on Environment and Development (WCED) put forward the concept of "sustainable development", since then, the sustainable development of landscape has been paid more and more attention. When designing landscape sketches, we should also follow this principle of sustainable development, respect the nature, reduce the interference and damage to the ecological environment, rationally protect and utilize the natural and traditional landscape resources, rationally plan and efficiently use the renewable resources, to realize the sustainable development of resources, and create landscape sketches with both natural characteristics, historical continuity and modern flavor.

4.4   Principle of Wisdom

In order to break through the traditional design method and innovate thinking of landscape sketches, we must make full use of science and technology and follow the principle of wisdom. According to physiological structures, behavior habits, psychological status, thinking modes, etc., landscape designs should be optimized on the basis of the original design, and use projection, LED, laser, virtual technology and other composite transformation to create a humanized intelligent landscape sketches to enhance interaction, so that people can feel more satisfied and respected psychologically and spiritually, which is the main direction of landscape sketches design in the future.

5   Concept Design Method for Landscape Sketches with Five Senses

The concept design of landscape sketches with the five senses is based on the full use of the existing theoretical basis and technical means, as well as local history, culture and themes of landscape design. Without the latter, designs of landscape sketches will lose its soul and value. Therefore, the following five aspects of vision, touch, sound, smell and taste brought by landscape sketches are studied in this paper to explore new ideas and methods of landscape sketches design.

5.1   Visual Concept Design Method of Landscape Sketches

Vision dominates all senses, which has the function of conveying the most intuitive environmental information to people. Therefore, visual experience is the first purpose of landscape design. In the following, the application of visual concept design of landscape sketches will be discussed from the following three visual elements of shape, color and texture.

Color is the most powerful and expressive factor in design. Different colors can cause different emotional reactions due to people's different physiological feelings and their different cultural, regional, religious, folk, hobbies and aesthetic differences. For example, warm colors bring people warmness, while cold colors brings out the opposite; red brings enthusiasm, while blue calms people; Buddhism advocates yellow and white, while Taoism advocates black and yellow, etc. Therefore, all these color factors should be considered in our design.

Form is another important factor in landscape aesthetics. Each shape gives a different feeling. As the continuous mountains are as stable as Mount Tai, they all have the characteristics of a big top and a small bottom. Therefore, triangles give people a sense of stability, while inverted triangles give people a sense of softness and amiability; circles make people feel soft and gracious; squares make people feel stable and solemn, etc. According to these characteristics, the design of landscape sketches should adopt different lines and shapes in different space environments to give people suitable visual experience.

Texture refers to the tactile and visual characteristics of the surface of an object, including texture and quality. In the design of landscape sketches, people mainly study the micro perception of landscape materials, so as to grasp the application principle of landscape sketches texture.

With the rapid development of science and technology, the design and research on landscape sketches with interactive visual experience is particularly important, which can be realized in two ways: The first is to use new media technology to enable people to dispose of the layout in some environmental scenes according to their own wishes. For example, in terms of the projected flower wall, people can adjust the position and color of flowers according to their own preferences; and the second is to communicate and granting feedback between people and landscape sketches through interactive means, and change the temperature, color and touch of landscape sketches according to different instructions and behaviors made by people. For example, the "Tide Box" gift

mountain in Beijing Zhonghai Huanyu era demonstration zone. When visitors are sensed, it will trigger the interaction mechanism and constantly change the screen according to the gestures of the participants (see Fig. 1).

Fig. 1. "Tide Box" gift mountain.

Fig. 2. "Anemone" device sketch.

5.2   Design Method of Tactile Concept of Landscape Sketches

Touch is the most sensitive, direct and realistic sense of human beings. In modern landscape design, people have begun to emphasize and encourage the interactive nature of landscape, and pay more attention to tactile experience. Therefore, in the design of tactile concept of landscape sketches, more consideration should be given to the use of tactile materials. For example, stone, wood, metal, plastic, glass, etc. can be used. Their quality, texture, temperature, concave-convex feeling, transparency as well as their safety will create different perceptions of landscape sketches. For example, Taiwan's Taipei Anemone device sketch uses thousands of high and low flexible transparent rods to form a special shape and stimulate people's curiosity about touch (see Fig. 2).

Under the background of modern society, by paying more attention to humanization, the service objects of tactile landscape design becomes more comprehensive, detailed and diversified, especially in children's amusement facilities, the humanized design for the elderly and the accessible landscape sketches design for vulnerable groups. When designing for children, we use the potential of tactile perception to design a tactile landscape that is conducive to early childhood physical and mental development, so as to accelerate the early childhood development and improve their ability to feel while outside; when designing for the elderly, we make full use of the touch of the materials, such as sand, plastic, soft plants, water and so on, to make the elderly have a rich sense of touch, to stimulate their perceptual degradation and improve their perceptual ability; and in the tactile design for the disabled, in addition to the blind road, there are Braille identification signs and voice systems and other landscape sketches, which have opened up a new space for the disabled.

5.3   Design Method of Auditory Concept in Landscape Sketches

Through sound, we can feel the characteristics of materials and space. Actually, people's different experiences of sound enable them to have different feelings of space. We

divide the sound in the landscape environment into natural sound and artificial sound. The use of natural sound is mainly expressed through plant landscape and waterscape sketches. In Chinese classical gardens, raindrops drummed rhythmically against the banana leaves, and the tinkling springs are typically representative. In the conceptual design of landscape sketches, we should be good at capturing these natural characteristics of plants and water features, and use them rationally [4]. The research of artificial sound should make full use of the new technology of modern materials and structure, so as to artificially create landscape sketches that enable people to enjoy natural sounds. For example, the echo wall of the Temple of Heaven in Beijing can always attract people's attention and create different experiences to them. The construction of the walls of the imperial dome coincides with the sound transmission principle of acoustics. As long as two people stand behind the East and West halls respectively and stand against the wall, and one person talks northward against the wall, the sound waves will continuously reflect along the wall and travel to the other end of one or two hundred meters (see Fig. 3).
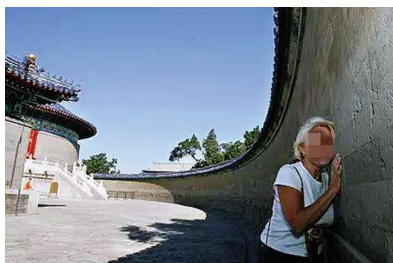
Fig. 3. The echo wall of Temple of Heaven in Beijing.

Fig. 4. Suzhou park avenue interactive water curtain.

5.4   Design Method of Olfactory Concept of Landscape Sketches

Smell has been proven to be a better way to penetrate into people's perceptual depth than images and sounds, which is also a method frequently used in landscape design to establish scene memory based on smells. Since the 20th century, aromatherapy has gradually become popular, because different smells can change people's mood, purify the air, and even prevent and treat diseases. Therefore, the participation of smelling should be an important factor in the conceptual design of landscape sketches.

There are three ways to design the olfactory concept of landscape sketches. The first is to directly set up plants that can release fragrance. For example, in the environment that requires quiet cultivation, we should choose tree species that emit natural and serene smells, such as pines, cypresses, etc. in the design. We should make full use of the fragrance of flowers, fruits, leaves, branches, etc. to create a perfect sense of smell. The second is to install a device for spraying fragrance on architectural sketches, or to add perfume or fragrance to the water sketch and mist spray facilities, which should be designed according to different environments and the needs of different

groups of people. For example, if we add aromatics to the interactive water curtain device on Park Avenue in Suzhou, we can increase the olfactory experience based on the original visual, auditory and tactile experience (see Fig. 4). The third is to use building materials that can release fragrance, mainly metal and wood with artificial fragrance, and by such use, the landscape sketches can exude fragrant fragrance for a long time and make people feel happy.

5.5   Design Method of Taste Concept of Landscape Sketches

The design of taste landscape is not only a physiological response of the human body, but also people's psychological perception. The stimulation and feeling of taste are generally achieved through the combination of experience behavior in landscape environment and food activities. Objectively speaking, different space environments have different effects on human's taste and psychology. For example, it's hard for people to have an appetite when they sit in a sandpit under the hot sun and a glass pavilion like a greenhouse, but if they change to a wooden pavilion by the water, the result will be different. What's more, in seeing yellow staff or smelling sour food, people will naturally have an appetite. Therefore, in a specific environment, designers should pay more attention to the influence on people's taste from the color selection of architecture, facilities and plants, as well as the odor selection of plants. From the subjective point of view, taste also directly affects people's perception of the space environment. For example, the bitter taste is easy to make people feel depressed and sad, while the sweet taste can make people feel happy about the environment. Therefore, we can carry on the corresponding design of the taste concept of landscape sketches according to people's different sense of tastes.

In short, properly grasping the relationship between landscape sketches and taste can not only make people better enjoy and experience their sense of taste, but also create a taste environment space that people love.

6   Conclusion

The application of five senses in landscape design is more and more comprehensive, which has also become the trend of landscape exploration for designers all over the world. Design with five senses is of varied functions and effects in different places and different life situations, but no matter from which aspect to carry on the landscape design and the spatial construction, we should respect and conform to the nature, deepen people-oriented principles, create a cultural, artistic conception, humanized landscape spatial environment.

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Rethinking Gentrification: Emotional Conservation Design in Neighborhood Gentrification

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Abstract. In recent years, emerging conservation has taken place in the renewal of communities and quarters, which has led to several different outcomes. All these practices claimed to resist the urban uneven development and the privatization of urban space through their conservation management. However, throughout most of the conservation movements around the world, we're facing a serious issue which is called gentrification of the neighborhood. Part of the spectrum of neighborhood conservation is very strict planning, where emotional design was utilized as the main idea in conservation redevelopment planning. This concern for the sustained presence of the historic community is threatened by physical displacement and demolition, which has always described the term of gentrification. There is much to be done to find proven evidence to support the importance of emotional conservation in urban renewal planning to ease the negative effects of gentrification. The study rethinks the comprehensive definition of the term of gentrification and discusses how emotional conservation design plays a role in gentrification, which is based on a study of two historic communities where conservation and re-development took place; one located in Lee Tung Street in Wan in Hong Kong, and another in Society Hill of America. At the end of the paper are suggestions for the improved approaches that can be a sound reference for gentrification in China.

Keywords: Gentrification · Emotional design · Conservation

1 Definition of Gentrification in General

More than 50 years have passed since the term was first used. The word originated in Britain, and it has become a popular concept in the United States. According to the American Heritage dictionary of 1982, gentrification is the restoration of deteriorated urban property especially in working-class neighborhoods by the middle and upper classes. In a similar vein, the Oxford American dictionary [1] contains the following definition: "movement of middle-class families into urban areas causing property values to increase and having the secondary effect of driving out poorer families."

The timeline ranges from 1964, when the British sociologist Ruth Glass [2] was first seen to use the term "gentrification" in a book about urban and social change in London, to recent writings on the process. We can see how the process moves from

being defined as a relatively insubstantial urban process affecting residential neighborhoods in 1994, to a definition that is broadened out to include commercial redevelopment and that points to gentrification as a more significant process that is part of the wider restructuring of urban geographical space in 2004 [3], to the most recent definition from 2009, in the fifth edition of The Dictionary of Human Geography which extends the definition so that gentrification is now seen as a truly global urban process affecting big and small urban centers around the world.

I am suggesting, then, that the terms of gentrification and gentrifiers, as commonly used in the literature, are chaotic conceptions which obscure the fact that a multiplicity of processes, rather than a single causal process, produce change in the occupation of inner-city neighborhoods from lower to higher income residents. It needs to be disaggregated so that we may then re-conceptualize the processes that produce the changes we observe, and so that we may change, where necessary, our ways of seeing some forms of gentrification and some types of gentrifiers.

2 Issues and Debates

2.1 Is Gentrification Bad for Neighborhood Conservation?

As we know, gentrification often results in neighborhood revitalization, indicated by rising housing costs and infrastructure transformations geared towards gentrifiers. In most cases, it is always regarded as a negative outcome of unadaptable redevelopment. However, the critical point behind the changing face of a gentrifying historic place isn't displacement, but succession. Thus, the conservation of human emotion is a decisive factor. The following Table 1 gives a summary of human emotional impacts of neighborhood gentrification [4].

Table 1. Summary of human emotional impacts of neighborhood gentrification.

Positive impact to human emotion	Negative impact to human emotion
/	Displacement through rent/price increase
Stabilization of declining areas	Community resentment and conflict
Increased property values	Loss of affordable housing
/	Unsustainable speculative property
Reduced vacancy rates	Price increases homelessness
Increased local fiscal revenues	Greater take of local spending
Increased viability of further development	Commercial/industrial displacement
Reduction of suburban sprawl	Increased cost and changes to local services
/	Housing demand pressures to poor areas
Increased social mix	Loss of social diversity
Rehabilitation of property	Under-occupancy and population loss

We should rethink the working stage of gentrification and encourage mixed-income neighborhoods in which human emotion could be preserved while displacement is avoided or minimized [5].

2.2   The Inconclusive Relationship of Conservation and Gentrification

In different locations, gentrification takes different forms but the common form is the renovation of old inner and central city building stock for new uses, generally associated with the middle class. It is no doubt that conservation with emotional design is the most innovative outcome of neighborhoods under these reinvestments, while other methods are demolition and replacement, incumbent upgrading, and rehabilitation or renovation. As the inconclusive correlation between the two, many other experts found more positive results in historic areas than those in ordinary areas. The historic areas which were the focus of conservation projects were more likely to accept the moving people. Thus, whether or not the historic buildings were occupied or pre-served, the correlation of gentrification and conservation was compatible.

Gentrification is a gradual process, slowly reconfiguring the neighborhood. It is quite significant to understand that conservation can play an important role in mitigating some vulnerability of gentrification for a neighborhood and their heritage. I suggest that gentrification is needed in present day conservation in some disinvested historic neighborhoods, but the biggest challenge for us is to have enough rather than having too much. Moreover, conservation with emotional factors can help a neighborhood to reshape and retain its identity and sustainability in an effective way.

3   Methodology

This article, based on a study of two historic communities where conservation and redevelopment took place; one located in Lee Tung Street in Wan Chai, Hong Kong, and one in Society Hill, the neighborhood of Philadelphia city in America. Both examples demonstrate several results determined by neighborhood conservation design. Both cases have much in common: near to the city center, high rate of renters, high architectural value, comparatively low housing values, influx of amenities that serve higher income class, and influx of households and individuals specifically interested in urban amenities and cultural niches. Thus, my intention is not to draw a definitive conclusion of gentrification in a neighborhood, but to discuss whether conservation with emotional design can mitigate the negative effects of gentrification in a historic neighborhood.

4   Case Studies

4.1   Lee Tung Street, Wan Chai, Hong Kong

The Background and Context. Lee Tung Street was established between 1911 and 1920, which was full of almost three-story tenement buildings without toilets. In the late 1950s, the street was reconstructed into six-story and seven-story buildings by a private department. At the same time, the printing industry started to develop, which mainly printed business cards for the stationery and commercial enterprise. Parts of the shop turned to printing wedding cards and money packets, specifically from the 1970s. Therefore, the street was renamed as "Wedding Card Street" based on its typical printing business. In 1997, it was on the list of Urban Renewal Projects of Wan Chai District. According to the outline of the redevelopment plan of URA, despite it claiming that the purpose was to preserve the local culture and lifestyle, what was strange is that all of the old buildings on Lee Tung Street and nearby would be bought out and demolished for the purpose of redesign and development. Moreover, all the residents were resettled to another place to make room for commercial use. The redevelopment plan was undertaken in 2003, and some residents set up an organization called "H15 concern group" to oppose the decision of the government. Although it was a failure in the end, it also reflected some issues regarding urban renewal, and the most eye-catching debate was on gentrification.

The Different Roles Under the Gentrification Impact. The debate was focused on the solution of existing habitation and shops. As I have mentioned previously, gentrification is involved in different roles of people, original residents, shopkeepers and newcomers.

All comments made by the original residents were focused on the living and business space, and most of them supported the redevelopment plan. The reason for the furious opposition by the H15 concern group (mostly shopkeepers) was they cannot receive the compensation from the government as original residents. They claimed that all the so-called memory and culture will be lost with no original residents living here to practice their culture and tradition, although the government explained they will preserve and reconstruct the local culture and atmosphere.

According to the media comments on the Wan Chai District, such as "Apple Daily", it can be concluded in several sentences: near the core commercial area; saved the transportation fees; various shops around; enough facilities; potential higher housing price; local Hong Kong culture. It is quite similar to the comments of local residents. In this case, gentrification is bound to happen with a good location and well-equipped supporting facilities like Wan Chai.

The Strategies and Implementations. As the government and the URA claimed that they will preserve the culture and memory of the neighborhood, I make a contrast between what original residents complained about and what the URA has done to see if the so-called conservation has reached its own aim. After struggling with the planned implementation by URA over two years, the H15 concern group designed an alternative proposal with their own suggestions which was overruled in the end, and the

URA sold the land to private developers to build elite residences and a modern themed shopping center. As a consequence, we need to acknowledge that the local community was totally displaced by the newcomers, which also means that the traditional lifestyle has disappeared.

The Assessment of Emotional Aspects. After the contrast of the before and after of the redevelopment, we can easily find that the most common argument is the emotions of original residents and their living space. The redevelopment plan induced the gentrification of the neighbourhood and the assessment to emotional aspects in neighborhood could be concluded as below in Table 2:

Table 2. Assessment of emotional aspects.

Social culture	Local community	The URA	Assessment of emotional aspect
Social network	Residents/shopkeepers lived here for a long time;	Changed the original working-class residents to middle-class;	Lost authenticity and human emotion
Social economic	The traditional technique industry rooted in community for many decades; The social and commercial relationship was set up by local business;	Set up a shopping center based on the theme of wedding; The new center welcome the original shopkeepers to rent prior;	Try to keep the local culture, but lost its traditional shopping style;
Collective memory	The living memory of original residents;	Built upscale fin-shaped residences instead of old tenement buildings;	The new residence and comers cannot replace the original as their traditional lifestyle;
Community identities	Residential buildings which were built in 1950s–60s as a sign of Wan Chai culture;	Retained three historic buildings and one of them was revitalized to a wedding heritage museum of Chinese and Western culture;	Mainly gone only left three buildings;

Authenticity of Community. The tenements on the street were redeveloped into residential high-rise buildings for the new middle class. As a result, the local lifestyle and the traditional living space were replaced by the new and modern type. Without the original residents in this place, how to retain the collective memory of this area? Thus, the authenticity of the community was totally gone. As a solution to better housing, gentrification facilitated relocation of residents with certain compensation. The reason was that the compensation was not enough for them to purchase a house here.

