

DESIGNING USER EXPERIENCES FOCUSED ON MULTIMODAL PERCEPTION

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ABSTRACT

Design disciplines and research have been rapidly transforming which includes not only objects but also services as the target of design. The paper presents a methodological-practical approach to determine the vectors of affective design which is one of the research on transformative design. The research has a twofold aim which are (1) to rethink the definition and vectors of design for practical usage (2) to verify more modifiable information and a significant value to be a key in enabling affective functionality through an experiment on multisensory integration using visual-olfactory stimuli. The findings of the research provide a new perspective on practical research on affective design in terms of effective and sustainable vectors.

Keywords: multimodal, constructive perception, evaluation methodology, intuitive preference

1. INTRODUCTION

Design has mainly been discussed in terms of the study of industrial design (Buchanan & Margolin 1995; Cross 2007) and engineering design (Pahl et al 2007). However, society is already saturated with various high-end technological products, and design is continually reconfiguring itself from object-centred to human-centred. Therefore, current design produces not only form or function based objects but also produce designs that involves user expectation from the objects or services and this is known as user experience design. As to the importance of experience, it is defined that *Kansei* and the validation process that gives clear understandings which contributes to subjective and intuitive evaluations to the objects or services with physiological and psychological approaches are invalid. Two questions that is answered in the study are: (1) how to determine a cause-and-effect relations of the sensory information and the evaluation results in accordance with our daily life (2) how to phase the perceived information in user experience design? The paper is organized as follows: First, it reviews a new design discipline towards an enhanced affective design, and presents the validated model of the subjectivity-modification process, which was validated by Kim et al. (Kim et al 2012; Kim & Cho 2016; Kim

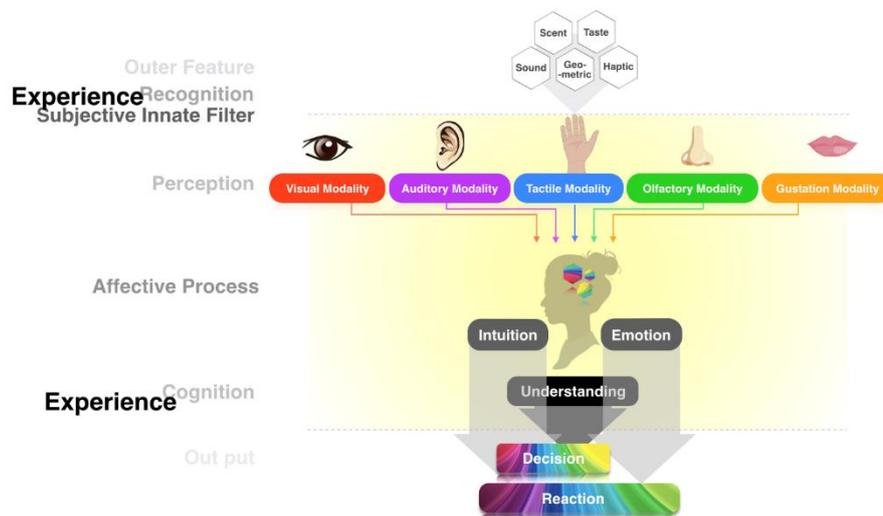
2017). Second, it verifies a cause-and-effect relations of the perceived information and the evaluation results using visual-olfactory stimuli; and establish a point of view on what can be improved aiming at proposing a conceptual framework for integrating user experience into objects. This approach strengthens the vectors of user experience by aesthetically pleasing added and clarifies the link between the product and the perceptual impacts on the users which attribute to user expectations.

