COMPARATIVE ANALYSIS OF THE USERS’ KANSEI EVOLUTION OVER THEIR CARS LIFETIMES BETWEEN JAPAN AND IRAN

Approaching Product Subjective Sustainability (II)

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Abstract: To approach Product Subjective Sustainability experientially and to expand it analytically, this paper presents the results of an analysis of the evolution of Japanese and Iranian users’ Kansei toward their private passenger car during its entire lifetime. The major outcomes of this analysis would be the patterns of evolution of two groups of Japanese and Iranian subjects’ Kansei over the lifetime of their private cars. Accordingly, the trends of subjective sustainability of passenger cars are drawn and compared between these two contexts. As the findings of this study show, product subjective sustainability is dominant and ongoing in both countries car market. Moreover, Attachment, as the most important trend in such a subjective sustainability, may appear at the different kinds or levels. However, it is not the only trend in this regard.

Keywords: Product Lifecycle; Psychological Lifetime; Kansei; Attachment; Private Passenger Car

1. Introduction

Regarding the concept of Product Subjective Sustainability (PSJS), the authors have presented two articles serially in this journal prior to this article. Within the first article, we have reviewed the background of PSJS and outlined a framework to approach it experimentally [1]. As we showed in the first article, most of the design researches – concerning the subjective issues of product sustainability and hence the product longevity – have focused on product attachment as the only means to extend the psychological lifespan of products. However, as the results of our study within the second article [2] showed, it is not the only means to this end. Considering the lack of an inclusive term for the product subjective issues associating with product sustainability, we named “a product’s capability of being pleasing, appealing and satisfyingly enduring during its expected long/short lifetime” as PSJS. Furthermore, the professional term of Kansei could identify the subjective issues more comprehensively than any other term.

Starting with a background of the issues briefly mentioned above and aiming to analytically expand PSJS, we presented the results of a comparative study on “the evolution of users’ Kansei toward their mobile phones over their entire lifetime between two different contexts” in the last article [2]. The current article presents the process and results of the same study with the same approach but on the users of private passenger car. Private passenger car is nearly a long-lived product, as its increasingly average lifespan is about 12 years in Tokyo in 2009 [3]. The entire lifetime of the product from the user’s perspective is similarly divided into three main lifecycle stages: Purchase (P); Keep/Use (KU); and End or Replace (R). To find out the effects of contextual differences on PSJS, we have here investigated the private car users living in two quite different contexts: Japan and Iran. The major processed
output of the investigation is the Kansei descriptive items regarding each lifecycle stage of the subjects’ private cars, the items themselves and the subjects’ groupings; from this data, we produced various patterns of the evolution of the subjects’ Kansei regarding their car during its lifecycle. Finally, as the main outcome of this study, the major trends of PSJS are drawn on the basis of the results and compared between these two contexts.

2. Method

This analytical study was performed in three main steps. In the first step, two groups of Iranian and Japanese subjects were investigated through a definite and descriptive questionnaire. The second step was the processing and analysis of the data derived from the questionnaire by using the KJ Method, Descriptive Statistics, Quantification Theory Type III (QT3) and Cluster Analysis (hierarchical method). In the final step, the results of the analysis are interpreted.

The Japanese subjects ranged from 49 to 74 years old, were 29% female and 71% male and consisted of Chiba University’s 18 professors or students’ parents. The Iranian subjects ranged from 25 to 73 years old, were 30% female and 70% male and consisted of 30 users of private car living in Tehran or Shiraz. They were questioned about the following: a brief history of their used/replaced cars, their reasons for replacing their cars, the level of dis/satisfaction with their current cars and their Kansei regarding their cars in each of the three lifecycle stages (P, KU and R) separately in three different questions.

The descriptive words that the subjects used to describe their Kansei about their cars in the lifecycle stages are summarized into Kansei items through the KJ Method. The Kansei items based on the subjects’ responses are processed by using QT3. To identify an appropriate grouping of the Kansei items and a grouping of the subjects based on their Kansei about their car in its three lifecycle stages, the spatial data in X, Y and Z dimensions derived from QT3 are then processed by using cluster analysis. This number of axes has been decided on the basis of the resulting Eigen values which were more than 0.500. Inputting the X, Y and Z dimensions separately into the cluster analysis for each set of the output spatial data relevant to the Kansei items or the subjects, two different clustering algorithms are outputted and used to more precisely draw the groupings, directions and trends. Using the axis dimensions, all of the subjects’ Kansei statuses in the three lifecycle stages of their cars are put into three-dimensional spaces.