Public Participation. The gentrification of Lee Tung Street caused much conflict and gained media attention at that time. The H15 concern group also designed an alternative proposal which was called "Dumbbell" to argue with the URA, they insisted on keeping the living space for themselves instead of making room for commercial use and relocation. In addition, they also tried to find a balance between urban renewal and neighborhood conservation. Unfortunately, the proposal was rejected by the URA in the end, which also meant that the public participation was downscaled to a form of recreational space.

Economic Value. As a consequence of this redevelopment, the property value increased higher than before and provided more opportunities to make money for private developers. They built elite residences for the new middle class and satisfied their psychological demands of experiencing traditional culture by living in a historic place. Thus, the value of the place has been boosted through this gentrification, which made lots of characteristic shops pop up during the renewal and brought commercial opportunities.

Characteristics. When the movement of demolition of Lee Tung Street became popular in Hong Kong, the Wan Chai Culture was strengthened continually. Wan Chai Heritage Trail was the result of gentrification that was introduced by a non-profit organization, who also made the place, and transformed it into a tourist attraction. The traditional private living space was now opened to the public as a brand promotion. Then, to meet the tastes of the middle class, more and more characteristic shops and boutiques opened up on the historic street. Ultimately, Lee Tung Street became a totally middle-class area with historic buildings, so-called old community network, and special shops.

Therefore, Lee Tung Street took inadequate emotional conservation design in the gentrification process and displaced the original residents and cultural businesses at the same time. However, it should be pointed out that only three high-value historic buildings have been well preserved but their original ambience could not be retained; however, one of them will be revitalized into a traditional museum to memorialize the local culture. By this point, it begs the question: is gentrification always bad for neighborhood redevelopment? What will Lee Tung Street look like if the URA used more strategies based on emotional conservation design in the process of gentrification?

4.2   Society Hill, Philadelphia, America

The Background and Context. Society Hill was a vast metropolis built up around a hollow center. Nearly all the rich and powerful had fled the city limits for the elite suburbs, and only the poor, aged, and minority groups remained [6]. In the early and mid-1800s, there was a mixture of race and economy in the neighbourhood in Society Hill. However, due to the limitation of transportation, those residents, especially the affluent and middle classes, moved to the west between 1860 to 1930, in order to live near their businesses and institutions, patrons, and suppliers. As a result, the lower-class European immigrants flooded into this place. Due to the influx of immigrants and

pronounced economic segregation, the area began to decline slowly with many residents moving out. The Philadelphia society for the preservation of landmarks had initially been formed during this period in order to save the noteworthy late-Colonial Powel House from decay. After World War II, the National Housing Act was admitted by the Federal Government, as an organization to authorize the use of federal money for urban renewal; and the early process was taken on by the Philadelphia Redevelopment Authority (RDA), which assisted lower income residents in rehabilitation work during that time.

The Strategies and Implements. The master plan of Washington Square East Redevelopment intended to preserve as many historic buildings as possible, and emotional conservation design played an important role in this plan to provide the so-called authentic neighborhood ambience. The plan divided the area into four units, with Unit One being the largest segment of the total Redevelopment Area. The Unit One was totally condemned by the RDA in 1959, giving that body absolute control over its reshaping. Much more land was to be devoted to higher quality residential uses interspersed with a generous provision of green spaces, pedestrian paths, and small sequestered parks. Wherever possible, painstaking care was given towards historical parks, and it's not just the recognized landmarks, but also the rank-and-file residential blocks and storefronts once their facades had been refurbished. Where demolition was followed by new construction, and efforts were made to harmonize scale and texture with that of the preexisting Colonial fabric. However, it aroused controversy as preexisting residents who wanted to stay there had to repurchase their properties according to this plan. This public distress made the RDA exclude certain properties from condemnation for the remaining units. It was the high-income people that were required in Unit One; any possibility of income mix was intentionally minimized. The later development of Unit Two and Three did give a nod in the direction of socioeconomic heterogeneity. Blanket condemnation of property was no longer invoked. Selective renewal left a much larger proportion of original residents in situ. Moreover, there was even a non-profit organization called "Benezet Court" built for the purpose of rehousing some displacees from the condemned portion of Society Hill. These processes have been identified as emotional conservation, and in 1971, the area was eventually listed on the National Register of Historic Places. Even some slum dwellings have been rehabilitated, which were lent publicity and cachet to the Society Hill project.

The Assessment of Emotional Aspects. Society Hill was a typical example of emotional conservation projects used to gentrify neighborhoods, while in many other cities of the world, gentrification indicated the wholesale displacement of original residents, and the condemnation and demolition of buildings. However, in Society Hill, the emotional conservation based plan mitigated the immediate effects of gentrification.

Halted the Overall Loss of Population. According to Pace [7], there were 112 preexisting families and individuals who were relocated to another place due to the little assistance. It also indicated that about 33% of the original residents remained from before the renewal, with almost the same proportion remaining after the private

rehabilitation. However in recent years, there were very few people left with such a successful renewal plan [8].

Preserved the Historic Heritage. From what can be seen in Society Hill today, we find that the renewal plan was quite successful. For instance, a large number of historic buildings have been preserved to retain the identified heritage of the neighborhood. At the same time, there is twice the number of housing units provided the abundance of housing for residents here, and as a mature redevelopment plan, the neighborhood was primarily residential with commercial corridors. Furthermore, many streets and parking lots have been updated and expanded to meet modern requirements.

Inheritance in Communal Space. When the urban renewal plan was underway, the trend towards private rehabilitation in Society Hill started to catch hold. This caused the developers of townhouses to begin seeing gainful opportunities, which then made better housing conditions and facilities for this area. The mixed community in Society Hill made the area more lively as the newcomers and residents of the original community shared a common space and enjoyed the better facilities together as a whole neighborhood. That is to say, the culture, heritage, and memory have been inherited instead of disappearing.

4.3   Summary of Comparison

Both of these cases utilized conservation in neighborhood redevelopment under gentrification pressure, but the outcomes were totally different. The gentrification was driven by many forces. In the Lee Tung Street, it was caused by a regional growth in the form of an expansion of the central business district in Hong Kong and Wan Chai became a potential area for development. The eye-catching debate is how to avoid displacement and retain the emotional and cultural identity of a neighborhood. However, in Society Hill, it was the urban renewal plan with the aim to rescue the deteriorated neighborhood. Gentrification is a gradual process, slowly reconfiguring the

Table 3. The effects of two cases.

Name	Lee Tung street	Society Hill
Catalysts of gentrification	Urban renewal plan	Urban renewal plan
Reactions to gentrification pressures	Formation of H15 concern group by original people	Formation of community association; Relocation services provided by RDA;
Emotional conservation strategy	Adaptive reuse of 3 historic buildings, while others were demolished;	Reconstruction, renovation and rehabilitation of historic houses;
Mitigation effects	Community heritage used as economic catalyst;	1/3 of the preexisting residents remained;
Gentrification impact	Intrusive	Stable

neighborhood. It is quite significant to understand that conservation can play an important role in mitigating some vulnerability of gentrification for a neighborhood and their heritage. I suggest that gentrification is needed in present day conservation in some disinvested historic neighborhoods, but the biggest challenge for us is to have enough rather than too much. Moreover, conservation with emotional factors can help a neighborhood to reshape and retain its identity and sustainability in an effective way. The following Table 3 gives a summary of the comparison between the two cases.

No matter what comments these renewal plans earned in the end, it cannot be denied that if emotional conservation design had been used in the gentrifying process, it would benefit the historical neighborhood, and at least mitigate certain negative impacts. In other words, the gentrification is not always bad for the neighborhood to some extent. That is, at the neighborhood level, appropriate gentrification can be encouraged rather than too much. For Lee Tung Street, if the URA could cooperate with the community to explore the most adaptive proposal for the neighborhood, and provide more affordable apartments for house owners or enough compensation, and retain the traditional retail clusters, the gentrification would have been be more welcomed by society, and more helpful for the stabilization and development of the community. It is worth learning from Society Hill where it has acquired many benefits from this value-based strategy and cooperation between government and neighborhood, which has made the community more stable and prosperous through the gentrifying process.

5 Conclusion

Nowadays, many progressive strategies are used in the gentrifying process, and emotional conservation design is one of them. For this reason, we need to analyze these processes in terms that go far beyond concepts of undifferentiated "gentrifiers" and upwardly mobile neighborhoods. Emotional conservation design in gentrification can be regarded as a tool to enhance the diversity and ensure the integrity and sustainability of a neighborhood, which would assist the gentrifying process to be more effective and adaptive for the community as a whole.

That is to say that gentrification, when based on the sufficient emotional conservation design, will bring much more benefit to the neighborhood. Despite some inevitable issues that are still under debate, the advantages far outweigh its weakness. As different places have their own identity and condition, it depends on a wide range of backgrounds on each individual case. The neighborhood will be emotionless without its original residents. Meanwhile, we should not reject the newcomers from joining the original neighborhood, as some critics have indicated that they have little to no influence on the character and network of the community. Another important aspect is, the result of urban renewal planning depends very much on the way emotional design is used, and by whom. It is clear that if the governments could coordinate with the community, gentrification would be more beneficial for the neighborhood. Based on the cases I have presented above, I think the most effective way to achieve redevelopment goals is if the government and relevant departments can provide enough funding and expertise, while the community people on the other hand should have a comprehensive understanding of the area and occupy the area (see Fig. 1).
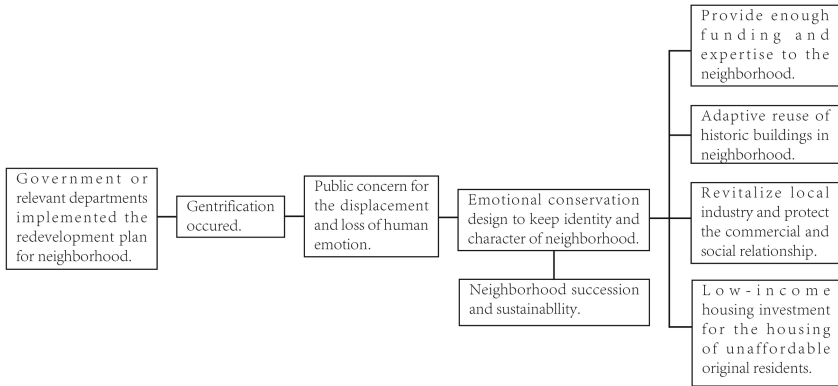
Fig. 1. The process of gentrification with sufficient emotional design.

In conclusion, to some extent, emotional conservation design plays an important role in gentrification, which would mitigate its negative impacts and make it more beneficial to the neighborhood. Regardless of the residents or the context of the neighborhood, gentrification should not be a displacement but a succession.

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Supporting Systematic Conceptual Design with Knowledge-Based System

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Abstract. Conceptual design is the core stage in the process of product design. At this stage, designers make product design decisions with vague and imprecise information. Compared with the high-efficient computer-aided tools in the detailed design, the computer-aided tools are relatively backward in the conceptual design stage. The Systematic-TRIZ conceptual design computer-aided tool (STCD) proposed in this study can assist designers to fill this gap and improve the design process in the conceptual design stage. In order to achieve this goal, the conceptual design support tool (STCD) for product design is developed, which integrates the systematic design method, TRIZ method and knowledge-based system. The STCD tool is in the development stage, and only part of the conceptual design knowledge of the hair dryer is collected and stored in the computer system. STCD supports four stages in the conceptual design process: function modeling, concept generation, concept composition, and concept evaluation. Each knowledge is divided into Subject-Action-Object using the functional definition of TRIZ. This study aims to show how STCD tools acquire conceptual design knowledge from experienced designers and store it in a computer system for later use, and how STCD tools assist designers in conceptual design by dealing with repetitive and time-consuming tasks.

Keywords: Systematic design · TRIZ · Computer aided design

1 Introduction

In the past decades, many scholars have done a lot of research on design theory and methodology [1]. Most of the design theory are based on the German system design method of the 1870s [2] which is also cited in the famous design textbooks in the United Kingdom and the United States [3]. Systematic design method is widely used in conceptual design, and systematic design is the process of system design to meet demand [4]. The systematic design process can be broadly divided into four stages: project planning, task presentation, conceptual design, and detailed design [5]. In these stages, conceptual design is the core stage in the process of product design. Conceptual design exceeds 75% of the cost of the product lifecycle since it is the stage of defining

the basic characteristics of a product [6, 7]. In the conceptual design stage, decision-making contains vague and inaccurate information. Decisions made at this stage will impose a significant impact on the cost, quality, and manufacturability of the product life-cycle. Usually, it's hard to make up for a poorly conceived concept with a good detailed design process [8, 9]. Therefore, conceptual design requires a reasonable concept in order to succeed in the design.

At present, there are several computer-aided design tools (CAD) can reduce the designer's workload and save the product development time. Most tools, such as geometric information-based drawing, geometric modeling and element analysis, are used in the detailed design stage. These tools, however, can't deal with the four aspects of function modeling, concept generation, concept composition and concept evaluation in conceptual design process. These aspects are important in the conceptual design stage and are based on function. More CAD tools are used only in the detailed design stage than in the concept phase [10].

Conceptual design process, a type of knowledge aggregation, requires the cooperation of professional knowledge from different disciplines [11]. Designers have limitations in dealing with big data in spite of their creativity and design experience. Consequently, a good design scheme and a reasonable judgment are hard to be developed in a given time. On the other hand, computers can process big data quickly and reasonably. Combining designer's creativity with computer function, this study can carry out conceptual design process more effectively than pure manual design.

With the development of the product design process, knowledge about the product needs to be acquired from the conceptual design to the detailed design stage, during which the decision-making influence will decrease [9]. Since the decisions made at the conceptual design stage have limitations on decision-making at the detailed design stage. As the design evolves, the design requirements may be changed or developed into new requirements which are not mentioned at the beginning of the design. This allows the design process to be repeated over and over again, through which a number of design activities are repeated for improvement. Designers shall study feasibility design options in detail so that they can make the necessary changes early in the design process. Because it's more expensive to make changes at the end of the design stage, and ultimately leads to delays in the release of products [12]. The computer-aided tools can deal with the repeated design tasks so as to save the product development time and improve the design process.

The study is targeted at studying the conceptual design process and proposing a computer-based conceptual design assistant tool model. As shown in Fig. 1, a framework of a new conceptual design aid tool (STCD) is proposed in this study, which combines the Input-Output function definition of the systematic design method with the SAO function definition of the TRIZ method, and establishes a function structure by decomposing the whole function into several easy-to-solve sub-functions, so that each sub-function corresponds to the SAO model and is finally integrated into a knowledge-based system. STCD tools can assist designers in the conceptual design process, but that does not mean replacing designers with fully automated conceptual design processes. However, it helps designers in conceptual design by handling repetitive and time-consuming tasks. It presents more time for the designers to focus on the creative parts of the design process.

2 STCD in Conceptual Design Process Model

The conceptual design process, a design process that meets the requirements, can be transformed into one or more concepts developed to meet the requirements. The better design solutions can be developed with careful and extensive exploration of the design field. There are more than one solution that meets a given requirement in most cases. A conceptual design process model is proposed in Fig. 1. In this model, the systematic design method, TRIZ method, and knowledge-based system are integrated, including a range of activities and outcomes [5]. Activities (i.e. function modeling, concept generation, concept composition, and concept evaluation) are performed by the designer's knowledge and design knowledge base system. The results of the specified activity will be displayed to the user and will be used as input to the design knowledge-based system to perform the next activity.
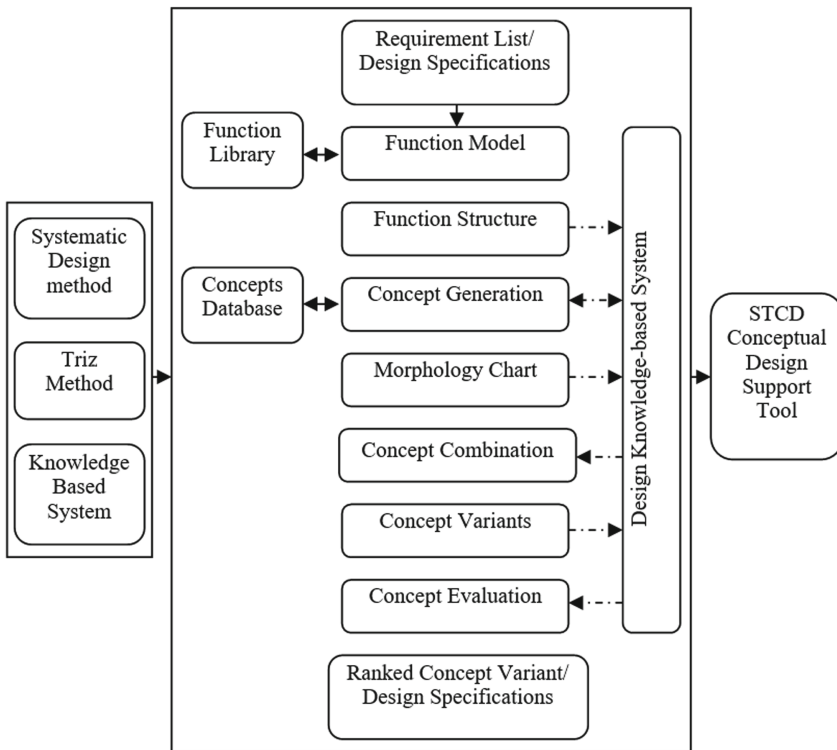
Fig. 1. Conceptual design process model.