1.1. Re-think Design

Currently, design is present in our daily lives. It means that designers do not only have to develop new products with which people pursue their lives but also have to decide what kind of life and society that these products support (Hummels & Frens 2009) in terms of the so-called transformative design. Therefore, it is to rethink the notion of the transformative design for the near future, it should be understood that focus should not be on the design per se, but focus on what design that is expected by users. User research is about understanding users and their needs and user experience design is designing a user's interactions with a product from moment to moment (Hassenzahl M). A user's experience is the cumulative effect of many factors, some that you can control, and some that you can't control (Bule 2013). How to design what the individual wants and needs? This question has fascinated researchers in the design field and continues to motivate them today. Design doesn't address a single issue anymore. Design has been more complex involving the notions of the user, eco, universal, sustainable and so on. What is design, and how does design fit the new era society? "Dividing" could provide an answer to this. Form and functions are two fundamental aspects of design, and it is expected that the two interact to impact user's evaluations of a product. Form and function based design is mainly evaluated by the baseline knowledge or previous experience (Gregan et al 2005; Hoeffler 2003; Meyers & Tybout 1989). A typical form design is conceptualised as the specific prototype in individual memory. Thus, if the form is more typical, users can have easy access to memory. In other words, more typical form leads to positive product evaluation due to its perceptual fluency. Perceptual fluency reflects the ease with which users can identify the physical identity of the stimulus on subsequent encounters, and involves the processing of physical features such as shape (Lee & Aparna 2004). In addition to that, perceptual fluency is influenced by several variables such as perceptual priming, clarification, presentation duration, or repetition (Reber et al 2004). Most of all, perceptual fluency is known to be enhanced through prior exposures (Lee & Aparna 2004). On the other hand, conceptual fluency reflects the ease with which the target comes to individual minds and pertains to the processing of meaning that is related to semantic knowledge structures (Reber et al 2004). Whereas perceptual fluency is not influenced by attention or elaboration, conceptual fluency benefits from elaboration at the time of exposure (Lee & Aparna 2004). In other words, perceptual fluency originated from "external feature context and subjective innate filter" whereas conceptual fluency originated from "the phase of the subjective innate filter (Kim & Cho 2017)". This will be detailed and elaborated in the following section.

1.2. Re-think Human Being

There can be no doubt that all human knowledge begins with experience. Humans experiences external features through their senses like eyes, ears, nose, and so on. As I. Kant said that although all our knowledge begins “with” experience, it does not mean that it arises “from” the experience (Kant 2008 a). Even human knowledge is a compound of that humans receive through impressions, it is undistinguished from that of a raw material and it takes a prolonged practice to make humans attentive to the knowledge and rendered humans to be capable of separating one from the other (Kant 2008 b), where accumulative knowledge is in relation to intuition. The unanswered question is how does an individual’s experience affects or be affected in relation to knowledge and intuition?.



The flow of affective process in the relationship of perception, cognition, and experience which presents subjectivity-modification process (Kim & Cho 2017; Kim 2017)

Figure 1 represents the process of *Kansei* information and outcomes. The term of *Kansei* has been developed in Japan in order to design feelings into products and according to Kim et al. (Kim & Cho 2017; Kim 2017) defined *Kansei* information as Figure 1 based on the previous *Kansei* engineering and design studies. It is postulated that individuals have a subjective innate filter considering the variety of subjectivity. This subjective innate filter separates individuals as “one individual” where by having a subjective innate filter, the inner and outer filter of an individual are separated. When human captors like the eyes, ears and nose receive a stimulus as an external feature and is considered as an outer filter, the sensor data integrates as *Kansei* information. *Kansei* information contains full perceptive data acquired by a subjective innate filter which are human sensors or modalities and the information synthesises through in the brain and comes out as reaction such as emotion or intuition. Hence, *Kansei* information as an integrated sensory data is assimilated (*Kansei* process) and is sent to the understanding process. *Kansei* presents as two types of outcome: emotion or intuition as *Kansei* information per se; decision as a result of understanding (Kim et al 2012; Kim & Cho 2017; Kim 2017). The two types of outcomes influence perceptual and conceptual fluencies as familiarity, preference, aesthetic feeling, and so on; and the two interact to impact user evaluations of a new product again through the individual

experience. As to the definition of *Kansei*, perceptual fluency originated from “external feature condition and subjective innate filter” whereas conceptual fluency originated from “the phase of the subjective innate filter”.

