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Item Response Theory Approach to Kansei Design：

Basic Concept

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Abstract: This paper points out that Kansei Design needs a good match between the customer and the producer. Recently, in the field of educational testing, Item Response Theory is drawing attention. In classical test theory, tests were given to examinees without considering any individual characteristics. The same tests were given to all examinees. But everybody knows that we have strong points and weak points. Some are good at sports. Others are good at arts. If a test is about sports, then those who are good or who like sports make a good score. And the score will be better, if the examiner likes sports. Now, it is found out that if an examiner and an examinee have more in common, then the examinee makes a better score. This is considered to be because an examinee understands the question better. And the examinees are more motivated and their scores keep going up question after question.

Many people emphasize the importance of considering personalities of customers in Kansei Design. But very few discuss how it is important to find a good match of Kansei between the customer and the designer. If their intersection is small, the product would not appeal to the customer. A designer should know who will be his or her customer and should make efforts to increase the size of intersection. It would not work if they do not share intersection at all or would not work effectively if the intersection is small.

Keywords: Kansei Design, Intersection, Matching, Item Response Theory, Lifetime Value.

1. LEVELS AND TRAITS

1.1. European Kansei and Japanese Kansei

Kansei Engineering is very different between Japan and Europe. In Japan, when they talk about Kansei, it is about the levels in most discussions. They believe that if the level of Kansei is high, then a product is very personalized and appealing. And customers are thought to be not so much

creative and active. Most of them seem to regard customers as passive consumers. Japanese designers seem to think that If he or she can provide their customers with a product with a high level of Kansei, it will satisfy customers.

In other words, Japanese regard Kansei more in a framework of extrinsic motivation. Europeans, on the other hand, regard Kansei, more in a framework of intrinsic motivation. They seem to be more interested in how they can motive their customers from within.

1.2. Item Response Theory (IRT) and Classical Test Theory (CTT)

In this sense, the difference between European Kansei and Japanese Kansei may be compared to Item Response Theory (IRT) and Classical Test Theory (CTT) [Wikipedia, November 22, 2013]. What differentiates IRT from CTT is best explained if we know another name for IRT is Latent Trait Theory. IRT assumes there are latent traits in every examinee so that there should be a test best fit to measure abilities, attitudes and/or other variables of an examinee.

If an examinee is good at sports, he or she would respond very well to the questions about sports. And if an examiner is good at sports so that a examinee and examiner share common interests, then the examinee's latent traits would show up more clearly.

1.3. Static Kansei and Dynamic Kansei

In other words, Japanese Kansei researches focus more on Kansei at present and how they can measure with higher accuracy the levels of preferences or what Kansei pattern a customer has. In short, Japanese discuss more in the static sense. European Kansei researches, however, focus more on how customer's Kansei can be developed. In short, they are more interested in dynamic Kansei. This may be understood better if we recall the word Emotion has strong relation with the French word "emouvoir" or to stir up, although Emotion and Kansei are not identical. But they have a lot in common.

This is author's very personal impression about Japanese Kansei and European Kansei researches. There may be Japanese researchers who are pursuing dynamic Kansei or European researches pursuing static Kansei. What the author would like to insist here is not the difference between two areas, but we should distinguish these two approaches and we should move more toward dynamic Kansei, since our world is changing very frequently and extensively.

1.4. Kansei and Emotion

Japanese developed many excellent approaches to measure static Kansei. So if it comes to static Kansei, we can utilize them in many applications. But our environments and situations change very often and very extensively, so our preferences change accordingly. This will be best described if we use Emotion instead of Kansei. As described above, the word "Emotion" has a strong relation with the French word "emouvoir" or "stir up", but if we know it comes originally from the Latin word "e=ex=out" and "movere=move", it literally means "to move out" and in addition, the words motivation and motive come from the same Latin word. Thus, making decisions on which direction to go or whether to go further is crucial in emotional engineering (Fukuda, 2011, 2013). Motivation-Action-Emotion constitutes a cycle as shown in Figure 1.

