ISASE 2019

The Effect of Time Passage on Kansei Evaluation

– Wearing comfort of on-ear headsets as an example –

Jun-Ming LU*, Yu-Hsuan TSAI ** and Yu-Ling LIANG ***

** National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu, Taiwan 30013, R.O.C.*
jmlu@ie.nthu.edu.tw
*** National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu, Taiwan 30013, R.O.C.*
s31640h@gmail.com
**** National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu, Taiwan 30013, R.O.C.*
s101036511@gmail.com

Abstract: This study aims to investigate the effect of time passage on kansei evaluation, i.e. whether the results may change as the user interact with the product for a longer time compared against his/her first impression. Eight on-ear headsets covering three levels of ear pad material, two levels of headset weight, and two levels of clamping force were considered. Each of the 30 participants was asked to evaluate each of the eight headsets with 18 bipolar kansei keywords related to wearing comfort right after it was put on from behind by the test giver, so as to exclude the influence of visual stimuli. After experiencing the headset for 15 minutes without auditory input, the same evaluation was performed as the headset remained on the participant's ears. Results indicate that the representative semantic concepts of wearing comfort changed over time, so did the corresponding design parameters. More specifically, users tend to underestimate the value of more breathable ear pad materials and the higher stability contributed by the stronger clamping force, unless they can experience on-ear headsets for a considerable time.
Keywords: *ear pad material, headset weight, clamping force*

1. INTRODUCTION

Kansei evaluation of product design has been widely used to relate design parameters to the user's emotional experiences. For most cases, it is conducted based on the user's instant responses right after interacting with the product(s), no matter what type of stimuli is given. In other words, this could be considered as the user's first impression toward the product(s). However, in the real user scenario, the user's experience may come from a longer interaction with the product(s), which could make the responses different from the user's first impression [1]. Therefore, it would be necessary to better understand the potential effect of time passage on kansei evaluation.

If the interaction mainly relies on two-dimensional visual stimulus, e.g. looking at the pictures of products, there could be a slight effect of time passage in terms of fatigue or tire. However, in the case of three-dimensional visual stimulus, i.e. seeing the real products or watching video clips, the user may develop richer experience as time passes. It would be similar as auditory and or tactile stimuli are involved [2], and this is exactly what the user may really experience while interacting with purchased products. In order to ensure that kansei evaluation can reflect the user scenario faithfully, it seems that the duration of interaction has to be sufficiently long.

Among the consumer products that are used frequently in our daily lives, headsets would be one of the most appropriate choices to be studied. First, the interaction with a headset involves visual, auditory, and tactile stimuli. Besides, the user usually wears the headset long, no matter the purpose is to communicate with others or to listen to music. Generally speaking, manufacturers or designers of headsets are particularly interested in the wearing comfort [3], which is mainly influenced by the tactile stimulus. Even though there is usually only one channel of sensation considered, the user's responses did change owing to the passage of time [4].

Therefore, taking the wearing comfort of headsets as an example, this study aims to investigate the effect of time passage on kansei evaluation. More specifically, the purpose is to understand whether the representative semantic concepts and corresponding design parameters might change over time. If such effects of time passage were found, special attention needs to be paid while conducting kansei evaluation.

2. DATA COLLECTION AND ANALYSIS

2.1 On-Ear headset samples

Eight on-ear headsets were selected from the market according to the popularity. These headsets cover three design items and eight design categories, as shown in Table 1. To be noted, weight of headset and clamping force are divided by the average of the eight headsets.

Table 1: Design items/categories of interest

Design items	Design categories
Ear pad material	PU
	Sponge
	Silicone
Weight of headset	Heavier (>144.7g)
	Lighter (<144.7g)
Clamping force	Stronger (>200g)
	Weaker (<200g)

2.2 Participants

This study recruited 30 adults (23 males and 7 females; from 20 to 50 years old) who use headsets for more than three times a week in the recent year. In order to ensure every participants is able to wear all the 8 headsets, the bitragion breadth needs to be between 12.4 cm and 20.7 cm. All participants agreed to the purposes, risks, benefits, and rights of this study, as well as signing a consent form.