Function Module

There are several documents that define function from different perspectives [5, 13, 14]. As shown in Fig. 2, function can be defined as the system's input-output relationship, designed to perform tasks independently of any particular solution. A function model is

the overall function of a design problem raised after the analysis of a requirement or design specification and then decomposing it into several sub-functions that are easy to solve to establish a function structure [11]. Form follow-up function, each product has its function meaning. Function plays a key role in conceptual design. As shown in Fig. 3, input-output information function is represented as noun (subject) verb (action) + noun (object) by TRIZ method, which is convenient for computer knowledge system identification and storage [13]. The repeatable design process also requires a unified standard of functional vocabulary. In this study, it adopted the method of developing a computer function library based on the coordination function proposed by Hirt et al. [14]. On the basis of coordination function, function can be divided into 8 Class I, 45 Class II and Class III verbs. There are three types of Class I conduction in this function library: material, energy and signal, which are further divided into 42 Class II and Class III conduction. Function can be expressed as (noun + verb + noun) Class I function, Class II function and Class III function composited by conduction.
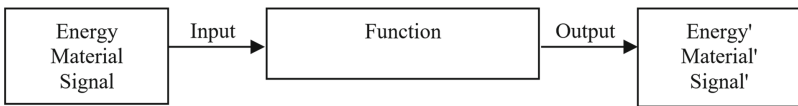
Fig. 2. The EMS function model.
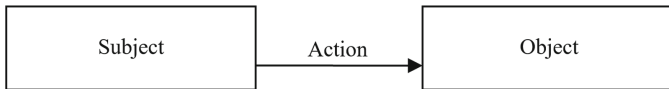
Fig. 3. The EMS function model.

Each product designed by the STCD tool includes a function model that breaks down the overall function into sub-functions by analyzing existing products and experts' opinions. Designers can also modify it to new function, and all of the sub-functions in the function model are represented by function in the function library. In a knowledge base, the function is represented by the following attributes:

Function
Name: Subject(noun) + Action(verb) + Object(noun)
Complement: additional information
Input: input conduction
Output: output conduction
Matched: yes/no

The Name column refers to the function represented by a noun + verb + noun. The Composition column is optional and can be used to complement the description information.
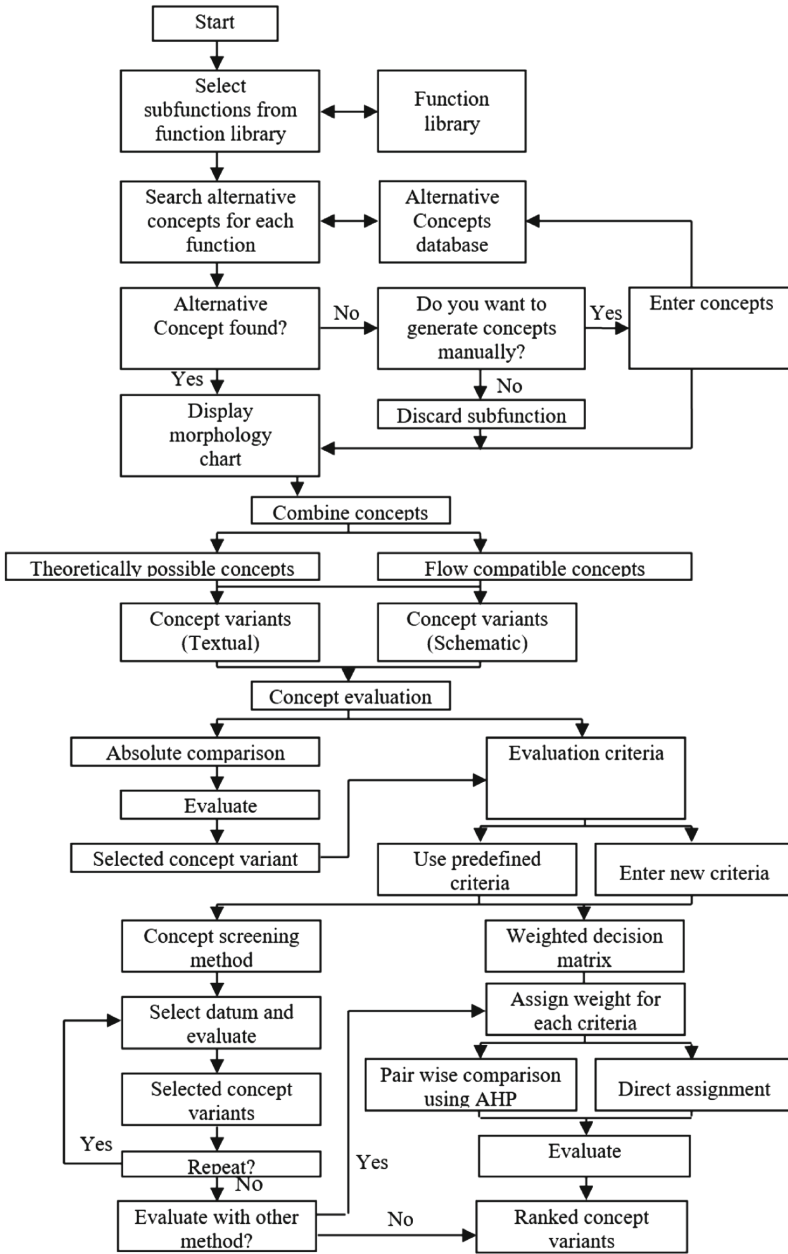
Fig. 4. Flow chart of the STCD.

Concept Generation Module

As shown in Fig. 4, the concept generation stage uses preset product rules in the knowledge base to complete the concept generation process by searching for alternative concept databases. To this end, a conceptual database of hair dryers is established by collecting manuals, patents, manufacturer's catalogs and concepts from the designer's personal experience. Concept generation has two available types. The first is mapping, in which the system searches for concepts of Class I and Class II that match the sub-functions in the working memory. Sub-functions and all optional concepts will appear in the schematic and be stored in working memory if there are alternative concepts in the conceptual database. If a single or multiple sub-functions in the database do not have alternatives, the second approach will be automatically executed. In this case, the user will be required to perform concept generation manually and provide an optional solution for input, and moreover, these concepts will be stored in the database for future use. In the end, the sub-functions and their corresponding alternatives are shown in the schematic diagram. With 40 problem-solving principles in the TRIZ approach, the existing design knowledge can be acquired and stored in a database.

Concept Composition Module

After generating alternative concepts for each of the sub-functions in the function structure, the overall function can be achieved by combining these concepts. Preset product rules can be used to create concept variants. For reducing the failure rate of the composite, designers evaluate the concept of sub-function generation and delete the useless concepts in the schematic before the composite concept. Generally, a total of two types of product rules in the knowledge base can be used to perform the concept composition process:

A General Principle for Creating Concept Variants in Theory. In this case, a concept variant is created by adopting a scheme for each of the sub-functions in the schematic.

Conductive Constraint Principle, To Create a Conductive-Compatible Concept Variant. The synthesis process is the same as the general rule, but increases the constraint of conduction compatibility. Only if the output stream applicable to the previous concept is the same as the input stream of the subsequent concepts in the schematic diagram, it is a variant of the compatibility concept.

Because the number of sub-functions of different products varies, the knowledge base contains product rules for each case. The combined concept variants are shown in text and schematic form, displaying all the components that make up the concept variants.

Concept Evaluation Module

The concept evaluation process will be conducted in three steps. First, an absolute comparison method is used for evaluation, in which concepts are compared directly with a set of requirements. This leads to the elimination of some unworkable concept variants. Next, the concept-filtering approach is used to evaluate the remaining concept variants over and over again, based on a product or a concept variant. If a product is used as a benchmark concept, it should be reduced to the same level as other concept variants. This process will further reduce the number of concept variants, and the

remaining variants will be evaluated using the matrix decision method. The degree to which the criteria are chosen can be assigned directly or compared in pairs in virtue of the analytic hierarchy process. The output from this evaluation process will rank the concept variants based on grades, select one or more concepts for further development, or combine some concept variants so as to achieve the concept variants with better performance and repeat the conceptual design process.

3   STCD of Knowledge-Based System

In this study, the implementation and application of STCD tools requires the development of knowledge-based systems. A knowledge-based system is an artificial intelligence system that uses stored knowledge to solve problems in a particular domain. Three major components of the knowledge-based system structure are: 1. Knowledge base containing knowledge domain; 2. Inference engine (control device); 3. Interface with the outside world (user interface). In these major components, the knowledge acquisition components are also included, so as to add the new knowledge to the program development process and the program life-cycle [15].

The STCD prototype tool is developed by applying these programming environments on the basis of the above-mentioned methods. Users can easily browse the design information according to the flow chart's using buttons, options and menu bar, and perform the conceptual design on Windows program.

4   Hair Dryer's Application of STCD

In this section, the hair dryer conceptual design is taken as an example so as to demonstrate the auxiliary role of the STCD tool proposed in this study in the conceptual design stage. Meanwhile, in this second, it also explains how to use the auxiliary tools to design the function.

4.1   Function Model

The designers' job is to design a hair dryer that generates hot air by heating and spinning at high speeds. As shown in Fig. 5, the overall function can be defined from customer requirements: split wet hair into water and hair.
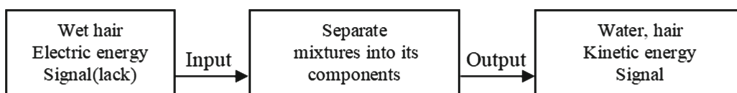
Fig. 5. Overall function of hair drier.

In the first step, the designers manually transform customer requirements into function model. This step can be used to weaken the relationship between the sub-functions and separate them into components, while studying the existing products, the function structure can be gained and the function in the function library can be used to represent the function structure.

The next step is using these sub-functions as input information for STCD, and the function structure is used as input to the system and to generate concepts in the function library. The sub-functions in the function structure can be selected from the function library, and then these sub-functions can be added to the system one by one. The function library can also be used to load the function structure. The user must use the following format to edit function in the function structure in any text editor and save as "filename.txt":

(function(noun airflow) (verb distribute) (noun hair-water location))
(function(noun wind) (verb separate) (noun hair-water location))

Function Model
Once all the sub-functions are added to the working memory, the concept generation step is taken. If each of the sub-functions in the database has a corresponding concept, it shows that "the concept has been successfully generated for all of the sub-functions". If there are no alternative concepts for a single or multiple sub-functions, a notification message window will pop up, where the user can generate the concept by manually entering the concept. What's more, in cases where the concept has side-effects, the system will advise users to consider its side-effects as new requirements. It explains that there will be ever-changing requirements arising during the conceptual design process and it also describes how the STCD tool integrates this situation.

STCD users can reject concepts that are not feasible in schematics, which helps to reduce the error rate in later concept composition. The concept name is displayed when the user clicks on any concept in the schematic. If considering that the concept is not feasible, the user can delete it by refreshing the concept sketch and redrawing the schematic.

Concept Composition
When a user starts a concept composition function, there are two options: create all theoretically feasible concept variants or create concept variants of compatibility conduction. A number of theoretical concept variants will be produced in the concept composition process. Based on the user's requirements and the feasibility of using the hair dryer concept, the user can remove the unusable concept from the schematic diagram. The rest of the concepts are merged after refreshing the schematic, so as to form some alternative concept variants. The concept variants can be viewed from both text and schematics. Completed concept variants represent the names of all the concepts in each concept variant in textual form. Theoretically, all concept variants can satisfy the overall function. The reason is that the concept of generation is designed to satisfy the sub-functions in a function structure that is decomposed from the overall function. Concept composition is a bottom-up process, the reverse operation in function decomposition.

Concept Evaluation

The concept evaluation process begins with defining the evaluation criteria. Users can either use the default evaluation criteria or define a new one. Next, the concept variants are evaluated by the STCD tool in virtue of absolute comparison, concept filtering, and weighted decision matrix iteration methods. After each evaluation process, unworkable concept variants can be eliminated or recombined, and viable concept variants will proceed to the next evaluation process. According to the evaluation results, the most suitable concept variants are selected for further development. Finding out the component of the selected concept variant from the existing concept variant of the hair dryer ensures the validity and practicability of the selected concept variant. The concept evaluation stage explains how to use STCD to re-apply existing concepts saved in the database to the design process. Through selecting the name of the concept variants in the matrix, users can view information about each concept variant.

5   Conclusion

In this paper, the STCD tool can assist the designers to perform conceptual design processes more efficiently than they do by hand alone by handling repetitive tasks and providing concepts that are available in the database. The STCD tool supports the designers through the conceptual process of inputting the designers' decisions step-by-step and providing the output. The STCD tool proposed in this study generates alternative concepts for a given set of sub-functions in a function structure, and the alternative concepts are shown in a schematic diagram. Design knowledge is stored in the brain of experienced designers. STCD can be used as a knowledge management system to retain knowledge of an expert when the expert leaves the company or retires from the company for future use. The concept that the tool generates and displays on the schematic may inspire the user to generate new concepts. What's more, novice designers can learn from expert experience by exploring concepts. It is important to note that conceptual design is not a one-step process and cannot be fully automated. Its nature is dynamic, and requirements may change over time.

STCD tool combines the Input-Output function definition of the systematic design method with the SAO function definition of the TRIZ method, and establishes a function structure by decomposing the whole function into several easy-to-solve sub-functions, so that each sub-function corresponds to the SAO model and is finally integrated into a knowledge-based system. STCD tools can assist designers in the conceptual design process, but that does not mean replacing designers with fully automated conceptual design processes. However, it helps designers in conceptual design by handling repetitive and time-consuming tasks. It presents more time for the designers to focus on the creative parts of the design process.

Currently, the STCD tool is in the experimental stage of development and cannot be placed in the paper for demonstration. At present, the available conceptual database is still in the development stage, which can not be used by the general users for the time being. The STCD tool can be further improved by extending the relevant database and solving problems through the provided knowledge acquisition module.

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Kansei Research on User Experience Appeal and Market Value System of Products

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Abstract. With the development of Kansei engineering, in order to pursue the users' Kansei demands, research approaches are increasingly diversified. In this study, we employed CAP research and Kansei analysis techniques, analyzed the market value system and consumers' design acceptance. Through an effective combination with physical properties of products such as usage, functions, modeling and materials, we can effectively improve the quality and efficiency of product development. The results showed that a product should shift from hardware orientation to the orientation around software and service. The market positioning of a product may change significantly according to the requirements of customers.

Keywords: Appeal · Market · Value system · Kansei research

1   Introduction

1.1   Research Background and Purpose

In recent years, with the development of Kansei engineering, in order to pursue the users' Kansei demands, research approaches are increasingly diversified. In the design, research and development process of products, it has become a necessary and important task for us to analyze the value system of customers, which involves the use of functions and understanding and application of different aspects such as processing technology, sentimental value, aesthetic value and market environment [1].

The research and development mindset centered around manufacturer rather than customer has made new products be seen as an obstacle in marketing. In the market dominated by customers, in the attempts to select products for them, it is particularly important to establish a value assessment system for products [2]. Design is more than just an activity of designer and producer, but is also vital to sales. The main link influencing the sales is acceptance of design, which is reflected in customers' love and purchase of design products. It has a substantial influence on the outcome of the design. It indicates that to achieve a high level and quality of design, a design is closely related with the market and demands of customers. Through Kansei analysis and research, we can have a better understanding of customers' demands and the market and optimize and enhance the strategic level of designs.

1.2   Research Methods and Areas

According to the system of Kansei engineering research methods, the research methods for quantization of human's Kansei cognition can be classified into two categories, namely measurement of human's physiological response and psychological response. The subjective quantitative research method frequently used in earlier times was mainly a semantic decoding method. Pairs of adjectives for analysis are formed based on the users' subjective understanding and appeal in products, thereby forming a scale of subjective assessment.

With the mutual influence between design science and inter-disciplines, physiological response, as an important measurement of ergonomics and psychology, can also provide an excellent objective basis for product development. In conclusion, physiological indicators focus on the development availability of products, while psychological indicators focus on the subjective assessment of products. The Kansei factors of the two sorts of indicators can be combined effectively with the physical properties of products such as the usage, functions, modeling and materials of products through the CAP analysis mechanism. After taking into account the users' physiological and psychological indicators, we can more effectively enhance the success rate of product development.

2   Theoretical Basis

Uchida Hiroyoki, a leader of Japan's design circle, suggests the concept of "design acceptance" in his book. An analytical tool can analyze the Kansei factors of customers. The Kansei factors of customers are applied in the works of best-selling Japanese manufacturers. The pragmatic Kansei factors of future product designs are analyzed. The author says that even a good manufactured product and an excellent completed service cannot finish the best sales of a product. The most important idea about a product is "acceptance" or reaching a consensus with customers to win their favor. Customers' favor of products depends on three elements–the perception of consensus, aesthetics and comprehension. Such kind of perception exists in the subconsciousness of our brain and cannot be turned into an image.

The "design acceptance" proposed by Uchida Hiroyoki has provided a useful tool for analyzing best-selling products and can well explain popularization and popularity [3]. The analysis seems limited at a first glance. The analysis of a product's visual appearance can serve as a strong tool. Influenced by the personal preference arising from the differences of society and culture, this hinders an accurate and consistent evaluation. The concept of analytical tools can evaluate the subconscious demands of customers and make a great contribution to the development of products or services. In evaluating the demands of customers with conventional methods, we mainly rely on analyzing the data collected by the value system of consciousness. "Design acceptance" shows the analysis result and suggests that evaluating the value system of subconsciousness is more important than analyzing the value system of consciousness [4].