2. METHODS

2.1. Experiment Design

Experiments consist of three phases (1) stimuli-screening aiming to stimulate the screening for the main experiment (2) stimuli-producing for the main experiment and, (3) evaluation. In the first phase, visual and olfactory stimuli were verified its subjective sensory giving, such as sweetness, sourness, lightness, and so on. In the second phase, screened visual and olfactory stimuli were combined to form experimental stimuli according to visual-olfactory congruence degree. In the final phase, the subjects evaluated the prepared visual-olfactory stimuli using the same traits as the stimuli-screening.

2.2. Stimuli and Subjects

In the stimuli-screening phase, twenty-five essential oils and its representing photos were used as olfactory and visual stimuli. The essential oils were categorised into citrus (lime, orange, grapefruit, lemon, tangerine), floral (chamomile, lavender, jasmine, ylang-ylang, rose), herbaceous (tea tree, peppermint, eucalyptus, rosemary, basil), and woody (cinnamon, sandalwood, cedar-wood, cypress, juniper-berry) by five each (Figure 2).



Visual and olfactory stimuli which used in the stimuli-screening

Only verified visual and olfactory stimuli which presented its significance in the stimuli-screening experiment, were used in the second phase of the experiment. Which showed statistical significance in visual stimuli were, orange, lemon, tangerine, peppermint, eucalyptus, cinnamon, cedar-wood, cypress, and tea tree. The olfactory stimuli which showed a statistical significance were, cinnamon, lemon, orange, peppermint, grapefruit, basil, ylang-ylang, and chamomile. With those visual and olfactory stimuli, twelve visual-olfactory stimuli were prepared (Table 1). The olfactory stimuli, which presented a significant trait in the stimuli-screening experiment, were used in the main experiment, but L-l-, B-b-, L+l-, B+b- were excluded from the stimuli-producing process, as a reaction of disgust was reported by Japanese subjects during the stimuli-screening. The stimuli used in the main experiment were perfectly sealed in a jar with a lid. Screened essential oils were dropped in jars, and a prepared visual stimuli were firmly affixed to lids. Thirty university students participated in the experiment that consists of 20 males and 10

females with the age ranging from 19 to 22 years old (mean= 20.03, SD±0.99). All the subjects were Japanese natives.

Table 1: The attributes of visual-olfactory stimuli to be used for the main experiment

Stimuli factors		The matrix for stimuli-producing					
Visual	Olfactory	<i>SWEETNESS</i>	<i>FRESHNESS</i>	<i>SOURNESS</i>	<i>LIGHTNESS</i>	<i>BRIGHTNESS</i>	<i>PREFERENCE</i>
PV Positive Visual	PO Positive Olfactory	+s+s	+f+f	+so+so	+l+l	+b+b	+p+p
NV Negative Visual	NO Negative Olfactory	-s-s	-f-f	-so-so	-l-l	-b-b	-p-p
PV Positive Visual	NO Negative Olfactory	+s-s	+f-f	+so-so	+l-l	+b-b	+p-p
NV Negative Visual	PO Positive Olfactory	-s+s	-f+f	-so+so	-l+l	-b+b	-p+p

2.3. Procedure

The subjects were informed that this was a research concerned with the Semantic Differential of sensory perception; and were carried twice including the pre-test before conducting the main experiment. It aims to evaluate the visual-olfactory stimuli, the experimenter made sure that the subjects checked the number on the lid of the jar before writing the results of their evaluation on the SD questionnaire sheet. The subjects were instructed to rate using the subjective states, which are: Each trait on below the stimulus that you will use to rate your feelings about the stimuli. The evaluation traits are: *sweetness*, *freshness*, *sourness*, *lightness*, *brightness*, and *preference*. The evaluation implemented a 6-point Likert scale as follow: strongly disagree, disagree, slightly disagree, slightly agree, agree, strongly agree.