2.3 Semantic differential scale

149 pairs of kansei words were first selected from related websites and blogs. Negative words and words not related to comfort were then filtered out. Besides, words with similar meaning were categorized into the same group. 35 groups (3 to 6 words in each) of kansei words were hence picked. Subsequently, 100 headset users were invited to choose one word that best represents the group with similar meaning. After that, 11 experts (4 with the backround of engineering, 3 with the background of product verification, 2 with the background of design, and 2 with the background of management) identified 16 pairs of kansei words that are suitable for the final use. With “Uncomfortable - Comfortable” and “Not willing to buy - Willing to buy” added, there were eventually 18 bipolar kansei words (shown in Table 2) used to generate the semantic differential scale.

Table 2: 18 bipolar kansei words considered in this study

Burdensome - Not burdensome	Not lightweight - Lightweight
Not skin-friendly - Skin-friendly	Not natural - Natural
Not ergonomic - Ergonomic	Unfitting - Fitting
Not ear-covering - Ear-covering	Not soft - Soft
Sweltering - Not sweltering	Unstable - Stable
With foreign body sensation - Without foreign body sensation	Not flexible - Flexible
Prickling - Not prickling	Ear-pressing - Not ear-pressing
Not loose - Loose	Uncomfortable - Comfortable
Not breathable - Breathable	Not willing to buy - willing to buy

2.4 Experiment procedure

The experiment starts with explaining the purpose of the stduy. After signing the informed consent form, the participant was asked about the headset brand that he/she owns, frequency of use, and acceptable price of headsets. At the 0^{th} minute of interaction, each of participant was asked to evaluate each of the eight headsets with the semantic differential scale right after it was put on from behind by the test giver, so as to exclude the influence of visual stimuli. After experiencing the headset for 15 minutes without auditory stimulus, the same evaluation was performed (at the 15^{th} minute of interaction) as the headset remained on the participant’s ears. At last, each participant was asked to choose one favorite headset out of the 8 samples that they have experienced in the study.

2.5 Data analysis

For the data collected at the 0^{th} minute, Pearson correlations of 18 bipolar kansei words and overall comfort were calculated. The pairs with significant correlation with overall comfort were then trasformed to the representative semantic concepts by using Principal Component Analysis (PCA) with varimax rotation. Clustering analysis with the scores of the first PC (principal component) and the second PC was then performed to group the 8 headset samples. At last, Quantification Theory type 1 (QT1) was performed to find out the relationship between overall wearing comfort or the representative semantic concepts and desgning items/catergories. All the analyses were also performed on data collected at the 15^{th} minute.

3. RESULTS AND DISCUSSION

3.1 Kansei words and overall wearing comfort

Among all the 18 bipolar kansei words, only "Not ear-covering - Ear-covering" is not correlated with "Uncomfortable - Comfortable" at both the 0th minute and the 15th minute. The possible reason is that all the headsets considered in this study are on-ear ones, leading to slight differences in terms of "ear-covering." Generally speaking, this result indicates that the subjective data collected by the semantic differential scales is reliable for representing the participant's wearing comfort.

3.2 Representative semantic concepts

Table 3 shows the results of PCA at the 0th minute and at the 15th minute. At the 0th minute, the concept of "pressure-free" is the most dominant one, followed by "ergonomic" and "smooth." Participants seem to prefer looser and less ear-pressing headsets. However, after 15 minutes of experience, the concept of "ergonomic" becomes the most dominant one. Participants tend to consider more stable and more natural headsets as more comfortable ones. This result shows that the first impression of wearing comfort may change over time. While wearing a headset for a period of time, people inevitably change their posture or slightly shake their heads, leading to the slip or drop of headsets. For this reason, more stable headsets that help users reduce the times of adjustment would be considered as with better wearing comfort.