3   Establishment of User (Customer) Experience Appeal System

3.1   Analysis Method of "Design Acceptance" by Customers

The perceptual cognition of humans is usually "vague" and "ambiguous". Quantization of such intention indicators cannot be detected with devices or instruments. The research method based on statistics describes the vague semantics of users as design elements, which is an important approach to accurately grasp the users' perceptual cognition. Known quantitative indicators can acquire relatively consistent users' subjective assessments and preferences based on semantic analysis, and acquire a series of physiological indicators such as eye movements data and physiological feedback data that influence emotional state, direction of attention and cognitive processing from the perspective of psychology.
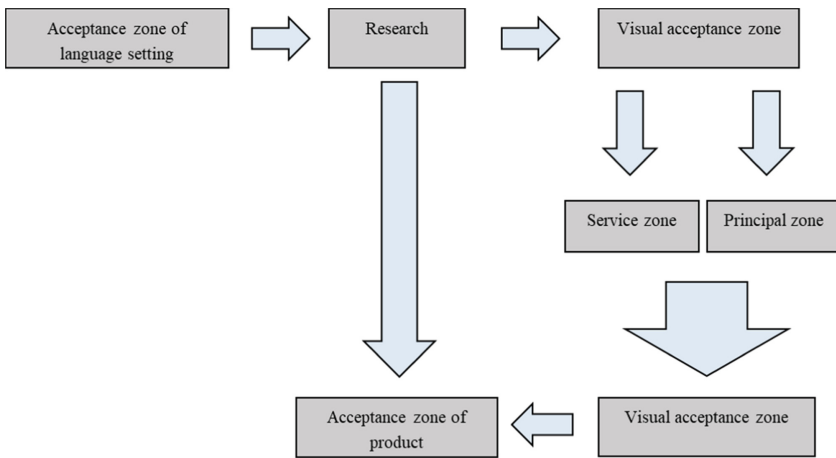
Fig. 1. Schematic diagram of design acceptance.

According to the orientation of analysis results, the "design acceptance" of customers can be divided into two zones. The service zone refers to the original purposes of products and the principal zone refers to the demands or preferences of customers. By analyzing physiological and psychological reactions of the principal zone and service zone, we can infer the "acceptance status". (Figure 1) shows the overall logic and mentality of the design acceptance framework and provides a design method route that can help us understand and grasp the three aspects [5], namely users' preference, Kansei demands and market orientation.

The physiological and psychological quantitative indicators available in the analysis of principal zone and service zone are as follows.

Measurement of Physiological Indicators

The physiological indicator measurement in the research method system of Kansei engineering applies the measurement methods of ergonomics, such as measurement of the brain wave (EEG), the electromyography of muscle load (EMG), the electrocardiogram of vegetative neutral response (ECG), skin potential reflex (GSR), pulse (EKG), the electro-oculogram recording eye movements (EOG) and eye tracker focusing on the dot changes. The above indicators are measured with special measurement devices. The measurement results of these indicators are objective and quantitative. Small, integrated and high-precision devices for the above-mentioned indicators are now widely applied in Kansei engineering laboratories of product experience [6].

Measurement of Psychological Indicators

In the perceptual cognition of the measurement of psychological indicators, the most important should be interpretation. Users are inquired on through samples or questions directly. Survey data collected is used to analyze basic data of psychological indicators. In order to correctly, visually and effectively interpret the perceptual cognition of users, the analysis methods for psychological indicators are applied constantly in this field. Based on different research contents and purposes, the adopted analysis methods can be classified into two categories, namely exploration of structures and the grasping of causal relations. In the exploration of structures, Kansei demands are sorted out and the clusters are grouped while the inherent constitutive relations among the demand clusters are grasped, thus discovering new solutions to design issues. In addition to the qualitative KJ method, the main quantitative methods include factor analysis, principal component analysis, Category ID and IV theories concerning math, physics and chemistry of Chiko Hayashi, cluster analysis, multi-dimensional analysis and analytic hierarchy process [7].

In the grasping of causal relations, the inherent connection between Kansei demands and specific design elements are confirmed, thus pointing a direction for the design tasks. The main methods include Category I and N theories concerning math, physics and chemistry of Chiko Hayashi, decision-making and trial evaluation laboratory method and interpretive structural modeling [8]. In recent years, other methods applied in the field of Kansei engineering also include conjoint analysis for the study of balance mechanism of users' demands, covariance structure analysis of the causal relations between phenomena and substance, and non-linear rough sets for grasping the optimal integration of design elements.

By analyzing "acceptance semantics" of the image and layout of acceptance tone, the research ultimately interprets the principal zone and service zone. The semantics acceptance zones can be divided into six categories, each of which corresponds to descriptive terms. There are four layouts: A represents the considerable energy of "market"; B represents the randomness of "symmetry modification"; C represents randomness of "symmetry"; and D represents "non-confronting" emotions of fashion and city (Fig. 2). By setting acceptance "picture" for the acceptance "position", the designer judges Kansei factors of users (Fig. 3).
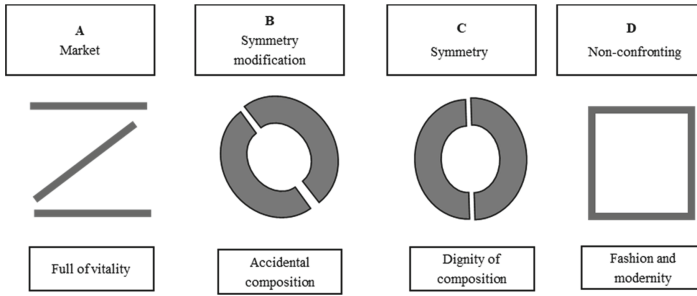
Fig. 2. Schematic diagram of semantics acceptance.
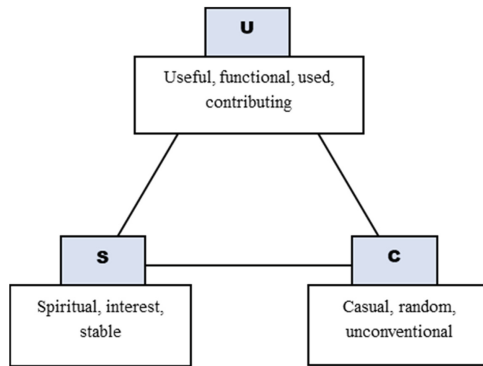
Fig. 3. Schematic diagram of acceptance.

4 Establishment of Value System of Customers

In analyzing product acceptance, product designers evaluate the factors of customer values in a design with quantitative analytical methods, in accordance with the handling of consciousness towards the shape or layout of design. It is a psychological process of dealing with subconsciousness with the principal zone. The service zone represents the original purposes of products and mainly represents the subjective emotional demands in the subconsciousness of customers.

In solving the cases of product acceptance by customers in terms of design or style, the principal zone is perhaps much greater than the service zones. There are common zones between principal zone and service zone [9]. Product acceptance refers to the evaluation process of products at the ultimate stage. This process is correct before purchasing. Among the products purchased, the main factor is the similarity in terms of appearance, interface and vision. Yet, the effect of design acceptance is limited, because lots of variants still exist in the products with similar functions, rather than in shapes and styles. Based on these mechanisms, a more accurate CAP analysis method is applied to solve the above issues.

C: Consistency. The data obtained by visiting all nodes should be identical. To note, here consistency refers to strong consistency. That is to say, after the update of data, the data seen in any node is completely consistent, that should be different from weak consistency and ultimate consistency.

A: Availability. All nodes remain highly available. To note, here high availability also means that there should be no delay. For example, if the request for synchronization of data is blocked at node B, then node B cannot be considered as highly available, which means, any service without any fault shall return a reasonable set of results within a time limit.

P: Partition tolerance. Here partition refers to the partition in the sense of network. Since the network is not reliable, there may be a failure of communication among all nodes. When there is no communication between nodes, we should guarantee that the system can continue to serve normally.

Spoken from actual effect, partition is equivalent to a time limit requirement on communication. If the system cannot reach data consistency within a time limit, it means that there is partition. The current operation shall be chosen between C and A.

Spoken from the CAP mechanism, it is impossible for a data distributed system to satisfy the three conditions of C, A and P at the same time. Therefore, when designing a system, the system architect shall not waste energy on how to design a perfect distributed system to satisfy the three conditions, but should make choices. Since the network is unreliable, most open-source distributed systems can realize P, that is to say, partition tolerance, and later make a choice between C and A. It is a useful measurement tool for all design acceptance factors and re-interpretation of the service zone and the principal zone. As such, it can ultimately solve the demands of customers.

4.1 CAP Analysis Method of Products

Product designers applying "image outside the picture" argue that design acceptance only provides design and color, yet in CAP the form picture will also be analyzed and integrated with its material. In design acceptance, it can be converted into a tool and structure to extract emotional requirements of the product. Color image is converted into the modeling of the structure. Production shapes include simple shapes, stable shapes, basic shapes, regular polygons, traditional polygons and irregular polygons, and the use of the same category of linguistics (Fig. 4).

The design acceptance center classifies the substance of products into three categories, namely useful, spiritual and casual. While there is a classification in terms of vision [10], CAP advocates a wider classification. Therefore, a new classification should be utility, experience and pride, which represent the demands of customers (Fig. 5).
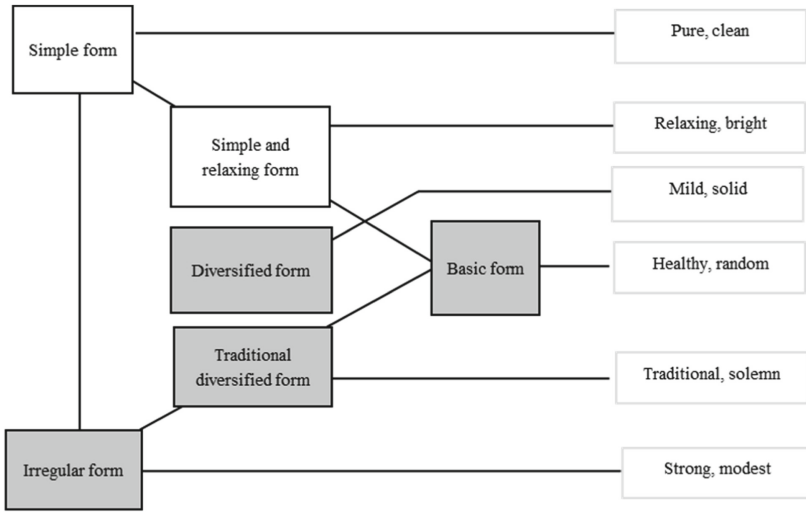
Fig. 4. Semantic diagram of semantics acceptance by customers.
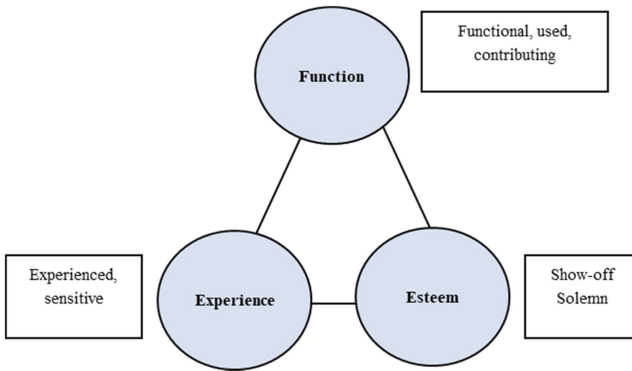
Fig. 5. Classification of product values.

Among the various classification factors like color image and form, materials and texture of products are also very important in the termination of CAP. The analysis of materials is differentiated between natural and synthetic materials and between gloss and decoration firing (Fig. 6).

Based on the classification of the above list, CAP is ultimately classified as follows: A represents the original purpose of products, B means preference and requirements of customers, and C means quality and lifestyle of customers. The purpose is so that among every three orders, each opposite order will be combined to avoid errors of analysis.
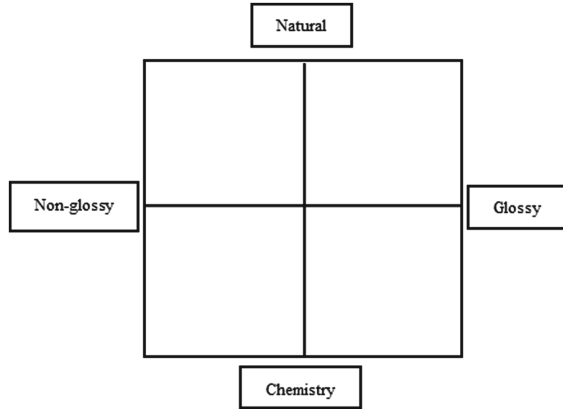
Fig. 6. Schematic diagram of material image.

As shown in Fig. 7, the analysis chart of the wishes and background of customers, if it is a concept to explain product acceptance and integration of CAP, then a critical acceptance point should be discovered in the current market products of CAP. Customers will only accept a product through the technology of the product and its Kansei appearance. This is the real consistency of a product presented in the market of customers.
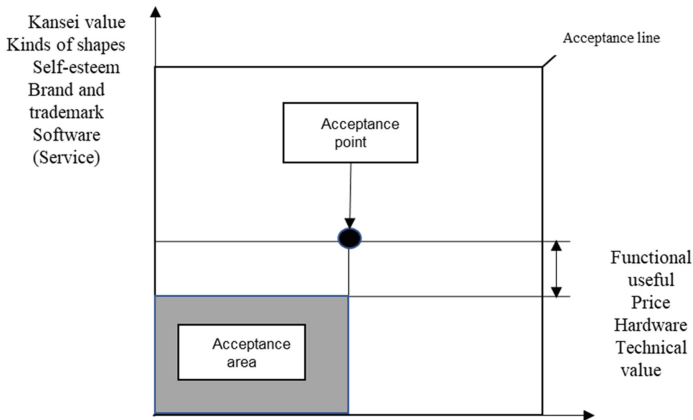
Fig. 7. CAP analysis chart.

Emotional manifestation refers to customer's feelings of a product including appearance, pride, trademark, software and service [11]. Technical manifestation includes functions, utility, price and hardware. The critical acceptance of customers should exist on the diagonal line between the Kansei axis and the technology axis. If the gap along a certain axis is discovered in the entire analysis period, this indicates the need for a math point to shift along a diagonal line.

4.2   CAP Analysis Process of Product Market

The CAP analysis of product markets can be divided into two areas, namely the analysis contents after the concept of product, and discovery of differences between perceptual cognition and technology of CAP. In the analysis of a product's contents, the colors, form, materials and identity of the product are described vividly in detail (definition). In analyzing different aspects of CAP, some customers describe each sensitive and technology aspect, including form and functions, trademark (brand), values and price and the value setting of software, service and hardware [12], which are analyzed for finding out the gap and inferring the success factors in the market.

In terms of technical values of the product, like materials, form and color, it is near the equivalent value, yet their identity is different, which may result in difference in terms of dimensions and market form [13]. Considering the wishes and requirements of customers, as displayed in the principal zone, the fourth "fun" and "pride in ownership" brought by the various rich contents play a role of criticism in the purchase. Therefore, the analysis result indicates that there is no big difference in the hardware manual of different computers, which is easy and quick to master, so it does not act as a critical strength to each other in the competition. One way to gain ability is to discover that the service and contents before the computer have been missed. Therefore, to enhance the brand's value, one will be chosen from two options. Alternatively, in order to facilitate the use, reform and innovation will also be useful in design (Table 1).

Table 1. Market information of products

Evolved products	The development going on in technical innovation and loyalty of customers through their demands or products will be very good	Loyal customer market
Products that can be reconditioned	Products are geared to purchasing power through actual values and extremely high desire	Floating customer market
Demanded products	Actual values and personal preferences, strong products	Fixed customer market
Products lack of creative idea	Availability of limited function and public or luxury nature of products	Small customer market

5   Conclusion

In conclusion, through CAP, the research analyzes the demands of customers for functional and aesthetic values of the products in purchasing them. Customers tend to judge the products based on various information such as the original purpose of purchase. They may choose a manufacturer that is sector friendly to the ecological environment and products that are easy to use or abandon, and even reuse them; then they may achieve a reasonable and economical purchase. Such tendency is indicated in

the change of customers, where a product should shift from hardware orientation to the orientation around software and service. This also means that in entering the market, emotional aspects should be replaced by logical aspects. They are relatively easy for the brain of customers to identify and analyze, because they are logical and objective. At the same time, the emotional demands of customers replace the strong emotional requirements perceived by customers, which is a market positioning issue based on the surrounding environment of a product. The market positioning of a product with a surrounding environment and without one may quickly result in dissatisfaction of customers. The market positioning of a product may change significantly according to the requirements of customers. Yet the methodology based on design acceptance does not rely on its concept, the product acceptance of customers and the assessment methods of the market value system of a product. It can perform a comprehensive analysis of emotional values. Common requirements and market form determine the development of critical acceptance points and future of the product, and lead it to success in the market.

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An Exploration on the Application of Chinese Traditional Art in the Chinese Culture Experience Hall of Colleges and Universities - A Case Study of Fuzhou University of International Studies and Trade

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Abstract. This study explores how the Experience Halls for Chinese Traditional Culture in colleges and universities inherit and promote traditional Chinese culture. This paper takes Fuzhou University of International Studies and Trade (hereinafter referred to as "our university") and the establishment of the Experience Hall for Chinese Traditional Culture as an example. By integrating the layout of China's *I Ching, Five Elements of Yin and Yang,* based on the local traditional culture, the experiential art teaching is realized. By learning the perceptual cognition of Chinese traditional culture and various knowledge in specific practice, through the promotion of traditional Chinese culture, the study provides a significant guidance with educational value in the practice of the application and promotion of traditional Chinese culture for domestic and foreign universities, overseas Chinese schools and Confucius Institutes.

Keywords: Chinese traditional culture · Experiential teaching · Structure of the experience hall for Chinese traditional culture

1 Introduction

Since the 18th National Congress of the Communist Party of China, President Xi Jinping has proposed the Chinese dream of realizing the great rejuvenation of the Chinese nation. He pointed out in the report of the 19th National Congress that "Culture is the soul of a country and a nation. Without cultural confidence, there will be no cultural prosperity, nor the great rejuvenation of the Chinese nation". The Chinese nation has made indelible and outstanding contributions to the progress of human civilization during more than 5,000 years of civilization [1]. Our nation has suffered hardships, our national culture has been hit hard, the inheritance of our national culture has been interrupted for several times, since modern times. It is our responsibility and obligation, as well as the core of our education, to revive our outstanding traditional culture, and promote the inheritance of Chinese traditional culture.