The various patterns of the subjects’ Kansei evolution are then extracted from the resulting groupings of subjects’ Kansei statuses in each lifecycle stage. The patterns are sorted based on their similarity in the R stage or their eventual Kansei status and, accordingly, their major trends are drawn. Here, the positive, negative or affective-plaintive nature of the eventual Kansei status of the patterns is considered the indicator of their association with PSJS/ un-sustainability. Finally, the patterns and their trends are compared between the Iranian and Japanese subjects’ responses.

3. Results

3.1. Lifetime and Replacement

The general results of investigating the Japanese and Iranian subjects regarding car replacement are as follows. Japanese and Iranian subjects have averagely used 4.9 and 5.6 previous cars over the past 23.6 and 20.3 years, respectively. The average lifetimes of the cars used by the Japanese and Iranian subjects are, respectively, 5.2 and 4.7 years. Among the Japanese subjects, 93% are satisfied with their current car and like it as well. But, just 70% of the Iranian subjects are satisfied with their current car whereas 77% of them like it. For easy comparison, the histogram of relative frequencies of Japanese and Iranian subjects’ car lifetimes is shown in Figure 1.

3.2. Resulting Kansei Items Groupings

In total, 430 Japanese Kansei keywords (including 135 for the P stage, 163 for the KU stage and 132 for the R stage) and 398 Persian keywords (including 125 for the P stage, 104 for the KU stage and 169 for the R stage) were derived from subjects’ responses regarding their Kansei about their car in its different lifecycle stages. These two groups of keywords were separately summarized into 47 and 44 Kansei items or descriptive keywords through the KJ method. The Japanese and Iranian subjects’ responses
about their *Kansei* regarding all three lifecycle stages of their cars were adapted to these 47 and 44 *Kansei* items, respectively, and processed by using QT3 and cluster analysis. The overall output distributions of the *Kansei* items describing the car’s lifecycle stages for each country’s subjects are shown as X-Y and X-Z graphs in Figures 2 and 3.

The chosen cut-off lines for the clustering algorithms have yielded seven clusters, which are marked from Cv1 to Cv7, in the X-Y graph and seven clusters, which are marked from Gv1 to Gv7, in the X-Z graph representing the Japanese subjects (Fig. 2). The cut-off lines yielded six clusters, which are marked from Cc1 to Cc6, in the X-Y graph and five clusters, which are marked from Ge1 to Ge5, in the X-Z graph representing the Iranian subjects (Fig. 3). These choices of cut-off lines were carefully made to arrive at the most meaningful groupings to understand the relationship between various *Kansei* items. To differentiate among the lifecycle stages (P, KU or R) that each item associates, different point shapes and gray levels have been used in the graphs. These suggested associations were decided based on the high frequencies of each item in the lifecycle stages. The *Kansei* items and the clusters they belong to in the X-Y and X-Z graphs derived from the Japanese and Iranian subjects’ responses are, respectively, presented in Figures 2 and 3.

In the graphs relevant to the Japanese subjects (Fig. 2), the three axes of X, Y and Z are, respectively, named ‘Active Emotion – Passive Affectation’ (AcE – PAf), ‘Satisfaction – Dissatisfaction’ and ‘Rational/Dissociation – Emotional/Association’ (Rat/Ds – Emo/As). The clusters Cv1 to Cv7 can be characterized, respectively, as follows: Lively Pleased, Lonely Grateful, Valid Object, Attached, Foreign, Displeasing and Trouble. Similarly, clusters Gv1 to Gv7 can be characterized, respectively, as follows: Attached, Affected, Valid, Practical Relation, Concerned, Joy/Fresh and Sorrowful Parting. As can be seen, the items having more association with the lifecycle stages of P and R are located, respectively, on the left and right sides of the graphs.

In the graphs relevant to the Iranian subjects (Fig. 3), the three axes of X, Y and Z are, respectively, named ‘Passive Affectation – Active Emotion’, ‘Pleasant – Unpleasant’ and ‘Emotional/Association – Rational/
Dissociation’. The clusters Cc1 to Cc6 can be characterized, respectively, as follows: Attached/Parted, Careful, Distressed, Joy/Fresh, Efficient and Disquiet. The clusters Gc1 to Gc5 are also named: Attachment, Detachment, Concern, Gratification and Bother. Oppositely, the items having more association with the lifecycle stages of P and R are located, respectively, on the right and left sides of the graphs. All of the above given names were chosen based on the context and distribution of the Kansai items in the graphs.