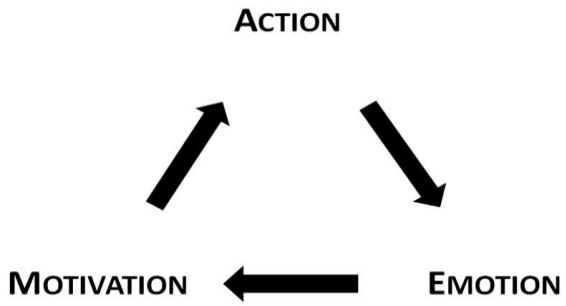

Figure 1: Motivation-Action-Emotion

1.5. Importance of Process

IRT is also called “Computerized Adaptive Testing”. The word “adaptive” means how a test can adapt to the change of an examinee because his or her abilities, attitudes and/or other variables change in response to the changing environments and situations. So IRT may be interpreted as a testing approach focused not on the outcomes or the final results but on the processes. If an examinee has a very good adaptability or large room for growth, he or she would develop his or her abilities to a great extent, no matter how the situations may change. But if his or her adaptability or room for growth is low, then even if his or her scores are good in the present situation, he or she cannot show that high level when the environments or situations change.

1.6. Adaptability of a Product and Marketing

The evaluation of customer adaptability is very important in marketing. If a customer is very much adaptive, we can develop many different products and a customer would accept them as a good product, because he or she maintains high level of Kansei feeling, no matter what new or unexpected products come up.

But if a customer’s adaptability is low, a new or unexpected product would not appeal to him or her. It would be better to develop his or her attachment more and turn them into a lifetime customer. To describe this in other words, we can employ a disruptive innovation approach to adaptive customers, but we have to apply a sustaining innovation approach to not-adaptive ones.

In the latter case, Japanese approach will be very much effective. They focus on fixed traits and makes efforts to bring these dimensions to the higher level. To achieve this goal, an open loop system will work. But to achieve dynamically adaptive Kansei, we have to change our system into a closed loop system so that we can keep track of how our customer’s Kansei is changing (Figure 2)

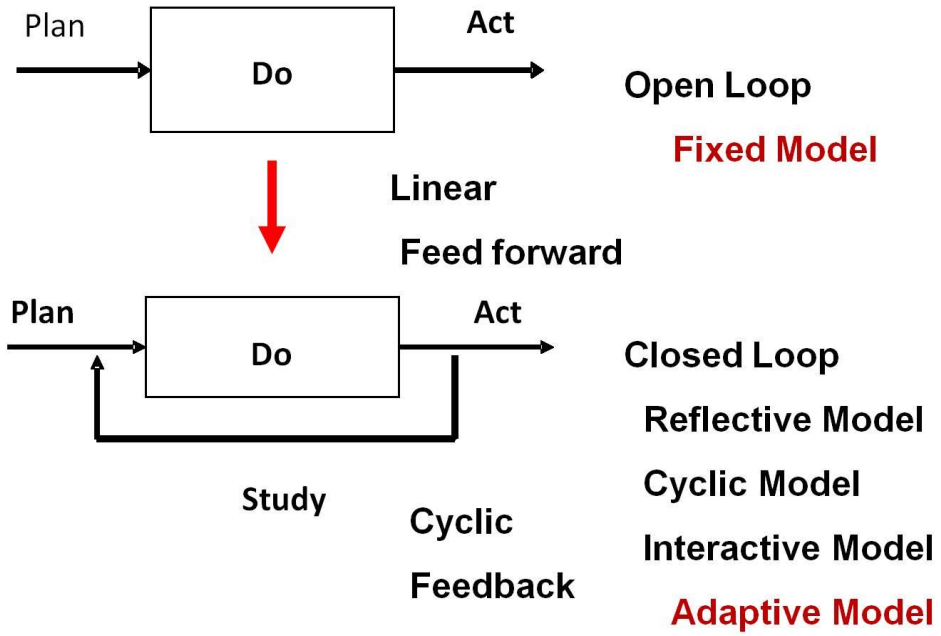

Figure 2: Open Loop and Closed Loop System

2. DYNAMIC KANSEI AND PRODUCT DEVELOPMENT

2.1. How We Can Make Adaptive Kansei Design Easier

Although it sounds very appealing that if we can prepare very adaptive Kansei products and if we carry out a very excellent design, the problem is if we change our product design very often, it will bring about many issues in production. Manufacturing equipments must also be changed every time in response to a new design. Then, how can we solve this problem?