2   The Significance of the Study in Theory and Practice

Traditional Chinese culture as an art form is easily overlooked in the wave of contemporary art, and its value is easily to be underestimated. However, traditional culture as a precious art form, shows the spirit of inheritance from connotation to presentation, which is a distinguishing feature from other national cultures [2]. How to inherit Chinese traditional culture from generation to generation is not only a sacred mission but also the responsibility of our generation. As a carrier, the Experience Hall for Chinese Traditional Culture provides a platform for practice and display. How to combine practice with display so that they can complement one another is worth thinking and exploring. It is hoped that this study can bring certain theoretical guidance to the Experience Halls for Chinese Traditional Culture in colleges and universities.

As a carrier, the Experience Halls for Chinese Traditional Culture in colleges and universities can help visitors and experiencers to have direct access to traditional Chinese culture. For people who live in mainland China, such culture means a sense of closeness and resonance in itself. If one can participate in the production process, he/she will feel much more than simply reading it from books. During the experience of culture in such an environment, you can fully appreciate the charm and essence of traditional Chinese culture. It is of great significance for "telling Chinese stories and spreading Chinese voices".

3   The Connotation of Chinese Traditional Culture and the Experience Halls

Chinese traditional culture has a long history and rich contents. It has become a system in the world of cultural diversity created by many ethnic groups, and eventually become a unique culture with the characteristics of the Chinese nation. Whether it's traditional art, craft techniques, structure, or patterns, they are all derived from the philosophical thoughts of Confucianism [3]. Taoism and Buddhism in China, namely, the golden mean, in conformity with the law of nature, in conformity with the instinct, enough is as good as a feast, integrity and ethics, which are used to create the ideal of harmony between man and nature.

The establishment of the Experience Halls for Chinese Traditional Culture in our university today, is to allow teachers and students of the university to realize the profoundness of Chinese culture through the exhibition in the experience halls. The construction tenet of the Experience Halls for Chinese Traditional Culture of our university is: Relying on the advantages of Fujian Province and the university, explore an experience-based art teaching and communication model, to perceive the education model in experience and to perceive art in practice, so as to realize the purpose of education and promotion of traditional Chinese culture. Specifically, it is hoped to achieve the following results: present traditional culture in life; realize the popularization of traditional Chinese culture in society; not only the teachers and students of our university, but also foreign guests can get to know the bright and time-honored 5000 years of Chinese history, so as to have a better understanding of Chinese

traditional culture and make the experience halls become a platform to spread Chinese traditional culture at home and abroad.

4   The Five Elements of Yin and Yang as the Application of Traditional Chinese Culture in the Experience Halls of Our University

4.1   The Five Elements of Yin and Yang and the Traditional Culture

The five elements of yin and yang are the essence of important thoughts in traditional Chinese culture. Confucianism is the philosophy of yin and yang, which is the so-called natural beauty concept of "Yin in Yang, Yang in Ying, the balance of Ying and Yang", thereby forming the unique artistic charm of traditional Chinese culture. Its characteristics can be highly summarized as the extremely vivid presentation of the five elements (Fig. 1).

Fig. 1. The five elements of Yin and Yang.

It is exactly the "Yin and Yang" and "Virtuality and Reality" movement that becomes the reincarnation of all things. The basic elements of the five elements are metal, wood, water, fire, and earth. The ancient Chinese philosophers used the Five Elements Theory to explain the relationship and formation of all things in the world, and they paid attention to the natural laws of seeking unity in opposition, mutual generations and restrictions [4]. "Mutual generations" in the Five Elements Theory refers to water allows the wood to grow, wood makes fire by burning, fire makes the ashes from the wood nourish the earth, earth contains metal and makes metal hard. There is generation between any two elements. This cycle forms the interdependent and mutually beneficial relationship. "Mutual restrictions" means wood absorbs the earth's energy, earth blocks the water, water extinguishes the fire, fire melts the metal, and

metal axe chops the wood. Any two elements are mutually restricted, opposite, to couple strength and gentleness, and to balance in harmony [5]. The Chinese culture has always focused on the aesthetic principle of seeking unity in opposition and "Virtuality and Reality", which is a unique and distinctive feature of traditional Chinese culture.

4.2 Integration and Application of Traditional Culture in the Experience Halls of Our University

The Experience Halls for Chinese Traditional Culture in our university adheres to the school slogan of "Integrating Chinese and Foreign, study of ancient classics should meet present needs", and positions the Experience Halls as the combination of traditional Chinese culture and the outstanding humanistic history and handicrafts of Fujian Province. According to the respective positions of the five elements of Yin and Yang (Fig. 1), and the geographical location of each experience hall of our university, five zones of metal, wood, water, fire, and earth are set up to display the Chinese culture. Each zone is divided into exhibition zone and experience zone. The total construction area of the experience halls is about 2,000 m^2. It is set up in different locations on the campus with different functions and needs. It is displayed in various forms such as physical objects, models, exhibition boards, audios, videos, MOOC, pictures and texts, which fully displays traditional Chinese culture. The rich and profound connotation of culture, while explaining the rich and profound connotations of traditional Chinese art and culture. It is of great importance in today's inheritance of culture [6]. The exhibition hall is located on the campus, which is convenient for students, faculty and staff to observe and study nearby. The exhibitions of each exhibition zone are as follows:

The "Earth" Zone—Display of the Painting and Calligraphy Exhibition Zone.
The exhibition hall is located in the center of the university, on the fifth floor of the administrative office building and the comprehensive service center, covering an area of about 372 m^2, placing the exhibits with display cabinets and passage walls. The main exhibition is the works of famous calligraphers in Fujian Province, the essence of traditional Chinese paintings and the production experience room (Fig. 2).
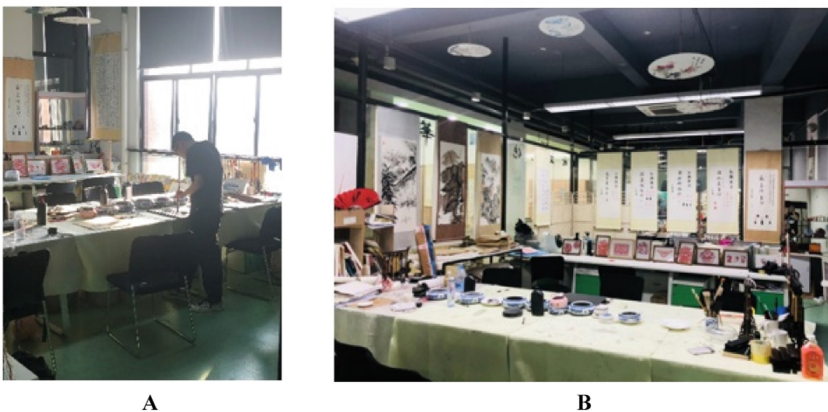
Fig. 2. A: The calligraphy and painting exhibition zone. B: The exhibition zone on the 5th floor of the administrative office building.

The works of calligraphy and paintings are mainly imitations of famous works of all generations in Fujian Province, such as the works of Zhu Xi, a master of Chinese calligraphy, and a believer of neo-Confucianism in the Southern Song Dynasty. Zhu Xi is a famous Confucian, thinker, philosopher representative of the Fujian School in the Song Dynasty, and a master of Confucianism. Zhu Xi founded the Northern Fujian Academy in the Southern Song Dynasty and made a great contribution to the Academy. The Academy is an important part in the history of Chinese Academies. Its art of calligraphy emphasizes the combination of virtuality and reality, and the combination of rigidity and softness. The art expresses the author's emotions with the lightness of the strokes of the Chinese characters and the structure of the font, pursues a sense of balance in form, and uses the Five Elements Theory and the law of conflict and unity. Calligraphy is to express the author's emotions with the structure of Chinese characters and the lightness of strokes. It emphasizes the combination of rigidity and softness, and the combination of virtuality and reality. Its form utilizes the law of conflict and unity in the Five Elements Theory.

The "Wood" Zone—Display of Clothing. The exhibition hall is located on the east side of the campus, which is in the East Comprehensive Teaching Building, namely, the fifth floor of the Department of Fashion Design, the School of Art and Design. With an area of about 310 m^2, it showcases the clothing of every generation in the Chinese history, as well as innovative works of clothing with modern trends combining the Hakka clothing of the western Fujian Province (Fig. 3).

<div align="center">A   B</div>

Fig. 3. A: East zone of clothing exhibition corridor. B: East zone of fashion design and production room.

Among the important parts of Chinese traditional culture, the folk costume culture is of rich traditional aesthetic values, which is the embodiment and representative of the national culture in all parts of China. It has great significance for the study of traditional culture. The Hakka folk costumes represent the unique local cultural characteristics of Fujian Province, with bright and harmonious colors. Its unique harmony is the core of Hakka culture, reflecting the idea of seeking unity in opposition in the Five Elements Theory.

The "Metal" Zone–Handicraft Experience Zone. The exhibition hall is located on the west side of the campus, in the Experimental Building 2, that is, the left of the first floor of the main hall of the School of Art and Design. It covers an area of about 220 m^2, and displays ceramics and lacquer crafts, mainly excellent works of Fujian Dehua Ceramics and Fuzhou bodiless lacquer ware. There is also an experiential production zone (Fig. 4).

Fuzhou bodiless lacquerwares are light and firm in texture, simple and elegant in shape, and colorful in decoration. It was firstly made during the Southern Song Dynasty and was the first batch of intangible cultural heritage in China. It is a witness of local culture and a gem of cultural inheritance for thousands of years.

Dehua Ceramics is deeply influenced by the Taoist idea of the "unity of man and nature". It inherits the characteristics of traditional ceramics, pursues nature, strengthens the functional requirements on the basis of beauty, and adopts different craftsmanship according to the different functional needs of utensils. Both its production and design follow the laws of nature. It not only inherits the characteristics of traditional ceramics, but also reflects the excellent local cultural characteristics and rich spiritual connotation. It is an integration of traditional Chinese ceramic art.

Fig. 4. A: West zone of handicraft experience zone. B: South zone of lacquer crafts room.

The "Fire" Zone—Display of Historical Deeds and Characters. The exhibition hall is located on the south side of the campus, on the fifth floor of the Student Development Center (Entrepreneurship Park). Covering an area of approximately 260 m^2, it displays the works of Bing Xin, a native writer of Fujian Province. It is a part of the promotion together with the statue zone of the campus.

Bing Xin, a native of Fuzhou, is a writer of children's literature and a modern Chinese poet. Her published work *To Little Readers* is the foundation of Chinese children's literature. Her main works are collected in *Bing Xin's Collected Prose*. Her works have gained her a great international reputation. The three major themes of the philosophy of love that she insists on and promotes, namely, "Love Your Mother, Love Your Children, and Love the Nature", have long been cited as our university's educational philosophy. They are also the embodiment of traditional Chinese Confucianism. The highest level of Chinese traditional culture is "harmony". Humans live in harmony because of love. Education itself is the education of love. To love and to be loved. Through admiring the statue of Bing Xin (Fig. 5), reading her works and learning her life, and admiring the sculpture of "love" in the university (Fig. 5), visitors can receive the baptism of love.

A   **B**
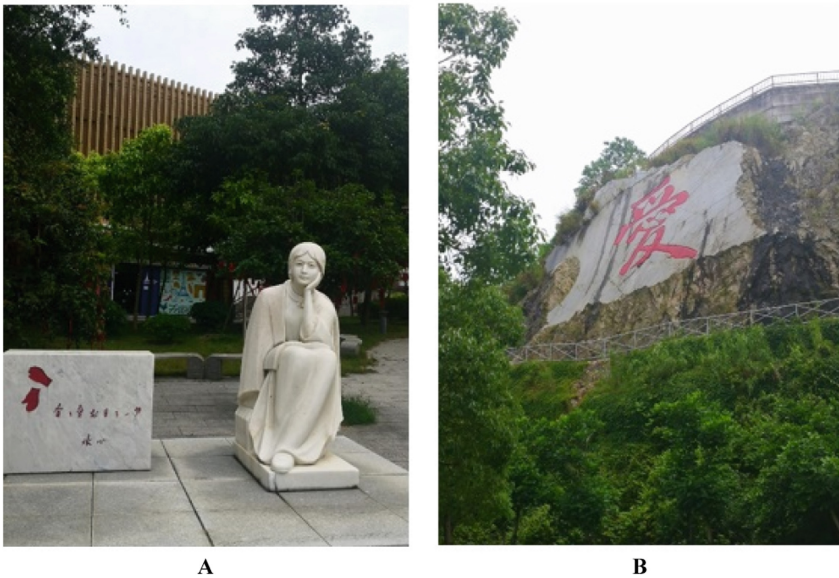
Fig. 5. A: Statue of Bing Xin on the south side. B: The sculpture of "love" at the entrance of the university. (Source: Photos taken on the spot)

The "Water" Zone—Display of Tea Culture. The exhibition hall is located on the northeast side of the campus, on the fifth floor of the student cafeteria, which is the literature zone of the School of Art and Design. It covers an area of about 280 m^2, and displays the development history of Chinese tea culture. There is also an experiential zone of Wuyi Tea (Fig. 6).

Wuyi Mountains are both a world heritage and a cultural heritage, and is rich in biological resources. Wuyi Tea is well-known at home and abroad. It has a long cultural history and is very important in the long history of Chinese tea culture. Wuyi Mountains is the birthplace of oolong tea and black tea. Wuyi black tea comes from the nature. From its growth, processing to drinking, it is natural and pure, absorbing the

Fig. 6. The tea culture workshop of literature zone.

spirit and essence of traditional culture. The tea ceremony focuses on "taste", that is, the mind and soul can be sublimated during the tasting process. It emphasizes the perception of sensibility. Tea culture also contains theoretical cores of the Confucian golden mean, etiquette, harmony, transcendence, and sustainable development, which reflects the cosmic view of the five elements of Yin and Yang. Through the promotion and experience of Fujian tea culture, visitors and experiencers can appreciate the unique connotation of tea culture in China in order to achieve the promotion of Chinese traditional culture and art.

5   Effectiveness and Promotion of the Experience Halls for Traditional Chinese Culture in Colleges and Universities

A scientific "experiential art teaching" system was established in the early stage of the current experience halls to realize the organic integration of projects such as "thematic presentation, situational teaching, DIY experience, course research and development, MOOC video and module output". In addition, active courses R&D can creatively carry out traditional Chinese art teaching and talent training at home and abroad.

R&D achievements related to experiential teaching have been widely promoted overseas in Confucius Institutes and teaching institutions in France, the Netherlands, Australia, Singapore, and some countries in Africa. In June 2014, with the support of the Confucius Institute Headquarters, the "Experiential Art Teaching" program was promoted in some Confucius Institutes and schools in South Korea, which has received great recognition [7]. Practice shows that the teaching model can be copied and exported overseas, for local traditional Chinese art experience and exchange activities. It has a relatively wide overseas promotion value and feasibility of module output.

Further, distance teaching and seminars at home and abroad with video can be regarded as an innovative and beneficial international expansion attempt and exploration of the teaching of Chinese traditional culture [8].

Based on the operation effect and evaluation of teaching practice, each zone of the experience halls basically meets the expectations of planning and construction, and initially realizes the organic combination of art experience, art and culture teaching, art and cultural communication, as well as the promotion benefits of social and cultural construction. From the perspective of social and cultural development, the experience halls basically conform to the functions and principles of art and culture. Because the experience halls are comprehensive, creative and sustainable, it has a large theoretical and practical potential for the study of traditional Chinese culture. In use, we need to continuously sum up experience, constantly review and perfect the application, and strive to achieve the ultimate educational goal of inheriting and promoting Chinese traditional culture.

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Study on Tea Furniture Characteristics of Tea Culture and Lifestyle in Tea Paintings of Tang Dynasty in China

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Abstract. The study is aimed at finding out the characteristics of Tea Furniture under the tea culture and lifestyle of Tang Dynasty in China. (1) The purpose is to protect and inherit intangible cultural heritage and realize the combination of tradition and modernity. (2) Method: the analysis of the contents of five tea paintings of Tang Dynasty, data statistics of tea culture and lifestyle and conclusion of the characteristics of eight kinds of Tea Furniture in four types under the tea culture and lifestyle of Tang Dynasty are carried out, according to User-centered five analysis standards of tea culture and lifestyle—User, Drinking Tea, Form, Tea Space and Furniture. (3) Conclusion: the data is studied, analyzed, summed up and counted by insight research method and statistical analysis method. The types and kinds of Tea Furniture of Tang Dynasty are clarified, which can clearly point out the functions, materials, colors and shapes, providing innovative ideas, inspiration and decision-making basis for contemporary Tea Furniture designers.

Keywords: Tea culture and lifestyle · Tea paintings · User · Tea furniture

1 Introduction

According to the statistics of the core journals between 2005 to 2019 on tea culture, furniture and tea paintings of Tang Dynasty in China, the total number of articles is 89. Views in these articles have little comparative analysis of behavioral science data and analysis of inheritance data on Tea Furniture. As Lord Kelvin said, "only when you measure what you are talking about and express it in numbers can you really have some understanding of it; otherwise your understanding is superficial and unsatisfactory". This article puts forward the study on User-centered tea culture and lifestyle. Through the study and analysis in tea paintings of Tang Dynasty, accurate data of Tea Furniture are obtained and demonstrated.

Study background: (1) The protection of intangible cultural heritage, use of tea culture and lifestyle and their application in innovative design of Tea Furniture. (2) The Chinese characteristics of design, the cultural consciousness or cultural inferiority of the masses. The so-called "Chinese characteristics" are often addition of traditional Chinese symbols on the basis of imitation. Study purposes: We study the characteristics of Tea Furniture of Tang Dynasty, guide the direction for designing Tea Furniture with Chinese characteristics and find the combining point of traditional culture and modern civilization. Study methods: (1) Insight analysis method: We study the contents of tea paintings and obtain quantitative data. (2) Statistical inductive method: We conduct scientific statistics of data of the forms of tea painting users and get the data proportion. Study scope: The characteristics of era, tea culture, social economy and social activities, living furniture, tea books, poetry and tea paintings of Tang Dynasty.

2   The Characteristics of Tea Culture and Lifestyle

The Tang Dynasty is of great significance in the history of Chinese tea culture, which contains the evolution characteristics of the Chinese nation's lifestyle for thousands of years. As Mr. Yang Wei said, "the integration of the thoughts of Buddhism, Taoism and Confucianism began in the Northern and Southern Dynasties (420–589) and became an irresistible historical trend from Tang Dynasty to Song Dynasty".