3.3. Evolution of Subjects’ Kansai Statuses

To delineate the subjects’ Kansai statuses about their car during its P, KU and R lifecycle stages, plots of the response distributions for the Japanese and Iranian subjects along the X-Y and X-Z axes are shown in Figures 4 and 5. The cut-off lines, which were chosen intentionally to promote clustering within the resulting X-Y and X-Z dimensions, have yielded six clusters marked from AV to Fv and five clusters marked from Gv to Kv in the graphs relevant to Japanese subjects and five clusters marked from Ac to Ec and five clusters marked from Fc to Jc in the graphs relevant to Iranian subjects.

According to the Kansai items given by a majority of the subjects belonging to each cluster, we have assigned names to the clusters to express each cluster’s exceptional characteristic. Regarding the graphs relevant to Japanese subjects (Fig 4), the names of clusters Av to Fv are as follows: Attached, Lonely Grateful, Lively Satisfied, Pleasant Valid, Displeased and Concerned. Clusters Gv to Kv are named as follows: Appreciated Utility, Satisfying Utility, Lively Valid, Affective Relation (Attachment) and Sorrowful Parting/Appreciation. Regarding the graphs relevant to Iranian subjects (Fig 5), the names of clusters Ac to Ec are as follows: Joy/Fresh, Efficient, Attached/Parted, Detached and Disquiet. Clusters Fc to Jc are named as follows: Gratification, Concerned, Attached/Parted, Disliked and Bored.

In these graphs, each point represents a subject’s Kansai status in each of the three lifecycle stages, which are discernible by three different shapes and gray levels in the graphs. The resulting clusters indicate each subject’s Kansai statuses for the three lifecycle stages of his/her car.

To distinguish among the various type of the evolution of subjects’ Kansai statuses during the three lifecycle stages of
their cars, the clusters to which each subject belongs in each lifecycle stage are used as indicators to sort the subjects into various types. As each subject’s Kansei status through the three lifecycle stages is quantifiably represented by three points specified by the X, Y and Z dimensions, the Japanese and Iranian subjects’ Kansei evolution during the lifecycle stages of their cars could be identified by which X-Y and X-Z clusters they belonged to in each stage.

4. Implication and Discussion

4.1. Contextual Differences

From the social, market, service and product points of view, Iran and Japan have two quite different contexts with regard to passenger cars. Japan is a developed and modernized country with an aged society highly respecting the Japanese customs and traditions, whereas Iran is a developing country with a young society transitioning from traditionalism to modernism. Japan has a highly competitive market especially regarding passenger cars. “The Japanese automotive industry is one of the most prominent industries in the world. Japan was the world’s largest vehicle manufacturer in 2008” [4]. The variety of the qualified cars available in the market of Japan is huge. Iran’s automotive industry is the second most active industry of the country [5]. Today, Iran is also the largest automaker in the Middle-East [6]. However, due to the limitation for importing car to Iran and the huge taxation for this, the market of car in Iran is not fully competitive. As the price of a good and qualified car (like Benz, BMW, Toyota, Mazda, Honda, etc.) in Iran is so higher than its real price in the international market, the majority of Iranians have to just use the domestic cars produced by the Iranian automakers. There are 13 Iranian automakers which are in joint venture with several popular international automakers such as Peugeot, Citroen (France), Volkswagen (Germany), Nissan (Japan), Toyota (Japan), Kia Motors (South Korea), Proton (Malaysia), Chery (China). Two of these - Iran Khodro and Saipa - accounted for more than 90% of the total domestic vehicle production [6]. These two automakers’ new model cars have no tangible differences with their old models. Accordingly, most of the cars moving in the Iran’s roads and cities look similar and not so integrated. Nevertheless, a variety of automotive brands are being presently imported into Iran including Toyota, BMW, Mercedes Benz (these three being the expensive and/or luxury brands), Rover, Ssangyong, Audi, Subaru, Volkswagen and Renault Leon [6].
4.2. Structure of Kansei Items

Among the Kansei items derived from the Japanese and Iranian subjects’ responses, just 19 items are in some way similar while more than half of them are not so. This point emphasizes the large effect of socio-cultural and linguistic context on the users’ Kansei about a product and the words that subjects responded with in this regard. As the distribution graphs of the Kansei items (Figures 2 and 3) show, the main axis (X) direction’s relevance to the Japanese and Iranian subjects, which generally identifies the biggest reciprocal trend of the items derived from each context, is the same reversely. In both contexts, however, the Kansei items having ‘Active Emotion’ nature most strongly associate with the stage of P, the first stage of use, while those having ‘Passive Affection’ nature are most associated with the stage of R, the end stage of use.