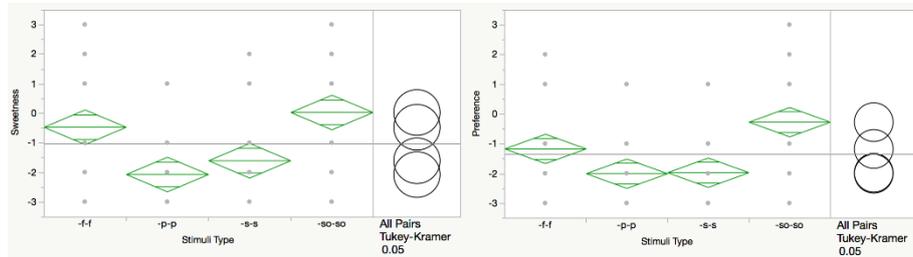
3. ANALYSIS & RESULTS

A one-way analysis of variance (ANOVA) was performed to investigate that (1) which sensory information affect stronger the evaluation values than another in each evaluation (2) which evaluation words in all six (*sweetness*, *freshness*, *sourness*, *lightness*, *brightness*, and *preference*) present a statistical significance either in general or specific.

3.1. In the NVNO Compositions

While as the evaluation words, *freshness*(p=.3136), *sourness* (p=.9601), *lightness* (p=.5838), *brightness* (p=.2293) don't present any statistical significances with the NVNO compositions, *sweetness* and *preference* present the significances (p<.0001). In an evaluation, the word *sweetness*, -so-so presents a significant difference from -p-p (p<.0001) -s-s (p=.0009). Also, -f-f shows a significant difference from -p-p (p=.0012), -s-s (p=.0388). In the evaluation, the word *preference*, -so-so presents a significant difference from -p-p (p<.0001), -s-s (p<.0001) (Figure 3).

It is reasonable to expect that *SOURNESS* consists of NVNO (NVNO-*SOURNESS*), has an affective factor to move on the contrary to *FRESHNESS*, *PREFERENCE*, and *SWEETNESS* consist of NVNO, in *sweetness* and *preference* evaluations.

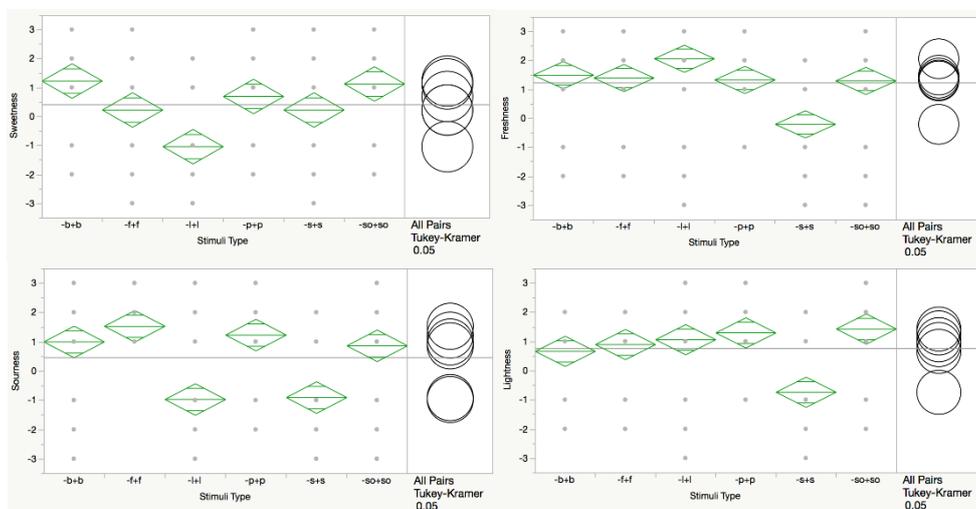


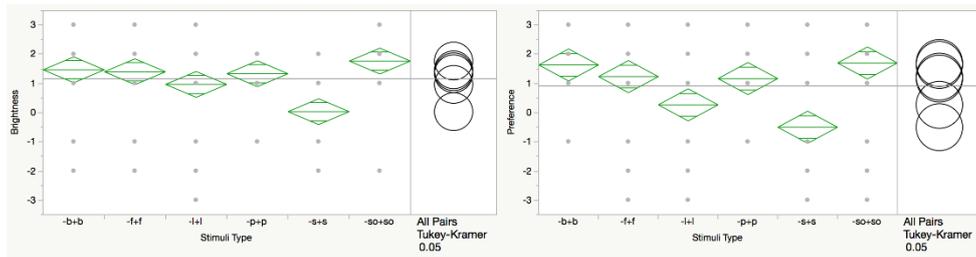
The significant values in the NVNO Compositions