2.1   The Characteristics of Era

Tang Dynasty is the most honored and proudest era for Chinese people. Culturally, the heyday of the Tang Dynasty brought a strong sense of national pride to the people and promoted the development of culture. "China became the most powerful, advanced and richest country in the world at that time" said Fei Zhengqing, who was a famous American Sinologist [1]. Thanks to national prosperity and advanced economy, the tea production grew vigorously, and the tea culture was spread locally and abroad and achieved worldwide recognition. The era characteristics of Tang Dynasty includes: first, openness; second, inclusiveness; third, tolerance [2].

2.2   The Characteristics of Social Economy and Social Lives

The prosperous social economy and stable social lives of Tang Dynasty are the result of political stability and unity, openness and compatible foreign policies of Tang Dynasty, and cultural influence of the previous dynasties. Social economy is shown in three aspects: the first is agriculture: advanced water conservancy, the progress of farming technology and cultivation methods, the emergence of new plant varieties (tea and new vegetables); the improvement of production tools; the second is the handicraft industry: advanced silk fabrics and ceramic industry; the third is advanced business: international metropolis with prosperous business [3]. The Law of the Tang Dynasty clearly stipulates that people are divided into "the noble" and "the humble". The gentry enjoy superior living conditions and have high cultural accomplishments. The status of women is relatively high, and the "general lifestyle of Hu, non-Han ethnic group living

in the north and west of China in ancient times" is popular and people's lives are rough. The stability of social lives is mainly reflected in colorful clothes, change in the previous habit of sitting on the ground, and drinking and tasting tea began to become a common practice [4]. In Tang Dynasty, with the development of the economy and the planting of a new plant known as the "tea tree", there exist prevalence of tea drinking and tasting.

2.3   The Characteristics of Tea Culture

The culture of Tang Dynasty is a relatively open and extroverted cultural type with enthusiastic tones. Li Bai's poems, Zhang Xu's wild cursive hand (in Chinese calligraphy) and Wu Daozi's paintings all surge with high vitality. The ancient stone carvings of "six majestic steeds in high spirits" in Zhaoling Mausoleum (the tomb of Emperor Li Shimin and Empress Wende of the Tang Dynasty) highlights the grand and magnificent national legacy. "Tea became popular in the Tang Dynasty and flourished in the Song Dynasty". The following begins mainly from the tea books, tea poetry and tea paintings of Tang Dynasty and Song Dynasty [5] and contents of tea culture and lifestyle of three types are summarized and compared. The development of Buddhism in the Tang Dynasty was the most prosperous, with almost everyone believing in it from the royal clans and descendants of aristocratic families to common people. Zen (Buddhism) paid attention to tea tasting, which affected the living habits of the Tang Dynasty to a certain extent [6].

| Painting 1-1 | Painting 1-2 | Painting 1-3 | Painting 1-4 | Painting 1-5 |
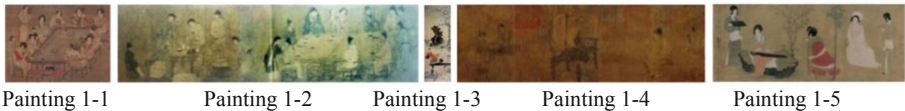
Fig. 1. 5 tea paintings of Tang Dynasty.

From Fig. 1, Painting 1-1, the Painting of Enjoying in the Royal Court (628–907 A.D.) portrays the life of the belles enjoying tea while appreciating the music in the courtyard [7]. Painting 1-2, the Painting of Spring Banquet (637 A.D.) describes the lives of 18 grand secretaries drinking tea of Tang Dynasty in the courtyard [8]. Painting 1-3, the Painting of Tea Making (813 A.D.) depicts the lives of reading and tea drinking in the courtyard alone [9]. Painting 1-4, the Painting of Xiao Yi presenting the Orchid Pavilion (627–649 A.D.) depicts the lives of monks and officials drinking tea in the courtyard [10]. Painting 1-5, the Painting of Belles Playing Chinese Guqin and Drinking Tea (627–649 AD) depicts the lives of belles appreciating music and drinking tea in the courtyard [11].

In Table 1, the contents of the five tea books on tea culture and lifestyle include ways of making tea, tea utensils, environment and space of tea and ways of drinking tea. The contents of the five tea poetry on tea culture and lifestyle include spirit of tea, environment and space of drinking tea, lives of tea farmers and tea banquet; the tea

Table 1. Tea culture and lifestyle of main tea books, tea poetry and tea paintings of Tang Dynasty.

Classification	Subject	Contents of tea culture and lifestyle			
A Tea books	*Tea Classics*, by Lu Yu	Tea utensils, ways of making tea, ways of drinking tea, outline and classification of tea, furnishings of teahouse			
	The Description of Tea, by Pei Wen	Efficacy and quality of tea			
	Records on Tea Making, by Zhang Youxin	Make tea, environment, utensils of making tea			
	Records on Tea Picking, by Wen Tingyun	The stories of tea (distinguish, addicted to tea, exchange, suffer, write a letter to ask for fine tea), tea space			
	Quality of SixteenTea Boiled Water, by Tang Yi	Boiled water, tea utensils and fuels of top quality			
B Tea poetry	*Enjoyment of Tea Drinking Lives in the Garden*, by Wei Yingwu	Tea spirit, quality of tea boiled water, tea environment: seclusion			
	Thanks Scholar Meng for Sending New Tea, by Lu Tong	The spirit of tea materials, the suffering scenes of tea farmers.			
	Ode to Taoist Priest of Tea Tasting in Xiling, by Wen Tingyun	Taoist priest; reading *Huangting Scripture* while drinking tea in caves			
	Tea Banquet with Zhao Ju, By Qian Qi	Tea banquet. Tea space: bamboo forest.			
	Tea Banquet on Lunar 3,Mar., By Lv Wen	Tea drinking environment: warbler flying and flowers swaying, refreshing breeze and bright sun, tranquil environment.			

Classification	Name of works,	User	Drinking tea	Tea utensils	Form	Tea space
C Tea paintings	Painting 1-1 *the Painting of Enjoying in the Royal Court*	10 belles and 3 maidservants	Make tea	Teapot, teaspoon, tea bowl, dim sum plate	Tea banquet, appreciate music	Royal courtyard
	Painting 1-2 *the Painting of Spring Banquet*	11 grand secretariesand 5 tea waiters	Make tea and Spot tea	Teapot, lamp holder, tea cup, charcoal fire pan (stove), tea zygote, tea sieve, water dispenser, soup bottle , dim sum plate	Tea banquet, tea tasting, scholars gathering	Garden
	Painting 1-3*the Painting of Tea Making*	1 scholar and 2 tea waiters	Make tea	Wind furnace, lamp holder, tea cup, tea zygote, tea sieve, water dispenser	Tea tasting	Garden
	Painting 1-4 *the Painting of Xiao Yi Presentsthe Orchid Pavilion*	1 scholar, 1 monk and 2 tea waiters	Make tea and Spot tea	Tea pan, tea cup, lamp holder, grinding tea, tea zygote, tea sieve, wind furnace, soup bottle	Appreciate books and paintings	Temple
	Painting 1-5 *the Painting of Belles Playing Chinese Guqin and Drinking Tea*	3 belles and 2 maidservants	Make tea	Tea tray, lamp holder, tea cup, dim sum plate	Appreciate music	Garden

culture and lifestyle in tea paintings and tea poetry are classified into five types - User, Drinking Tea, Tea Utensils, Form and Space.

The five tea paintings are classified according to the five types and the following results are concluded. There are 39 Users in total. The proportion of Men and Women is nearly the same. The proportion of Masters and Tea waiters respectively are 70% and 30%. There are 7 Drinking Tea. In the Tang Dynasty, Making tea was the main way and Spot tea was the secondary way. According to the time of works, Spot tea appeared in the late Tang Dynasty. There are 14 kinds of Tea Utensils in total including Teapot, Tea bowl, Teaspoon, Dim sum plate, Water dispenser, Tea tray, Lamp holder, Tea cup, Soup bottle, Tea pan, Grinding tea, Tea zygote, Tea sieve and Wind furnace. There are 8 Forms in total: the main forms are Tea banquet, Appreciate music and Taste tea. There are 5 Tea Space: the main Tea Space is Garden.

2.4   The Characteristics of Living Furniture

Furniture of Tang Dynasty is an important turning point of the development of high-type Chinese furniture, which can be divided into Sitting including Stool, Low stool, Pier, Chair, Round-backed armchair and Armchair; Lie furniture including Bed, Couch; Pedestal including small table, Desk, Square table and Long table; Harness including Cabinet, Cupboard, Box and Casket; Screen and Shelf including Hanger, Towel rack and Screen [12].

Based on the above research and classification, it concluded the six characteristics of User-centered tea culture and lifestyle of Tang Dynasty. The first is the characteristics of User - Gender (Men and Women), Class and Identity and 3 kinds of living activities (Community, Private and Group); the second is the characteristics of Drinking tea - Make tea and Spot tea; the third is the characteristics of Form -Reading, Appreciate paintings, Appreciate music and Dessert; the fourth is the characteristics of Tea Utensils - 14 kinds including Teapot, Tea bowl, Teaspoon, Dim sum plate, Water dispenser, Tea tray, Lamp holder, Tea cup, Soup bottle, Tea pan, Tea cup, Tea zygote, Tea sieve and Wind furnace; the fifth is the characteristics of Tea Space - Indoor and Outdoor and Private home and Public building; the sixth isthe characteristics of Living Furniture - 6 types including Lie furniture, Sitting, Pedestal, Harness, Screen and Shelf.

3   The Analysis of Tea Paintings of Tang Dynasty

Chinese painting on tea by Professor Qiu Jiping of China Academy of Art is the result of the famous paintings with tea culture contents of the previous dynasties of China, which directly reveals tea culture and lifestyle. Based on Fig. 1, we conducted classification and analysis of 5 tea paintings of Tang Dynasty, as shown in Table 2.

Table 2. The analysis and study on tea paintings of Tang Dynasty.

Works	the Painting of Spring Banquet	the Painting of Tea Making	*the Painting of Enjoying in the Royal Court*	the Painting of Xiao Yi Presents the Orchid Pavilion	*the Painting of Belles Playing Chinese Guqin and Drinking Tea*
Analysis					

3.1   The Analysis in Tea Paintings of Tang Dynasty

Based on (Table 2) The analysis and study on tea paintings of Tang Dynasty, data statistics on occurrences of the five tea paintings in the Tang Dynasty were conducted. 11 Users in total: 3 males, 2 females, 1 monk, 3 scholars, 2 belle, 5 tea waiters, 2 times in social mode, 1 time in private mode, 4 times in group mode; 7 times in total tea drinking forms: 5 Make tea, 2 Spot tea; 8 times forms in total: 2 Appreciate books, 1 Appreciate painting, 2 Appreciate music, 3 Dessert; 23 times of **Tea Utensils** in total: 1 Tea tray, 3 Wind furnace, 1 Tea cup, 1 Dim sum plate, 1 Tea tray, 1 Water dispenser, 1 Tea cup, 3 Tea sieve, 3 Tea zygote, 1 Tea bowl, 4 Lamp holders, 2 Soup bottle, 1 Tea pan; 5 times of Tea spaces: 1 Private home, 4 Public building, 5 Outdoor; 22 times of Tea furniture: 1 Couch of Lie furniture, 1 Armchair, 3 Stool, 1 Pier, 2 Low stool of sitting, 3 Small table, 2 Desk, 2 Square table, 2 Long table of Pedestal, 2 Box, 1 Casket of Harness, 2 Furnace frame of Shelf.

3.2   Data Analysis of Tea Furniture of the Tea Culture and Lifestyle in Tea Paintings of Tang Dynasty

According to the data analysis result of the lifestyle characteristics in tea paintings of Tang Dynasty in Table 5. Data analysis of the sixth category of Tea Furniture characteristics of the six main standards is as follows.

(6) Sixth: Tea Furniture

Table 3. The data of Tea Furniture of tea culture and lifestyle in tea paintings of Tang Dynasty.

	Tea Furniture											
	Lie furniture	Sitting			Pedestal					Harness		Shelf
5 Tea paintings	Couch	Armchair	Stool	Pier	Low stool	Small table	Desk	Square table	Long table	Box	Casket	Furnace frame
	1	1	3	1	2	3	2	2	2	2	1	2
Statistics proportion	22 5%	5%	13%	5%	9%	13%	9%	9%	9%	9%	5%	9%

In the lifestyle in the 5 tea paintings of Tang Dynasty, the most commonly used Tea Furniture are Stool of Sitting and Small table of Pedestal, followed by Low stool, Desk, Square table, Long table, Box and Furnace frame (Table 3).

4 The Characteristics of User-Centered Tea Furniture of Tang Dynasty

The specificity of traditional culture in Tea Furniture brings the origin of Tea Furniture design back to traditional culture. *Chinese Painting on tea* by QiuJiping and *Research on Tang Dynasty furniture* by Liu Xianbo both mentioned the functions, materials, colors and shapes of furniture. Based on this, we analyze and study 8 kinds of Tea Furniture in 4 types of User-centered Tea Furniture of Tang Dynasty.

4.1 The Characteristics of the First Sitting

Based on the above study, we analyze and conclude the two Sittings (Low stool and Stool) of Tea Furniture of tea culture and lifestyle in tea paintings of Tang Dynasty.

Table 4. The Characteristics of Sitting of Tea Furniture of lifestyle in tea paintings of Tang Dynasty.

Sitting			Function	Material	Color	Shape
Stool	A		For sitting	Solid wood, lacquer	Black	Rectangle, four legged stool
	D		For sitting	Solid wood, lacquer	Natural wood color	Rectangle, four legged stool
Low stool	C		For sitting	Solid wood, lacquer, cloth cover	Patterns of black, coffee, red and embroidered golden color	Crescent, four legged stool
	E		For sitting	Solid wood, lacquer, cloth cover	Black, coffee color	Crescent, four legged stool
Conclusion of characteristics			For sitting	Solid wood, lacquer, cloth cover, patterns of embroidered golden color	Black, coffee color, red, gray, natural wood color, golden	Crescent, rectangle, four legged stool

4.2 The Characteristics of the Second Pedestal

Based on the analysis shown in Table 4, we analyze and conclude the four Pedestals (Small table, Desk, Square table and Long table) of Tea Furniture of tea culture and lifestyle in tea paintings of Tang Dynasty.

Table 5. The Characteristics of Pedestal of Tea Furniture of lifestyle in tea paintings of Tang Dynasty.

Pedestal		Function	Material	Color	Shape
Small table	A	Place big bowls	Solid wood, lacquer	Black	Short square, four legs
	B	Place big bowls, tea zygotes, tea cups, lamp holders and rockery bonsais	Stone materials	Natural stone color	Short rectangle
	D	Place tea zygotes and wind furnaces	Stone	Natural stone color	Rectangle
	E	For sitting	Stone	Natural stone color	Natural shape
Conclusion		Place big bowls, tea zygotes, tea cups, lamp holders, rockery bonsais and wind furnaces	Solid wood, lacquer, bamboo, bamboo weaving	Black, yellow, natural wood color, natural stone color	Short square, short rectangle, natural shape, high square
Desk	A	Tea zygote, tea cup, lamp holder, dim sum plates	Solid wood, lacquer	Natural wood color	Rectangle
	D	Place big bowls, tea zygotes, tea cups, lamp holders and dim sum plates	Solid wood, lacquer, cloth cover	Black, coffee color	Crescent, four legged stool
Conclusion		Place tea zygotes, tea cups, lamp holders and dim sum plates	Solid wood, lacquer, bamboo weaving	Natural wood color, yellow, black, crimson	Rectangle
Square table	A	Place lamp holders and bottles	Solid wood, lacquer	Natural wood color	Square
	D	Place tea cups, lamp holders and bottles	Bamboo	Natural bamboo color	Short square
Conclusion		Place tea cups, lamp holders and bottles	Solid wood, bamboo, lacquer	Natural wood color, natural bamboo color	Rectangle, short rectangle
Long table	A	Place tea cups, lamp holders and bottles	Solid wood, lacquer	Natural wood color	Rectangle
Conclusion of characteristics		Place big bowls, tea zygotes, tea cups, lamp holders, bottles, rockery bonsais and wind furnaces	Solid wood, lacquer, bamboo, bamboo weaving	black, yellow, natural wood color, natural stone color	Short square, short rectangle, natural shape, high square, rectangle

4.3   The Characteristics of the Third Harness

Based on the analysis shown in Table 5, we analyze and conclude the Harness (Furnace frame) of Tea Furniture of tea culture and lifestyle in tea paintings of the Tang Dynasty.

4.4   The Characteristics of the Fourth Shelf

Based on the analysis shown in Table 6, we analyze and conclude the Shelf (Box) of Tea Furniture of tea culture and lifestyle in tea paintings of Tang Dynasty.

Table 7 shows the summary, where we conclude the characteristics: functions, materials, colors and shapes of 8 kinds of furniture in four types of Tea Furniture of lifestyle in tea paintings of the Tang Dynasty. The functions: sitting, placing tea utensils and rockery bonsais; The material: solid wood, lacquer, cloth, embroidered brocade, bamboo, bamboo weaving, pottery clay; The color: black, coffee color, gray, natural wood color, golden, natural stone color, natural bamboo color, dark brown, yellow, color of earthenware; The shape: Crescent, rectangle, square, four legs, short square, short rectangle, natural shape, high square, ladder-shaped cover, wheels at the bottom.

Table 6. The analysis of Characteristics of Harness of Tea Furniture of lifestyle in tea paintings of the Tang Dynasty.

Harness		Function	Material	Color	Shape
Furnace frame	**A**	Place tea utensils	Solid wood, bamboo weaving, lacquer	Natural wood color, yellow	Rectangular box, ladder-shaped cover, wheels at the bottom
	B	Place tea utensils	Wooden frame, bamboo weaving	Dark brown, yellow	Square
Conclusion of characteristics		Place tea utensils	Solid wood, lacquer, bamboo weaving	Natural wood color, dark brown, yellow	Rectangular box, ladder-shaped cover, wheels at the bottom

Table 7. The analysis of Characteristics of Shelf of Tea Furniture of lifestyle in tea paintings of Tang Dynasty.