Table 3: Results of PCA at the 0th minute and the 15th minute

Timing	Ranking	Semantic concepts	Top 3 kansei words	Loading
the 0th minute	1st	Pressure-free	Loose	0.973
			Not ear-pressing	0.932
			Not burdensome	0.869
	2nd	Ergonomic	Fitting	0.912
			Ergonomic	0.863
			Stable	0.804
	3rd	Smooth	Not sweltering	0.878
			Skin-friendly	0.798
			Not prickling	0.605
the 15th minute	1st	Ergonomic	Stable	0.961
			Natural	0.950
			Ergonomic	0.910
	2nd	Smooth	Not prickling	0.973
			Not lightweight	0.929
			Flexible	0.769
	3rd	Pressure-free	Loose	0.878
			Not ear-pressing	0.798
			Breathable	0.605

3.3 Influence of design parameters

Figure 1 and Figure 2 show the QT1 partial coefficients of design items and overall comfort and the PC scores of representative semantic concepts PC at the 0th minute and at the 15th minute. Figure 3 and Figure 4 show detailed coefficients of design categories in each comfort concept at the 0th minute and at the 15th minute. At the 0th minute, heavier weight corresponds to concepts of "pressure-free" and "ergonomic," whereas silicone ear pads correspond to the concept of "smooth." At the 15th minute, stronger clamping force, PU ear pads and heavier weight corresponds to the concept of "ergonomic," "smooth," and "pressure-free," respectively.

According to the results at the 0th minute, the headsets manufacturers may decide to design a heavier headset with weaker clamping force, in order to provide users with the experience of "pressure-free" and "ergonomic." However, considering the 15-minute experience, it would be recommended to rather design a heavier headset with stronger clamping force. Obviously, time effect influences not only the importance of semantic concept of comfort but also the design item/categories. If only the first expression was considered, manufacturers might be misled to design a headset that is not so comfortable in the real user scenario involving a longer experience.