3.2. In the NVPO compositions

Sweetness ($p < .0001$), *freshness* ($p < .0001$), *sourness* ($p < .0001$), *lightness* ($p < .0001$), *brightness* ($p < .0001$), and *preference* ($p < .0001$) presents a significant difference with the NVNO compositions. In the evaluation, the word *sweetness*, -l+l presents a significant difference from the others. In the evaluation, the word *freshness*, -s+s presents a significant difference from the others. In the evaluation, the word *sourness*, -f+f, -p+p, -b+b, and -so+so presents a significant difference from -l+l, -s+s ($p < .0001$, $p = .0001$). In the evaluation, the word *lightness* and *brightness*, -s+s presents a significant difference from the others. In the evaluation, the word *preference*, -s+s presents a significant difference from -so+so, -b+b ($p < .0001$), -f+f ($p = .0003$), -p+p ($p = .0005$); also -l+l presents a significant difference from -so+so ($p = .0049$), -b+b ($p = .0086$) (Figure 4).

SWEETNESS consists of NVPO (NVPO-*SWEETNESS*), affects all evaluation words except to *sweetness* whereas in the evaluation, the word *sweetness*, *LIGHTNESS* consists of NVPO (NVPO-*LIGHTNESS*) has a significant difference from the others. In the evaluation, the word *sourness*, NVPO-*LIGHTNESS* and NVPO-*SWEETNESS* shows a statistical significance from the others.



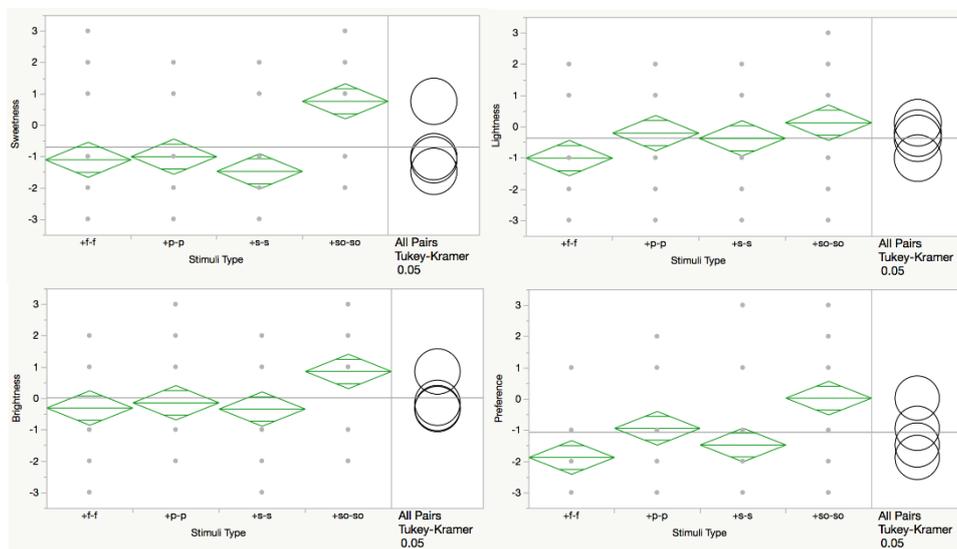


The significant values in the NVPO Compositions

3.3. In the PVNO compositions

While *freshness* ($p=.1732$), *sourness* ($p=.1846$) don't present any significances in the PVNO compositions, evaluation words *sweetness* ($p<.0001$), *lightness* ($p=.0454$), *brightness* ($p=.0074$), and *preference* ($p<.0001$) present the significances. In an evaluation of the word *sweetness*, +so-so presents a significant difference from +s-s, +f-f, +p-p ($p<.0001$, $P=.0001$). In an evaluation of the word *lightness*, +so-so presents a significant difference from +f-f ($p=.0302$). In an evaluation of the word *brightness*, +so-so presents a significant difference from +s-s ($p=.0145$), +f-f ($p=.0186$). In an evaluation of the word *preference*, +so-so presents a significant difference from +f-f ($p<.0001$), +s-s ($p=.0009$) (Figure 5).