2.2. Trucks

A design and production in truck industry gives us a solution. In the case of trucks, they have to carry many different kinds of loads so their load carrying bodies vary from truck to truck, although their chassis are common. So in fact, truck manufacturing companies are separated into two groups. One group produces just load carrying bodies. The other group produces common chassis. And they assemble them together. Thus, they can produce different kinds of trucks to respond to many different needs (Figure 3)

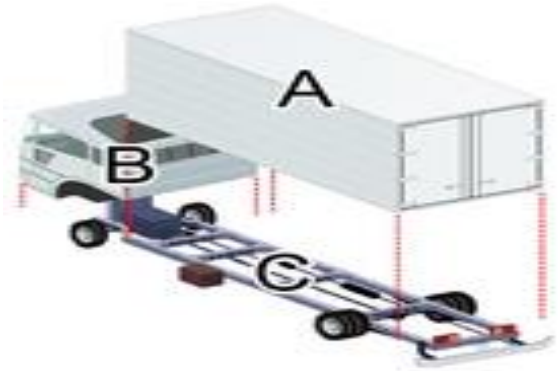

Figure 3: Truck design

2.3. Wedding Dresses

Interestingly enough, same idea can be observed in wedding dress design. Ladies would like to wear a wedding dress just for her alone. But not every lady is so rich that she can order a wedding dress just for her. Most of them have no other choice than to rent a wedding dress. But they insist that the dress should be just for her.

So wedding dress designer for rental companies observe where ladies are focusing their attention during the show, etc by using such technologies as eye tracking, etc. And they change only these eye-catching or Kansei-intensive parts and let the other parts be common. Thus, they can mass customize and personalize their wedding dresses. Thus such modularization brings happiness to ladies and to wedding dress companies.

2.4. One Time Based Modularization

Such strategy of modularization based on where we focus our Kansei attention can make products adaptable to many different Kansei needs and what is better is that we can easily update such parts to accommodate the changing expectations. Of course, our customers' preferences may change over time and their focus part of Kansei attention might change. But these changes are slow and do not change so quickly.

It may be understood better if we recall ladies change such small ornaments as earrings, etc very often to adapt to the daily needs or preferences, but they do not change their dresses so often. So if we separate parts whose Kansei attractions change very slowly from those which change quickly, we could make our Kansei design more flexible and make production much easier.

3. ATTACHMENT AND PRODUCT DEVELOPMENT

3.1. One Time Value and Lifetime Value

Although this is also time-related issue, attachment is another problem. The issue discussed above is how we can flexibly adapt to the change of Kansei expectations from our customers. This is a one time value. How we can design and produce a product which will appeal to customers whose Kansei requirements change frequently was the issue. Modularization is one of the

solutions to how we can make our products flexible and adaptive enough to accommodate such changes. The basic idea here is how we can make our product most appealing at the time of sale.

3.2. Feeling of Best Fit

Another time-related issue is attachment. It is the problem of how we can extend the duration of Kansei appeal.

Let us take shoes for example. We feel happy and enjoy walking, when we feel they come to fit us best. We would like to wear these best fitting shoes as long as possible. But these best fit conditions are not designed at first. The initial functions does not necessarily realize the best fit. But after using some time, they come to fit us better and better or in other words, they adapt to our needs and preferences. Then we are more and more attached to them.

But the current Kansei design is focused more on a one time value and it does not consider too much about this problem of attachment. How we can keep the condition of best fit as long as possible and keep the feeling of attachment growing?