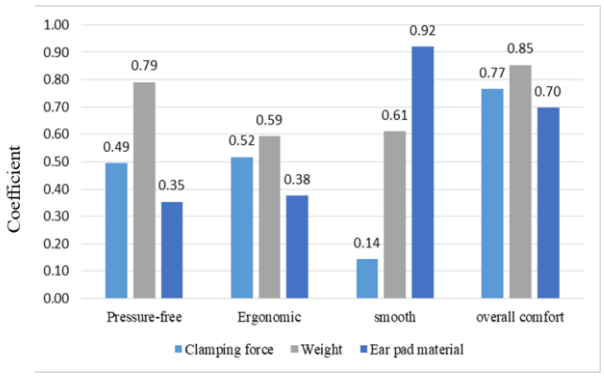

Figure 1: Partial coefficients at the 0th minute

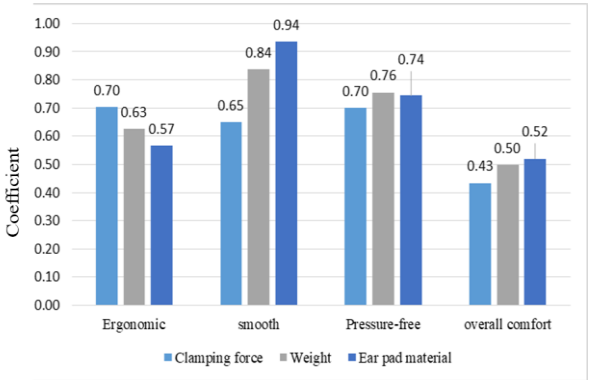

Figure 2: Partial coefficients at the 15th minute

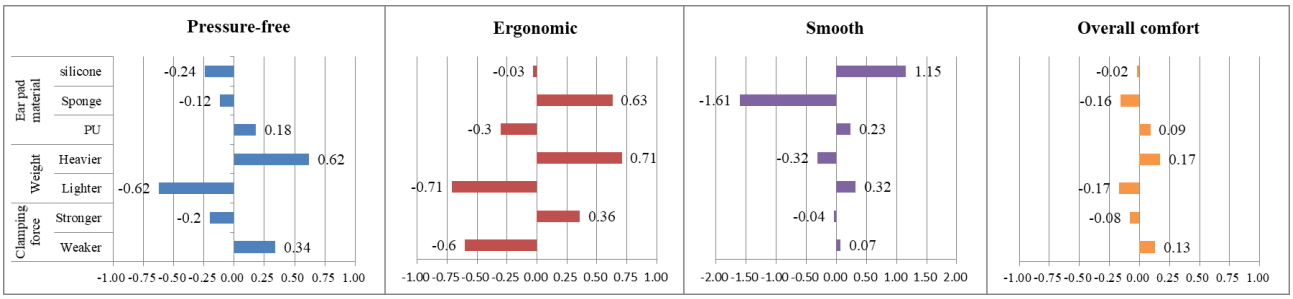

Figure 3: Coefficients of design categories at the 0th minute

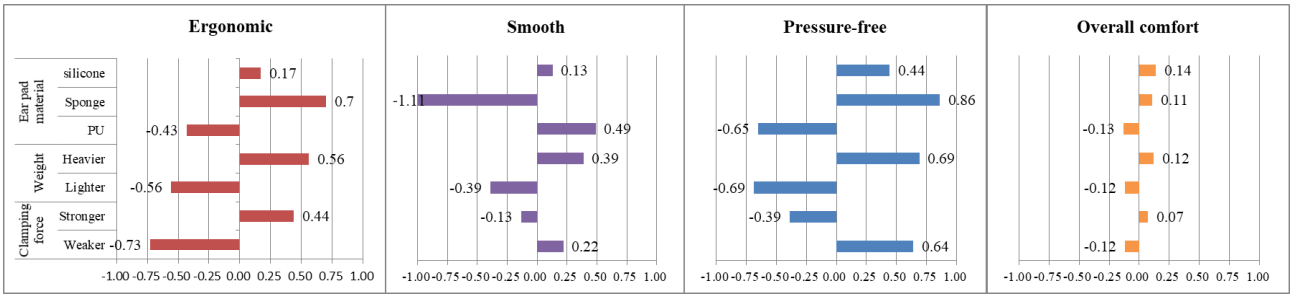

Figure 4: Coefficients of design categories at the 15th minute

4. CONCLUSIONS

In this study, 18 bipolar adjectives were adopted to describe the overall wearing comfort of on-ear headsets. According to the user's first impression right after putting the headset on (at the 0th minute), three representative semantic concepts were identified, including "pressure-free," "ergonomic," and "smooth." In addition, the most critical design parameter corresponding with each concept was found to be "heavier weight," "heavier weight", and "silicone ear pads," respectively.

Nevertheless, after a 15-minute experience of wearing, the concepts of "ergonomic" and "smooth" become more dominant than "pressure-free." Besides, the most critical design parameter contributing to the concept of "ergonomic" was replaced by "stronger clamping force." Further, "PU ear pads" and "heavier weight" was found to be the most critical contributor of the concept of "smooth" and "pressure-free" respectively.

The findings suggest that the effect of time passage does exist and hence is necessary to be studied, so as to better meet the real user scenario. In the future, the possible reasons behind this phenomenon will be investigated in more detail. Moreover, a longer observation of the user's experience over time needs to be conducted as well.

ACKNOWLEDGMENTS

The authors would like to express their special gratitude to Ms. Huei-Jiun HUNG and Mr. Shi-Chih CHEN for preparation of the experiment and data collection.

REFFERENCES

[1] K. Bongard-Blanchy, C. Bouchard, and A. Aoussat; Limits of Kansei-Kansei unlimited, International Journal of Affective Engineering; 12(2), pp.145-153, 2013.

[2] G.V. Georgiev and Y. Nagai; Time factor of core emotions derived from design materials: Towards a deeper understanding of product experience; The 4th World Conference on Design Research (IASDR2011), The International Association of Societies of Design Research (IASDR), 2011.

[3] J. Lin; Design Optimization of Headband for Headphone; Doctoral dissertation, Washington State University, 2009

[4] M.H. Sonneveld and H.N. Schifferstein; The tactual experience of objects; Product experience, Elsevier, pp.41-67, 2008.