The results show that *SOURNESS* consist of PVNO (PVNO-*SOURNESS*), has a statistical significance in the evaluation words *sweetness*, *lightness*, *brightness*, and *preference*.



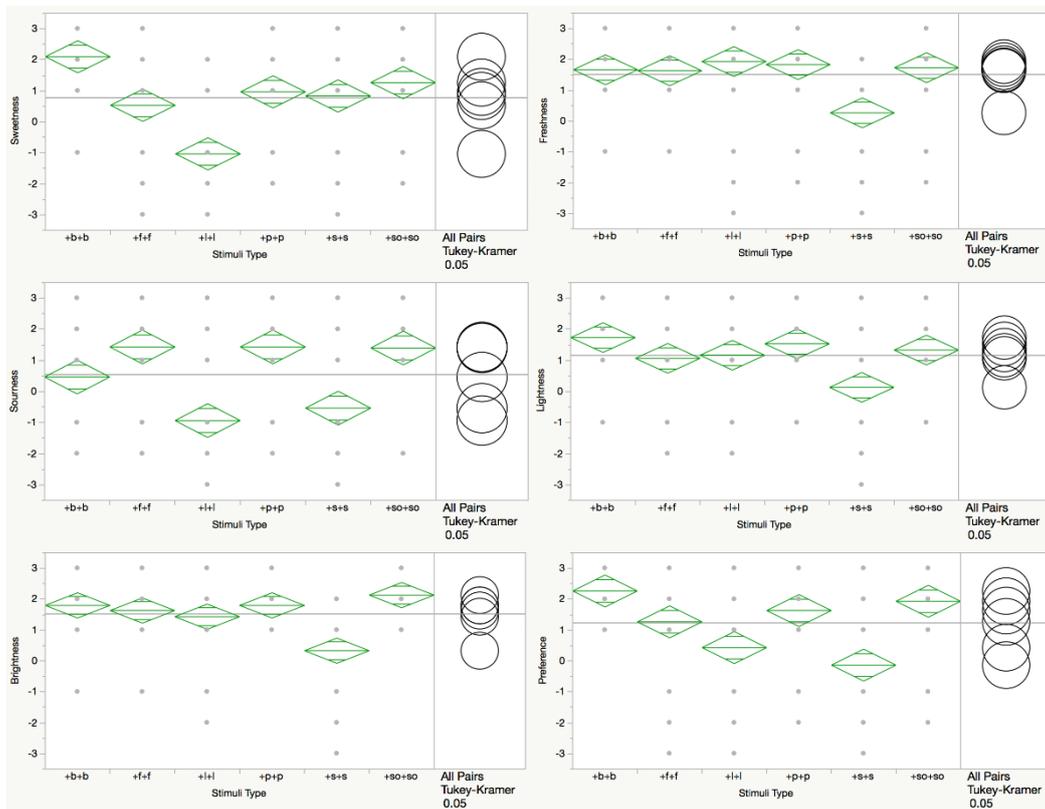
The significant values in the PVNO Compositions

3.4. In the PVPO compositions

Sweetness, *freshness*, *sourness*, *lightness*, *brightness*, and *preference* values present the significances ($p<.0001$). In an evaluation of the word *sweetness*, +l+l presents a significant difference from +b+b, +so+so, +p+p, +s+s. ($p<.0001$) and +f+f ($p=.0006$). Also, +b+b presents a significant difference from +f+f ($p=.0006$), +s+s ($p=.0106$), +p+p ($p=.0319$). In an evaluation of the word *freshness*, +s+s presents a significant difference from +l+l ($p<.0001$), +p+p ($p=.0002$), +so+so