The relative frequencies of positive, negative and affective-plaintive Kansei items derived from the Japanese and Iranian subjects’ responses both in total and in each lifecycle stage were compared and shown in two pie graphs and histograms in Figure 6. The majority of the responses in both contexts are positive Kansei. However, the Iranian subjects responded with more negative and affective-plaintive Kansei items than the Japanese subjects did. In both contexts, the histograms show that the relative frequencies of affective-plaintive Kansei items drastically increased and positive Kansei items decreased over the lifecycle stages from P to R. Nevertheless, in responses from Japanese subjects the relative frequency of negative Kansei items decreased during the lifecycle stages, but this trend was reversed in Iranian responses.

4.3. Building Models of Kansei Evolution

The distributions and groupings of the subject’s Kansei statuses during the lifecycle stages of their cars are visually summarized into two diagrams (Figures 7 and 9), which are to be used as reference models for the subjects’ Kansei evolutions. As there is a symmetric similarity between the axes directions in the distribution graphs derived from the Japanese and Iranian subjects’ responses, they are adapted to be in the same order in the diagrams to be more easily comparable. On the basis of the similarity of the clusters belonging to the various type of the evolution of subjects’ Kansei statuses during the three lifecycle stages of their cars mainly in the R and secondarily in the KU stages, namely, the eventuation of their Kansei evolutions, they are set into six main patterns with regard to each country’s subjects. Accordingly, all of the resulting patterns can be identified by which clusters belong to them in the R stage. The gray part of the scaled arrow located below each stage in the diagrammed patterns (Figures 8 and 10) is there to indicate the position of the ongoing clusters in that stage on the ‘Passive Affection - Active Emotion’ direction. The frequency of the subjects reposing in each pattern is also shown by the small lines in the right side of the diagram relevant to the pattern.

4.4. Patterns of Japanese Subjects’ Kansei Evolution

The resulting patterns of Japanese subjects’ Kansei evolution during the lifecycle of their cars are marked from i to vi in and shown Figure 8. ‘Pattern i’ is identified by clusters Av (Attached) and Hv (Satisfying Utility) and hence is called “Satisfying Attachment”. ‘Pattern ii’ is identified by clusters Av and Gv (Appreciated Utility) and is
Figure 7. The reference model for Japanese subjects' Kansei evolution during the three lifecycle stages of their cars

Figure 8. The patterns of Japanese subjects' Kansei evolution marked from i to vi characterized, respectively, as “Satisfying Attachment”, “Appreciative Attachment”, “Affective Attachment”, “Lonely and Gratefully Parting”, “Enduring Pleasure” and “Utility Concerns Lowering Attachment”

called “Appreciative Attachment”. ‘Pattern iii’ is identified by clusters $A_v$ and $J_v$ (Affective Relation) and is called “Affective Attachment”. ‘Pattern iv’ is identified by clusters $B_v$ (Lonely Grateful) and $G_v$ or $K_v$ (Affective Relation) and is called “Lonely and Gratefully Parting”. ‘Pattern v’ is identified by clusters $D_v$ (Pleasant Valid) and $G_v$, $H_v$ or $I_v$ (Lively Valid) and is called “Enduring Pleasure”. ‘Pattern vi’ is identified by clusters $F_v$ (Concerned) and $G_v$ and is called “Utility Concerns Lowering Attachment”. 

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Figure 9. The reference model for Iranian subjects' Kansai evolution during the three lifecycle stages of their cars.

Figure 10. The patterns of Iranian subjects' Kansai evolution marked from i to vi characterized, respectively, as "Gratifying Attachment while Parting", "Enjoyably Parting", "Strong Attachment while Parting", "Ultimate Attachment when Parting", "Low Attachment while Disliking & Parting" and "Disliking while being Detached".