Shelf			Function	Material	Color	Shape
Box	A		Place wind furnaces and soup bottles	Solid wood, pottery clay	Natural wood color, color of earthenware	Rectangle
	B		Place wind furnaces	Bamboo	Natural bamboo color	Square
	D		Place wind furnaces	Solid wood	Natural wood color	Rectangle
Conclusion of characteristics			Place wind furnaces and soup bottles	Solid wood, bamboo, pottery clay	Natural wood color, natural bamboo color , color of earthenware	Rectangle, square

5   Conclusions

Through the User-centered study, because the era, cultural background, social economy and social activities of the Tang Dynasty affected the characteristics of Tea Furniture in the daily lifestyle, from Make tea to Spot tea of Tang Dynasty, Tea Utensils also changed, leading to the change of Tea Furniture. In this paper, the five tea paintings in the Tang Dynasty are analyzed through image data analysis to obtain the data ratio, and the statistical methods are used to verify the four major types of Tea Furniture in the Tang Dynasty. The four major types are sitting, pedestal, harness and shelf. The four major types of Tea Furniture have 8 types of furniture, which are Stool and Pedestal of Sitting; Small table, Desk, Square table and Long table of Pedestal; Furnace frame of Harness; Box of Shelf.

From the static images of tea paintings, according to certain programming, the data related to the target problems are collected, sorted out and analyzed, and valuable knowledge is extracted from the complicated data and demonstrated, which is studied, analyzed, summed up and counted in insight research method and statistical analysis method. The types and kinds of Tea Furniture of Tang Dynasty are clarified, which can clearly point out the functions, materials, colors and shapes, providing decision-making basis, innovative ideas and inspiration for contemporary Tea Furniture designers.

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Safety and Human Factors

Towards Human Values, Ethics and Positive Emotion in Good Governance: A Reliability Test of Good Governance Index Model

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Abstract. Good governance is predetermined by the ability of a manager's advocates to focus on human values and ethics in yielding positive emotion. Therefore, it is crucial to measure through a Good Governance Index to discover the shortcomings and improvements possibilities in paving the future. Nevertheless, instruments to measure good governance are lacking, especially in public universities in Malaysia. Hence, developing good governance measuring instruments are critical and formulating the value-based good governance index to stimulate human emotions towards embracing the right behaviors goals are crucial. Past literature has revealed various indicators of good governance consisting of fairness, integrity, transparency, accountability, stewardship, etc. This study explains the process to develop an assessment instrument for Good Governance Index for Public University (GGIPU). Analysis of past literature and government circular has resulted in the emergence of four important domains namely integrity, transparency, accountability and stewardship. A questionnaire was developed based on the four domains, and a pilot study was conducted to obtain data to test the reliability of the instrument. Cronbach's Alpha Coefficient was calculated and showed Integrity domain was 0.918, Accountability domain was 0.963, Stewardship domain was 0.951, and finally, Transparency domain was 0.955. The overall reliability of the whole domain was 0.984. Hence, the GGIPU questionnaire is deemed reliable in assessing the level of good governance practices at public universities. The GGIPU will be useful for managers to assess good governance, hence facilitating them to devise strategies to inculcate good human values and ultimately yield positive emotion.

Keywords: Good governance index · Human values and ethics · Integrity · Transparency · Accountability · Stewardship

1   Introduction

Good governance practice has become a critical agenda in both private and public agencies as it evidently determines the success of an organization [1]. An established organization is required to have a governance structure in place that serves as a guideline in governing the corporation [2]. Effective governance structure boosts investor confidence, fortifies corporate accountability, and increases the reliability and quality of public financial information. Besides, it enhances the integrity and efficiency of the capital market [3]. The governance structure that promotes the execution and enforcement of a policy which is conducive for economic and social development may lead to a sustainable livelihood. Contrary to this argument, a governance structure that is unsuitable to meet this requirement could possibly become the major cause of underdevelopment [4]. In addition to that, the policies and guidelines may not completely warrant good governance practice as it is merely a black and white documentation that has a tendency to be manipulated by the "steward" [5].

The Good Governance Index is commonly used to measure the extent of good governance practice exercised by the organization. Hence, it is vital for the organization to develop the index that is relevant to its own setting and drive human emotions towards internalizing the right behaviors.

1.1   Good Governance

Governance is basically known as the exercise of economic, political and administrative authorities that govern a country's affairs, whilst good governance entails clear processes and structures that steer political and socio-economic relationships [2]. Good governance can be defined as a well governed organization that wisely utilizes the resources for the best interest of the stakeholders [6].

Good governance signifies good management practices, fulfilment of diverse stakeholder's needs and the ability to cope with challenges such as those posed by a dynamic environment [7]. Besides, "good governance means securing justice, empowerment, employment and ensuring efficient services" [8]. Good Governance can be inferred into numerous ways including wise allocation of resources, efficient public services with transparent decision making and effective execution of policy deprived of malfeasance and corruption [9].

Despite lacking any sanction section, the practice of sound governance has been recognized as a remedy for "corporation scandals" and strikes a balance between performance and conformance [10]. Achterstraat [1] revealed that "an increasing body of evidence is showing that effective governance will not only increase an organization's performance but will also increase an organization's conformance with regulations, laws, standards and public expectations. This is true in both the private sector and the public sector". Meanwhile, Newell, & Wilson [11] stated that good governance would increase the market valuation of companies by refining their financial performance, reducing the risk that boards will make, constitute self-serving decisions, and would generally raise investor confidence. Besides, good governance practices are critically required for enhancement and expansion of the economy. Hence, any action to improve institutional governance should be retained [12].

1.2   Good Governance Indicators and Human Emotions

Good governance indicators comprise accountability, efficiency and effectiveness in public sector management. It enables transparency in free flow information and provides a clear legal framework to uplift justice, respect for human rights and liberties in ensuring social and economic development of a country [13].

The renowned reports that debated on good governance practice including the Cadbury Committee Report, Greenbury Report, Hampel Committee Report and Organization for Economic Cooperation and Development (OECD) have eventually recognized fairness, transparency, accountability and responsibility [6]. Meanwhile, study in [14] stated that sound governance necessitates legitimate, accountable, and effective ways of acquiring and using public authority and capital within the pursuit of universally-accepted social desires. The parameters of good governance serve as an important measure in assessing the performance of governments. It configures a portion of the development framework for plotting the progress of the human development efforts at the local level [15]. As such the Malaysian Government has expressed their concern on this area through the Guideline to Enhance Governance in the Public Sector that was issued in 2007 [16]. Good governance principles according to the afore-mentioned guidelines consist of integrity, accountability, stewardship and transparency.

In addition to the above definitions, transparency can be perceived when the information and substantive procedures are available and comprehensible by the society. However it must be restricted to privacy and confidential limits. While accountability is a way of requiring officials and influential people to comply with established rules defining applicable processes and consequences, as well as to convince that they have obeyed those procedures. In addition, it enables check and balance within an organization [14].

Whilst there is a connection between emotions and values as both play a tremendously significant role in behavior, central beliefs (values) commonly expressed through explicit behaviors and emotions are feelings associated with specific behaviors [17].
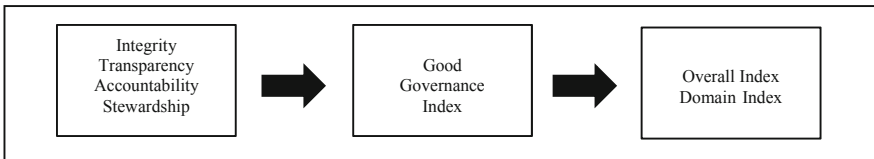
1.3   Good Governance Index

Shah & Huther [18] have developed a simple index of good governance pertaining to fiscal decentralization of the public sector. They argued that the index helps to reveal unambiguous conclusions. Apart from that, a good governance index exhibits the importance of good governance and how it can be quantified and enhanced. Besides, the disclosure would promote the application of sound governance [19]. Gisselquist [20] also claimed that a proper governance index would promote better governance.

There are numerous methods in constructing the index. For instance, through consolidated public information disclosed by listed companies and a survey-based index. Nonetheless, the survey-based has been widely used by other scholars to measure the association of governance and firm valuation [21].

Hinging on a discussion of previous studies, it is overtly significant to further research on good governance indicators that are appropriate to develop the index.

2   Methodology of the Research

This study employed a qualitative and quantitative approach. The method used is slightly identical with the study conducted by [20]. The study comprised of two major parts. Firstly, in order to deepen knowledge in this area, the preceding literature and publications were gathered to establish the research objective and conceptual framework (see Fig. 1). In particular, research literature that discussed good governance in general, relevant indicators or principles, and the index were reviewed. The Good Governance Index was deliberately developed to suit the organization setting and respective government circular. Based on the literature and conceptual framework, the four domains appeared to be the main themes in this study that formulated the level of good governance practices in the organization hence underlying the assessment instrument:

Fig. 1. Conceptual framework of good governance index.

Secondly, 25 questions that constituted the definition and determinants of each domain were established. The questions for the integrity domain comprises important aspects that are relevant to measure the extent of integrity practiced by the organization such as the dissemination of policies and procedures and declaration of interests. The questions that formed the accountability domain basically represents the degree of being answerable for the action, decision and results. Meanwhile, the stewardship domain is made up of parameters that are required in managing the resources, for example monitoring budgetary allocations, conformance and performance. Finally, the transparency domain solicited responses pertaining to flow of information with regards to decision making process, accessibility of substantive information for the view of stakeholders and the implementation of performance appraisal system.

Later, the verification of assessment instruments was done by internal experts that consist of four panels to elicit content validity. Based on the feedback and recommendations, a survey-based questionnaire for the GGIPU was constructed to measure the overall and respective domains.

The questionnaire was then distributed as a pilot test to 21 respondents comprising the chairman and secretary of committee meetings of university branches throughout Malaysia since they are considered as the custodians of governance whose responsibilities are overseeing and advising on the governance process. The respondents

consisted of 7 females and 14 males with ages ranging from 30 to 60 years old. The survey was conducted using the online survey mechanism and the Likert Scale (5: Excellent; 4: Good; 3: Fair; 2: Poor; 1: Very Poor) was used to measure the score for each domain. The 25 questions were divided into four domains (Table 1) with the aim to solicit responses pertaining to good governance practices based on the respective domains.

Finally, the items and the subset of items in the measurement instruments were examined to assess the correlation. The Cronbach's Alpha Coefficient was calculated to determine the reliability of the instrument owing to the fact that it is a common way to assess internal consistency [22]. Reliability refers to the ability of a measuring instrument to give accurate and consistent results. The measurements should be free from errors, and therefore yield consistent results.

3   Findings of the Study

Having said that, good governance helps to promote efficiency and effectiveness of a business and obviously beneficial for the entire organization in both private and public sector [1, 8, 10]. Hence it is critical for the organization to have appropriate measures to monitor the level of practices [15, 18]. It must be noted though, that good governance measures must be relevant and sufficient enough to support the organization's requirement as the failures might contribute to unwanted circumstances [4]. In addition, human emotions and values should not be sidelined as both play a significant role over human's behavior that eventually would accelerate good governance practice in the organization [17].

A proper Good Governance Index may accelerate good governance practice in an organization [19]. In addition, it might prevent undesirable actions that probably hinder the practice of good governance [5]. Therefore, the particular public university has to establish a Good Governance Index to effectively stimulate good governance practice within the organization [19]. Prior to its establishment, the organization has developed a governance structure to induce good governance practice and thereby enhance their value proposition [3]. Those arguments highlighted the significant integration between good governance structure and good governance index.

The domains used in this study were categorized based on related literature positing the recommendation to adopt the principles as stated in government's circulars [16]. Analysis of past literature resulted in four domains that were found suitable in the context of public universities to accurately determine the room for improvements [19]. These four domains are described in Table 1:

Table 1. Description of the respective domains.

Domain	Description
Integrity	The conflict of interest are declared in the decision making process
	The governance policies and procedures are widely disseminated
	The objective of governance policies and procedures are clearly explained
	The implementation strategies of governance policies and procedures are mutually deliberated
	The employees are involved in the implementation governance processes
	The pertinent issues are transparently discussed
Accountability	The compulsory committees are accordingly established
	The role and responsibility of the committees are clearly defined
	The committee members are noticeably informed of their role and responsibility
	The decision made by the committees are transparently and quickly conveyed
	The committee members are responsible for the decision made
	The special meeting will be held when urgency emerged
Stewardship	The chairman and committee members are appointed according to the committee's term of reference
	The activities are implemented accordingly based on approved planning and financial allocation
	The decision made by the committees based on details information and data
	The employees are monitored systematically in order to certifies the productivity
	The resources are wisely managed according to the procedures
	The performance indicator and targeted goals are systematically monitored
Transparency	The Standard Operating Procedures and policies of works processes are clearly and transparently established
	The strategic information are widely shared for continuous improvement purposes
	The consultation services pertaining to governance implementation are responsively provided
	The decision made are accurately and efficiently conveyed
	The employees are given an opportunity to give feedback or make an appeal on a decision
	The accessibility of important information is made available on various platform (online or offline)
	The employee's performance management are mutually discussed

Consequently, the formulation of the assessment instrument involved a content expert verification process to elicit a compelling index. In this regard, internal experts were engaged to review the questions that were designed in accordance with findings from literature and respective government circulars. In particular, an internal expert is defined as a person who is specialized, experienced, recognized and possesses

qualifications in the pertinent areas. This is aligned with the statement made by [23]. The questions were accordingly arranged based on the identified four domains. The survey-based (questionnaire) index was developed to obtain response from the target participants and the method used is a well-known approach that was applied in the previous research [21].

The evaluation score from all respondents were then used to calculate reliability and internal consistency of the questions using Cronbach's alpha. Cronbach's alpha score of 0.85 or more is used as a baseline for reliability and consistency for the study. As shown in Table 2, all domains show a score of more than 0.9, which indicates that all domains are reliable and consistent.

Table 2. Reliability analysis of the GGIPU.

Domain	Reliability index
Integrity	0.918
Accountability	0.963
Stewardship	0.951
Transparency	0.955
Overall	0.984

4   Conclusion

Due to subjectivity of good governance, specific measures are required to assess the level of practices. In this study, a GGPIU was developed to be a mechanism that bridges the gap in current state. Good governance practice within the organization can be enhanced thereby consequently improving the performance and conformance of the organization [1, 10, 20].

The findings of the study indicate that the overall Cronbach's alpha value is above 0.85. This value is considered good as the value is between 0.7 and 0.9. Thus, the GGIPU is deemed reliable in assessing the level of good governance practices at public universities. The GGIPU will be a useful tool for the manager's advocates to assess good governance, whilst facilitating them to devise strategies to inculcate good human values and ethics hence yielding positive emotion. This will ultimately result in good governance practices within the organization, and thereby elevate the performance of the organization. Additionally, the discussions provided clarity and insights into the importance of having good governance in place to stimulate human emotions towards embracing the right behavior goals, which are crucial.

There is a limitation associated with this study, which may have impacted the results obtained. The result of this study may not be a generalization to or represent the accurate population of public universities in Malaysia. The utilization of a particular guideline, i.e. government circular might limit comprehensive insight of good governance. Hence, it is suggested that greater literature review and established models be adopted for similar research in the future to enhance the results obtained and provide desirable generalization.

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Visual Features of the Touchscreen Keyboard Guide Attention and Text Entry Behavior: An Eye-Tracking Study

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Abstract. Text entry via the smartphone touchscreen is an increasingly important means of communication. However, there is an offset between the intended landing location and the actual touch location, which reduces the accuracy of text entry. The present study found that at least two visual features of the soft smartphone keyboards in the market may have an effect on touch behavior. Therefore, this study aims to investigate whether symbol shape and key border affect the distribution of attention and user's touch behavior. Four soft keyboards were designed to record the touch location while simultaneously using the eye tracker to capture the gaze data. The results show that the usability score of bordered keys is better than that of borderless keys, but the touch accuracy of bordered keys is poorer than that of borderless keys. In addition, the center of attention is not consistent with the touch location. The results of this research can be used as a reference for the design of the soft keyboard interface to reduce the error of text entry on the smartphone.

Keywords: Interface design · Smartphone · Eye movement

1 Introduction

The touchscreen has become popular in industrial, commercial, and consumer applications during the past decade because it provides natural and convenient human-machine interaction [1, 2]. The touchscreen interface that combines display and input has human factors and ergonomic benefits as well as space and design efficiency [3]. In terms of spatial efficiency, physical buttons can be replaced by virtual buttons so the touchscreen can minimize the size of the device [4]. The button size, spacing, shape, and elements on the touchscreen interface can be easily adjusted [5]. The touchscreen is easy to learn because it is easier for hand-eye coordination than mice or keyboards [6]. Inexperienced or disabled users can easily operate the touchscreen with less training [7–9].

Even though touchscreen has convenience and potential benefits, it still has some noteworthy limitations, such as reduced precision, finger occlusion, and interaction without clear feedback [10]. An offset between the intended landing location and the actual touch location exists due to the biological structure of the finger [11]. In addition, providing appropriate feedback can help users check whether their input has been

recognized by the device. Previous studies have been conducted to compare different types of feedback (visual, auditory, and tactile) and confirmed the effectiveness of visual feedback in improving the touchscreen performance [12, 13]. Once a finger occludes the target button, the target button cannot provide sufficient visual feedback [14]. Many studies have suggested that larger buttons have better touchscreen performance [14–16]. The effects of button size will vary depending on personal and environmental conditions [17]. However, whether the user hits the button correctly is based on the size of the touchable area determined in advance by the designers. When the user's touch locations frequently exceed the range of the smaller keys, providing a larger touchable area is necessary for appropriate controllability [14].