($p=.0006$), +b+b ($p=.0012$), +f+f ($p=.0017$). In an evaluation of the word sourness, +l+l presents a significant difference from +f+f, +p+p, +so+so ($p<.0001$), +b+b ($p=.0059$). Also, +s+s presents a significant difference from +f+f, +p+p, +so+so ($p<.0001$). In an evaluation of the word *lightness*, +s+s presents a significant difference from +b+b ($p<.0001$), +p+p ($P=.0009$), +so+so ($p=.0075$), +l+l ($p=.0340$). In an evaluation of the word *brightness*, +s+s presents a significant difference from +so+so, +b+b, +p+p ($p<.0001$), +f+f ($p=.0002$), +l+l ($p=.00032$). In an evaluation of the word *preference*, +s+s presents a significant difference from +b+b, +so+so, +p+p ($p<.0001$), +f+f ($p=.0030$). Also, +l+l presents a significant difference from +b+b ($p<.0001$), +so+so ($p=.0011$), +p+p ($p=.0030$) (Figure 6).

The results show that PVPO-SWEETNESS has a significance in all evaluation words except *sweetness*. PVPO-LIGHTNESS has a significance in the evaluation words *sweetness*, *sourness*, and *preference*.



The significant values in the PVPO Compositions

4. DISCUSSION & CONCLUSION

From the results, it shows that (1) NVNO-SOURNESS shows a contrary effect to NVNO-FRESHNESS, NVNO-PREFERENCE, and NVNO-SWEETNESS in sweetness and preference evaluations (2) NVPO-SWEETNESS affects all evaluation on all words except *sweetness* whereas, NVPO-LIGHTNESS has a significant difference from the others with *sweetness*. In an evaluation word *sourness*, NVPO-LIGHTNESS and NVPO-SWEETNESS show significant differences from the

others (3) The results present that PVNO-SOURNESS has a statistical significance in the evaluation words *sweetness*, *lightness*, *brightness*, and *preference* (4) The results show that PVPO-SWEETNESS has a significant difference in all evaluation words except *sweetness*. PVPO-LIGHTNESS has a statistical significance in the evaluation words *sweetness*, *sourness*, and *preference*.

Table 2: The visual-olfactory values showing a significance in each evaluation

<i>Sweetness</i>	<i>Freshness</i>	<i>Sourness</i>	<i>Lightness</i>	<i>Brightness</i>	<i>Preference</i>
PVPO-LIGHTNESS	PVPO-SWEETNESS	PVPO-SWEETNESS PVPO-LIGHTNESS	PVPO-SWEETNESS	PVPO-SWEETNESS	PVPO-SWEETNESS PVPO-LIGHTNESS
NVNO-SOURNESS					NVNO-SOURNESS
PVNO-SOURNESS			PVNO-SOURNESS	PVNO-SOURNESS	PVNO-SOURNESS
NVPO-LIGHTNESS	NVPO-SWEETNESS	NVPO-SWEETNESS NVPO-LIGHTNESS	NVPO-SWEETNESS	NVPO-SWEETNESS	NVPO-SWEETNESS

The findings as of Table 2 present that (1) PO-LIGHTNESS as the quality of having weight, affects the evaluation words *sweetness* and *sourness*. Also, PO-LIGHTNESS as the quality of having weight, affects the evaluation of the word *preference* only with PV-LIGHTNESS (2) PO-SWEETNESS is more affective that PV-SWEETNESS or NV-SWEETNESS. PO-SWEETNESS has negative effects on the evaluation of the word *sweetness*. It is reasonable to expect that PO-SWEETNESS is more effectible stimuli except as the same value as *sweetness* (3) NO-SOURNESS affects in *sweetness* and *preference*. PVNO-SOURNESS affects positively on the evaluation of *sweetness*, *lightness*, *brightness* and *preference*.

The goal of the present paper is not to solve daily life problems related to housing, food, ageing, transports or work, but is to acquire a place for creating a “pleasing” feeling in our daily lives in the design process for transformation as the debate on the acknowledgement of the methods to apply an individual feelings or emotions to design, that includes products can’t be fully designed and pre-determined. Through the research, it is verified that negative feelings from visual information is modifiable with positive olfactory information in the case of LIGHTNESS and SWEETNESS conditions. Furthermore, negative feelings from olfactory information affects *sweetness* feelings. What does *sweetness* mean for humans? And what do SWEETNESS, SOURNESS and LIGHTNESS mean for human beings in their daily lives? Further research will be focused on these issues.

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