4.5. Patterns of Iranian Subjects' Kansai Evolution

The resulting patterns of Iranian subjects' Kansai evolution are also marked from i to vi and shown in Figure 10. 'Pattern i' is identified by clusters Ce (Attached/Parted) and He (Gratification) or Fe (Attached/Parted) and hence is called "Gratifying Attachment while Parting". 'Pattern ii' is identified by clusters Ac (Joy/Fresh) and Fe and is called "Enjoyably Parting". 'Pattern iii' is identified by clusters Cc and He in both R and KU stages and hence is called "Strong Attachment while Parting". 'Pattern iv' is identified by clusters Cc and He in the R stage and Ac, Bc (Efficient) or Fe in the KU stage and hence is called "Ultimate Attachment when Parting". 'Pattern v' is identified by clusters Cc and Ic (Disliked) and is called "Low Attachment while Disliking & Parting". 'Pattern vi' is identified by clusters Dc (Detached) and Ic and is called "Disliking while
Figure 11. The relative frequencies of the patterns of Kansei evolution extracted from Japanese and Iranian subjects’ responses

being Detached”.

4.6. Comparing the Trends of PSJS of Car between Japan and Iran

To easily compare the most ongoing patterns of the subjects’ Kansei evolution between Japan and Iran, all of the resulting patterns regarding each country are sorted on the basis of their relative frequencies and shown into a bar graph (Figure 11). As can be seen in Figure 11, the most ongoing patterns, respectively, are “Appreciative Attachment”, “Enduring Pleasure” and “Lonely and Gratefully Parting” (in Japan) and “Gratifying Attachment while Parting” and “Strong Attachment while Parting” (in Iran). All of these ongoing patterns are concerned with a degree of PSJS. Accordingly; attachment is the most effective trend of PSJS although it is not the one; since “Enduring Pleasure” absolutely and “Lonely and Gratefully Parting” nearly look different from attachment. With regard to the patterns extracted from the Japanese subjects’ responses, there are three kinds of attachment implying a clear demarcation between various kinds of enduring relationships, which can be satisfyingly, appreciatively and/or affectively connections between a user and his/her car and the consequent attachments in Japan. But, in the patterns extracted from Iranian subjects’ responses, there are just two kinds of attachment characterized as: gratifying or satisfying; and general which has appeared into three different levels: strong, ultimate and low. Whereas “Gratifying (or satisfying) Attachment while Parting” has the highest relative frequency in Iran, the same pattern has conversely the lowest relative frequency in Japan. In both countries, the patterns indicating the lack of PSJS have the lowest relative frequencies. In Japan, only “Utility Concerns Lowering Attachment” may potentially demote PSJS. But, in Iran, three patterns – including “Disliking while being Detached”, “Low Attachment while Disliking & Parting” and “Enjoyably Parting” – are concerned with the lack of PSJS. The points we mentioned above reemphasize the large effect of context on PSJS.

5. Conclusions

The psychological lifetime of private passenger car in Japan is longer than that in Iran. Considering the high price of the qualified cars in Iran, the majority of the residents just afford to use the Iranian domestic cars which not so integrated. In both countries PSJS is dominant in terms of using such an approximately long-lived product as passenger car. Gratifying or satisfying attachment is the most common trend of PSJS of car in Iran while being conversely the most uncommon in Japan. User-product attachment is the most ongoing trend of PSJS and has different kinds and/or levels in both countries’ contexts. In Japan, there is a clear demarcation between satisfyingly, appreciatively and affectively attachments in terms a user’s relationship with his/her car. But, in Iran, in addition to gratifying or satisfying attachment, generally, attachment may appear into the levels of strong, ultimate and low. However, attachment is not the only trend in this regard, as there are two other trends in PSJS of car in Japan, “Enduring Pleasure” and “Lonely and Gratefully Parting”, being different from attachment. The lack of PSJS has different trends in Iran (characterized into the patterns of “Disliking while being Detached”, “Low Attachment while Disliking & Parting” and “Enjoyably Parting”), whereas there is just one pattern denoting PSJS of car in Japan.

Overall, the positive and affective-plaintive Kansei items could associate with extensions of a product’s subjective lifetime while the negative items might associate with shortening such a lifetime. To extend the subjective lifetime of car and to promote PSJS in each country’s car market, the above-mentioned trends of PSJS should be
considered carefully and the appropriate design solutions for each trend should be applied. As for the general impact of this research, trends in PSJS/un-sustainability such as those we have uncovered can be effective to develop guidelines for product lifetime management from the viewpoint of Kansei Engineering. In order to develop such design guidelines, our future work will focus on the design elements/factors associating with each of the patterns of users’ Kansei evolution or trends of PSJS.

Acknowledgements
This article is the outcome of research supported by the Japan Society for the Promotion of Science (JSPS) through a Postdoctoral Fellowship for Foreign Researchers and a Grant-in-Aid (2009-2011).

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