With the popularity of smartphones and tablets, text entry on the touchscreens of these devices is a frequent action every day. In terms of the text-entry interface, the soft keyboard can be hidden when text entry is not needed. The users can also modify the layout of the soft keyboard according to their preferences, thereby improving its usability and user experience [18]. In addition, the layout of the soft keyboards is similar to traditional QWERTY keyboards, so users can apply their prior knowledge from personal computers to smartphones [18].

However, the soft keyboard showed lower accuracy and speed than the physical keyboard in text-entry tasks [19, 20]. The poor performance is due to the limitations of the touchscreen mentioned earlier. In addition, the size of the buttons is a difficult problem to overcome. To allocate more than 30 keys to a small space on the smartphone screen, the size of the keys on the soft keyboard must be reduced. When the keys are too small, fingers may cover the target keys and result in other wrong keys being activated [21]. Xiong and Muraki [22] indicated that the thumb becomes fatigued rapidly when tapping on smaller buttons. Therefore, to avoid inadvertent tapping errors, more precise tapping and more attention may be required [11, 23].

The position of the keys on the soft keyboard also affects thumb muscle activity, tapping ability, and comfort during text entry. When using the smartphone touchscreen, the thumb moves more slowly in flexion-extension than in adduction-abduction orientation [22, 24]. The inward motions of the thumb require greater effort and a greater amount of thumb joint displacement [24]. The inward motions of the thumb bring more discomfort to the user than the outward motions. Therefore, the buttons on both bottom corners of the touchscreen need to be limited.

2   Research Purpose

In order to improve the performance of text entry on the smartphone, we can use obvious visual feedback, increase the size of the key, change the location of the key, enlarge the touchable area, and so on. However, the effects of increasing the size of the key and adjusting the location of the key were limited due to the large number of keys on the keyboard and the small screen size of the smartphone. Previous research claimed that visual cues can guide the user's touch behavior [3, 25]. The effective visual cues may be used to reduce the error of text entry on the smartphone.

In recent years, there are many smartphone brands in the market. These brands specifically developed soft keyboards with different key sizes, colors, layouts, and

operations. The present study observed these soft keyboards and found that at least two visual features that may have an effect on touch behavior. The first visual feature is the shape of the symbol on the key. Taking an English keyboard as an example, the letters on physical keyboards are uppercase while those on soft keyboards are lowercase by default. Uppercase letters are more symmetrical than lowercase ones. The size and proportion of uppercase letters are more similar than those of lowercase letters. The second visual feature is the visual boundary of the keys. In order to simulate the physical keys, the soft smartphone keyboard mostly has bordered keys. However, there are still soft keyboards with preset borderless keys, such as the Gboard.

Therefore, the purpose of the present study is to understand whether these visual cues (symbol shape and key border) affect the distribution of attention and user's touch behavior on soft keyboards. In order to observe the user's attention, the present study used an eye tracker to record the user's visual fixation when tapping the keys. The hypothesis and expectations are as follows:

- Hypothesis 1: Uppercase letters are more symmetrical and can draw users' attention to the center of the key so they trigger less gaze offset and touch offset.
- Hypothesis 2: Users will pay more attention to the letters of borderless keys so borderless ones trigger less gaze offset and touch offset.

3   Methods

3.1   Participants

9 college students were recruited from National Cheng Kung University in Taiwan. The participants included 3 males and 6 females (Mean age = 24.11 years). All had normal or corrected-to-normal vision. No one claimed that their hands had any disease, pain, or impaired touch. They had at least five years of experience of using a smartphone or tablet (Mean = 8.11 years). The brands of smartphones they used were Apple (7 students), HTC (1 student), and Xiaomi (1 student). The default format of English soft keyboards on these smartphones are all lowercase and bordered. All participants were right-hand dominant and their habit of text entry on the smartphone is by using two-thumbs (7 students) or one-thumb (2 students).

3.2   Experimental Design

The present study had a two-way within-subject design: 2 (letter font: uppercase vs. lowercase) × 2 (key border: bordered vs. borderless). Letter font and key border were used as independent variables (IV). The letter font, divided into uppercase and lowercase, was within-subjects variable. In the market, English letters printed on physical keyboards were in upper case while the English letters on soft keyboards were usually in lower case. The key border, divided into bordered and borderless, was within-subjects variable. In order to simulate physical keys, the keys of the soft keyboards were mostly bordered. However, the Gboard, designed by Google, has borderless keys preset.

Dependent variables (DV) were error rate, touch offset, gaze offset, time to first fixation, total fixation duration, and usability score. In the present study, the participants were asked to perform a text-entering task. The error rate is the ratio of the failure at tapping the target keys. The touch offset is the distance between the user's touch location and the center of the target key. Once the touch offset exceeds the touchable area, the target key can't be successfully activated. Error rate and touch offset could reflect the touch accuracy. Gaze offset is the distance between the visual fixation location and the center of the target key when the participants tap the target key. Time to first fixation (TFF) is the elapsed time before a participant fixates on a target area for the first time [26]. Total fixation duration (TFD) is the sum of the duration for all fixations within a target area [26]. Finally, the participants were asked to fill in a usability questionnaire, including the five dimensions of aesthetics, tapping speed, accuracy, comfort, and satisfaction. A five-point Likert scale is used for the usability questionnaire. The higher the score, the more positive the response.

3.3   Materials

Four soft keyboards, based on letter font variable and key border variable, were designed to simulate the smartphone soft keyboards (see Fig. 1). The keyboard size was 640 × 370 pixels. The uppercase and lowercase fonts of the keyboard letters were black and Kannada Sangam MN is the standard font. The positions of the letters were placed in the center of the keys. The bordered soft keyboard had white keys. The white key size was 50 × 66 pixels and equal to the size of the touchable area. A touch that lied outside the touchable area of the key was considered an error. Although the borderless soft keyboard had no visual boundary, it still had the same touchable area as the bordered one.
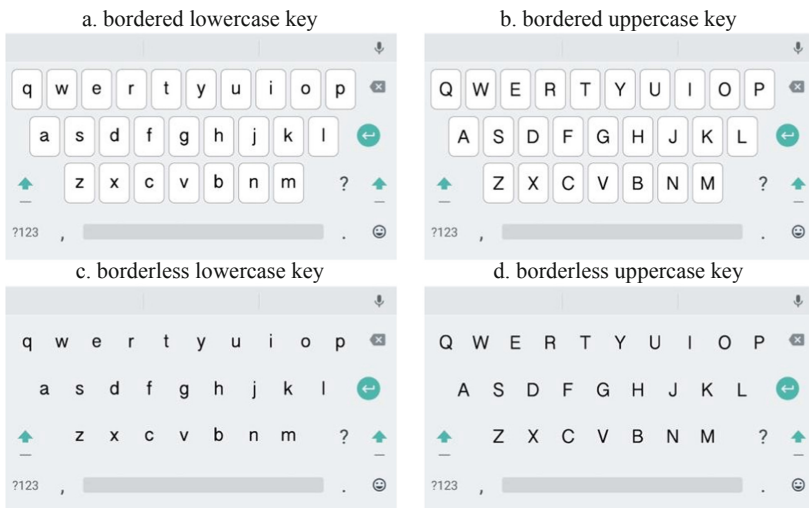
Fig. 1. The layout of four soft keyboards.

3.4   Apparatus

Tobii Pro X3-120 eye tracker was used in the present study. This eye tracker provided a non-invasive method to capture gaze data, with the sampling rate of 120 Hz. The accuracy and precision of this eye tracker were 0.4° visual angle and 0.24° visual angle respectively. In order to conduct the experiment and connect the eye tracker, the present study used a Sony VAIO notebook (model: SVP132A1CP, Intel i5 CPU, 4 GB ram). This notebook had a 13-in. touch screen so it could simulate the user's touch behavior on the soft smartphone keyboard. Tobii Pro Studio software was used to present experimental materials and output eye-movement data. Tobii Pro Studio software also recorded the mouse click positions. In order to minimize head movement, a chinrest was used to rest the participants' heads during the experiment.

3.5   Procedure

After the participants entered the laboratory, the experimenter asked them to read and sign the informed consent form and verbally reminded them about their rights. The participants were asked to provide background information and the mobile user experience. In the text-entering task, the participants were instructed to rest their head on a chinrest, to extend their right arm forward, and to tap the soft keyboard on the laptop screen only with the index finger of their right hand.

There were 26 practice trials before the experimental trials. At the beginning of each trial, a white cross appeared on the left side of the screen. The participants were asked to look at it (see Fig. 2). After participants pressed the "ctrl" key on the notebook with their left hand, the white cross would be replaced by an English letter which indicated the target key the participants should tap. Each trial had a random target key. At the same time, a soft keyboard appeared on the right side of the screen. The participants were asked to tap the target key on the soft keyboard with their right index finger. Each target key had only one chance to be tapped. As long as the index finger tapped the soft keyboard, the next white cross would appear.
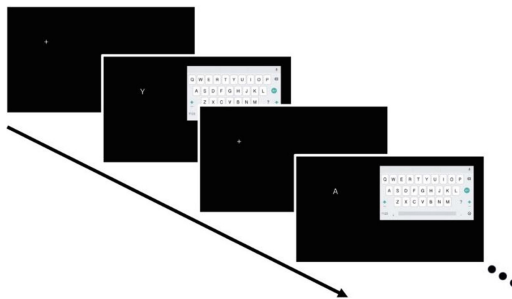
Fig. 2. The presentation of the materials in the text-entering task.

There were four stages in the formal experiment. The participants would use only one of the four soft keyboards in each stage. To avoid bias, the order of the four soft

keyboards was randomized. Each key was tapped twice in each stage so each soft keyboard accumulated 52 tapping data. Eye-movement calibration was conducted before each stage and the participants could stop for a rest after each stage. After completing the formal experiments, the participants would fill in a usability questionnaire to compare the experience between the four soft keyboards. The experiment took about 25 min.

4   Results

Table 1 lists the mean (*M*) and standard deviation (*SD*) of error rate, touch offset, gaze offset, TFF, and TFD for the four soft keyboards. In terms of gaze offset, two participants did not have the eye-movement data of the two soft keyboards due to the error in gaze estimation when tapping the target keys so their data were excluded from the analysis. In the following sections, two-factor repeated-measure ANOVAs were conducted on the error rate, touch offset, gaze offset, TFF, and TFD.

Table 1. Error rate, touch offset, gaze offset, TFF, and TFD for the four soft keyboards.

Dependent variable	N		Bordered Lowercase	Bordered Uppercase	Borderless Lowercase	Borderless Uppercase
Error rate	9	*M*	.016	.002	.007	.004
		SD	.022	.007	.014	.009
Touch offset (pixels)	9	*M*	10.40	9.80	9.14	8.90
		SD	1.87	1.15	1.11	0.95
Gaze offset (pixels)	7	*M*	19.94	18.86	19.95	17.94
		SD	5.03	4.92	5.18	5.46
TFF (msec.)	9	*M*	667	678	697	697
		SD	132	88	105	73
TFD (msec.)	9	*M*	380	334	318	338
		SD	94	130	159	115

4.1   Error Rate

The main effect of the letter font variable wasn't statistically significant, $F(1, 8) = 1.33$, $MSE = .00$, $p = .28$, $\eta^2 = .14$. The main effect of the key border variable wasn't statistically significant, $F(1, 8) = 4.56$, $MSE = .00$, $p = .065$, $\eta^2 = .36$. However, the interaction between the letter font and key border variables was marginally significant, $F(1, 8) = 5.26$, $MSE = .00$, $p = .051$, $\eta^2 = .40$ (see Fig. 3).

4.2   Touch Offset

The main effect of the key border variable was statistically significant, $F(1, 8) = 9.30$, $MSE = 1.13$, $p < .05$, $\eta^2 = .54$. The touch offset was significantly higher when tapping bordered keys ($M = 10.10$, $SD = 1.53$) than borderless keys ($M = 9.02$, $SD = 1.01$).
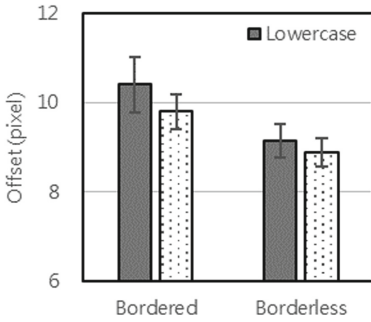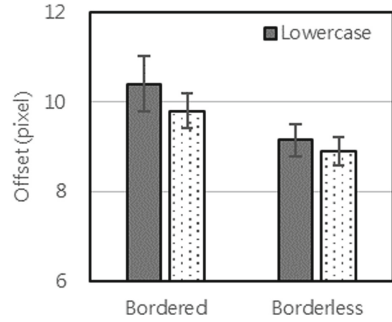
Fig. 3. Error rate.

Fig. 4. Touch offset.

However, the main effect of the letter font variable ($p > .10$) and the interaction between two variables ($p > .50$) weren't statistically significant (see Fig. 4).

4.3   Gaze Offset, TFF and TFD

The main effect of the letter font variable wasn't statistically significant for gaze offset, TFF, and TFD (all $p > .30$). The main effect of the key border variable wasn't statistically significant for gaze offset, TFF and TFD (all $p > .20$). The interaction between the letter font and key border variables wasn't also statistically significant for gaze offset, TFF and TFD (all $p > .10$).

4.4   Gap Between the Touch and the Gaze

In order to understand the gap between the touch and the gaze, the present study further analyzed the vertical offset and horizontal offset of the touch positions and the visual fixation positions respectively. The vertical offset of the touch positions was 1.35 pixels below the key center and that of the visual fixation positions was 6.93 pixels below the key center. The vertical gap between the two positions was somewhat significant, $t(6) = 2.38$, $p = .055$. The horizontal offset of the touch positions was 1.15 pixels on the right of the key center and that of the visual fixation positions was 1.80 pixels on the left of the key center. However, the horizontal gap between the two positions was not statistically significant, $t(6) = 1.24$, $p = .26$.

4.5   Usability Evaluation

Table 2 lists the mean (M) and standard deviation (SD) of usability scores for the four soft keyboards, including the five dimensions of aesthetics, tapping speed, accuracy, comfort, and satisfaction. Two-factor repeated-measure ANOVAs were conducted on these usability scores. The results show that the main effect of the key border variable was statistically significant only on aesthetics, comfort, and satisfaction dimensions (all $p < .05$). The aesthetics score was significantly higher for the bordered keys ($M = 3.78$, $SD = .73$) than for the borderless ones ($M = 2.89$, $SD = .90$). The comfort score was

Table 2. The usability scores and marginal means for the four soft keyboards.

	Aesthetics		Tapping speed		Accuracy		Comfort		Satisfaction	
	M	SD	M	SD	M	SD	M	SD	M	SD
Bordered Lowercase	3.78	0.83	4.00	0.50	4.11	0.78	4.22	0.83	4.00	0.50
Bordered Uppercase	3.78	0.67	4.00	0.71	4.00	0.87	4.22	0.67	4.00	0.71
Borderless Lowercase	3.00	1.00	3.67	0.87	3.78	0.83	3.33	0.87	3.56	0.73
Borderless Uppercase	2.78	0.83	3.33	1.22	4.00	0.71	3.22	0.83	3.11	0.93
Bordered	3.78	0.73	4.00	0.60	4.06	0.80	4.22	0.73	4.00	0.60
Borderless	2.89	0.90	3.50	1.04	3.89	0.76	3.28	0.83	3.33	0.84
Lowercase	3.39	0.98	3.83	0.71	3.95	0.80	3.78	0.94	3.78	0.65
Uppercase	3.28	0.89	3.67	1.03	4.00	0.77	3.72	0.89	3.56	0.92

significantly higher for the bordered keys ($M = 4.22$, $SD = .73$) than for the borderless ones ($M = 3.28$, $SD = .83$). The satisfaction score was significantly higher for the bordered keys ($M = 4.00$, $SD = .60$) than for the borderless ones ($M = 3.33$, $SD = .84$). However, the main effect of the letter font variable and the interaction between two variables weren't statistically significant in all dimensions (all $p > .05$).

5 Discussion

The purpose of the study is to understand whether the two visual cues of the letter font and key border affect the distribution of attention and the touch behavior on the soft keyboard. The result shows that the borderless keys have lower values of the error rate, touch offset, and gaze offset. Although these lower values are consistent with the expectation of hypothesis 2, there was a statistically significant difference only in touch offset between borderless keys and bordered keys. The result suggests that the borderless keys can narrow the touchable areas expected by the users, influencing them to tap the letter position and reducing the touch offset. However, in terms of usability evaluation, the bordered keys have significantly higher scores in aesthetics, comfort, and satisfaction dimension. This finding may be related to the participants' experience of tapping bordered keys frequently. Previous research has suggested that these kinds of visual cues (e.g., button border) can increase interactivity [3, 25]. Therefore, designers still need to consider multiple factors to decide whether to use key borders on the soft keyboard.

The result shows that the uppercase letters have lower values of the error rate, touch offset, and gaze offset. Although these lower values are in line with the expectation of hypothesis 1, there wasn't a statistically significant difference in the values between uppercase letters and lowercase letters. Previous research had used the obvious visual cues to guide users' touch behavior [25], so this result may be related to the lack of

significant visual characteristics of uppercase letters. In terms of usability evaluation, although lowercase letters had higher scores on four dimensions, there wasn't a statistically significant difference in these dimensions between uppercase letters and lowercase letters. Therefore, both letter fonts can be used in the design of the soft keyboard.

It is worth noting that the interaction between the two variables was marginally significant on the error rate. It can be further observed that the lowercase keys with borders have the highest error rate. According to the research hypothesis, bordered lowercase keys should be the worst design, which is demonstrated by the error rate. However, bordered lowercase keys are the most frequently tapped by users. Previous research findings revealed that users would have the best performance when using a familiar soft keyboard [27, 28]. However, the familiarity of the interface did not play a significant role in the error rate.

Another important observation is the center of attention when tapping the keys. The visual cues of the letter font and key border didn't significantly affect TFF and TFD. On the other hand, the result shows that the touch positions tend to be below the key center, which is consistent with previous study [29]. However, the vertical offset of the visual fixation positions below that of touch positions is somewhat significant, so the center of attention is not consistent with the touchpoint. In addition, the gaze offset is at least twice as high as the touch offset so touch behavior is more accurate than gaze.

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