3.3. Lifetime Based Modularization

Modularization again will give a solution to this problem. The part which gives such a feeling of best fit can be identified by using rapidly progressing sensor technology. ASICS (Moriyasu. 2013), for example, is one of the companies which demonstrate the usefulness of this approach. They developed many shoes for sports, jogging and walking.

What should be stressed is that this problem of attachment is not so well discussed, but from the standpoint of marketing, we can secure a lifetime customer and we do not have to worry too much about diversification and frequent or short term changes. As attachment is a long term issue, we can pay attention to selected parts and make efforts to keep them in their best fit conditions as long as possible.

3.4. IRT Approach

IRT approach is effective in this point. Such an approach will ferret out how their expectations or attachment will develop. Unlike CTT, IRT pays attention to how a test adapt to the changes of an examinee with respect to noticed dimensions. Although IRT techniques may not be directly applicable to this issue, because IRT was developed originally for educational testing, the basic idea of IRT is very much useful and effective in dealing with the problem of keeping the best fit conditions. This problem is very much associated with room for growth.

4. Matching between Designer and Customer

The above discussion does not touch upon the issue of matching between a designer and a customer. IRT is unique in that although CTT does not consider matching between an examiner and an examinee, IRT does. CTT assumes that the level of examinee can be evaluated by tests and these tests can be prepared by any examiner, if he or she has knowledge. It only considers the level of knowledge of an examiner and does not question what pattern or dimensions an examiner has.

But Some examiners may know mathematics well. Some others may know literature well. If an examinee likes or excels in mathematics, he might get better scores from the tests given by mathematics loving examiner. Thus, a mathematics loving examiner would stimulate a mathematics loving examinee's room for growth so that he or she accelerates the examinee's growth or brings about larger growth.

Why IRT is also called "Computerized Adaptive Testing" is because a computer adapts to the traits of an examinee and gives him or her the questions best fitted to him or her, which would bring out the latent traits to evaluate how much rooms of growth there are in his or her abilities and in which dimensions. Thus a computer adapts to an examinee so that it and an examinee have most in common.

There is very few, if any, discussion about the matching of a designer and a customer. This IRT approach teaches us that we should consider more about their matching. We should try to find out not only what Kansei dimensions a customer has, but also what Kansei dimensions a designer has and what dimensions he or she can develop.

It is the problem of increasing the intersection of Kansei between a customer and a designer as shown in Figure 4.

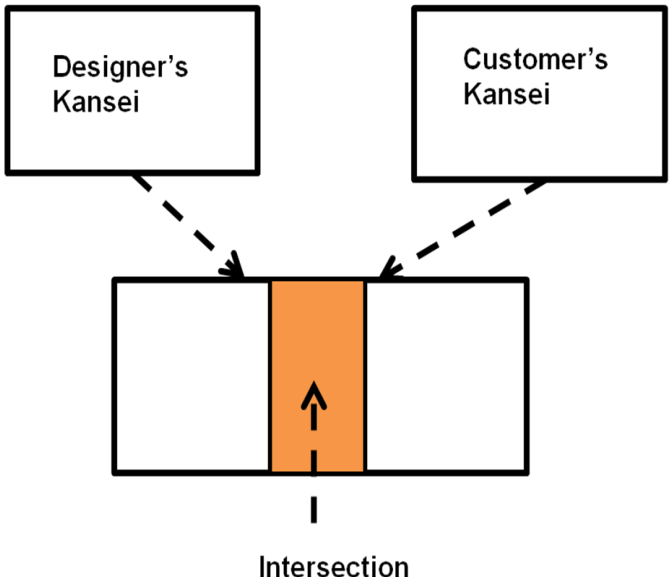

Figure 4: Kansei interaction between designer and customer

5. CONCLUDING SUMMARY

This paper describes how important it is to pay attention to dynamic aspects of Kansei and to try to establish a better match between a designer and a customer in their Kansei dimensions.

In this connection, IRT (Item Response Theory) in testing provides us with a very useful concept and it is expected that it will be a good tool for Kansei design, too. As it is originally developed for educational testing, small alterations may be needed.

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BIOGRAPHY

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