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Predicting Purchase Intent Using Pragmatic and Hedonic Kansei Engineering Scales

A Case Study of Kitchen Equipment in China

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Abstract: A Chinese premium kitchen equipment manufacturer was interested in knowing what their consumers liked about their product, and how they could use this to strengthen their market position. They wanted a set of repeatable scales that could be used to both evaluate their own products for future development and to benchmark competitors for sales predictions. To be successful, kitchen equipment should function perfectly, be easy to use and have emotional attributes that appeal to consumers. Kansei Engineering methods have previously been used to support the development of scales to improve the emotional response to such products. However within the Kitchen Equipment industry, there is rarely the time or resource available to implement a full and comprehensive Kansei Engineering analysis within a new product development process. We used a simplified Kansei Engineering process with two notable differences. To develop a set of useful scales we used a mix of hedonic and pragmatic adjectives and we used Kano analysis as a means to systematically reduce the number of adjectives. A factor analysis found four Kansei factors and scales were developed to measure them. The major factor was a Hedonic Scale. The next three factors measured more pragmatic attributes and specifically were: User Interface Quality, Smoke

Extraction Quality and Ease of Cleaning. The four factors contributed to 70% of the variance. These factors can be used by the company as repeatable measurement scales to both evaluate their own products for future development and to benchmark competitors for sales predictions.

Keywords: Kansei Engineering, Kano Analysis, Kitchen Equipment, AttrakDiff.

1. INTRODUCTION

To be successful in the marketplace, products must not only function correctly, and be easy to use, they need to have emotional attributes that appeal to the target buyers. This is increasingly important in today's consumer driven society but yet very difficult to develop. Many tools and techniques have been proposed as approaches that can systematically design successful consumer products such as QFD (Hauser & Clausing, 1988), robust design (Taguchi, 1987) and Kansei Engineering.

Kansei Engineering is an approach that successfully matches user perceptions against the physical features of a set of products but has been criticized as being very labour intensive. Thus a simplified Kansei Engineering process has been proposed (Barnes et al, 2008) to streamline the method and make it more suitable for implementation within an industrial context. But it still has problems and so researchers have looked at combining different tools together to create a more comprehensive methodology. Kano analysis has been suggested (Hartono & Chuan, 2011) as a tool to combine with Kansei Engineering to better understand the product attributes that are really important to the consumer.

This paper presents a case study in collaboration with a kitchen equipment manufacturer in China. Kitchen equipment is no different from any other consumer product. To be successful the products must meet the requirements of operation, and look pleasing within a domestic setting. Consumers choose their equipment based on both performance and aesthetics and therefore make this sector a good example of how Kano and Kansei Engineering can combine to predict sales performance. However, the company was also interested in knowing how they could improve these consumer attributes to strengthen their market position. They wanted the research to deliver a set of repeatable scales that could be used to both evaluate their own products for future development and to benchmark competitors for sales predictions. Thus the paper also shows how the study supported the development of a set of repeatable scales for implementation within the company's new product development process to enhance the design of future innovative products.

2. EXTENDING KANSEI ENGINEERING

Kansei Engineering in its many forms has long been used to successfully match user perceptions against the physical features of a set of products (Nagamachi, 1995). Over the last twenty years there have been many approaches and applications of Kansei Engineering to many different types of products such as work vehicles (Schutte & Ekland, 2005), gardens (Matsubara et al, 2011) and packaging (Henson et al, 2006).

However, it has been noted that to fully apply Kansei Engineering is a very resource intensive and time-consuming activity (Barnes et al, 2008). This makes it difficult for it to be widely adopted in industry, particularly for those sectors that do have long product development cycles. Thus some researchers have attempted to simplify the approach to make it more credible and easier to use in industry situations. One of these approaches was the development of a Kansei Engineering Toolkit targeted primarily at the consumer packaged goods industry, see Figure 1, (for a detailed description see Barnes et al, 2008). This approach has its roots in firmly in Kansei Engineering (Nagamachi

1995), which supports the definition of the relationship between product physical properties and consumers' response. However the toolkit further introduces a number of enhancements and simplifications to the more traditional Kansei Engineering approach to make it map onto typical new product development processes in use in industry. The changes that the toolkit proposed were:

- The type 1 'highest level Kansei' is replaced by brand values to ensure that any concept evaluations will be congruent with the brand personality.
- There are structured processes for a) the elicitation of physical properties and b) the selection of the Kansei words to improve robustness and repeatability.
- The semantic differential survey to elicit user perceptions has been reduced in complexity to bring it in line with industry requirements.

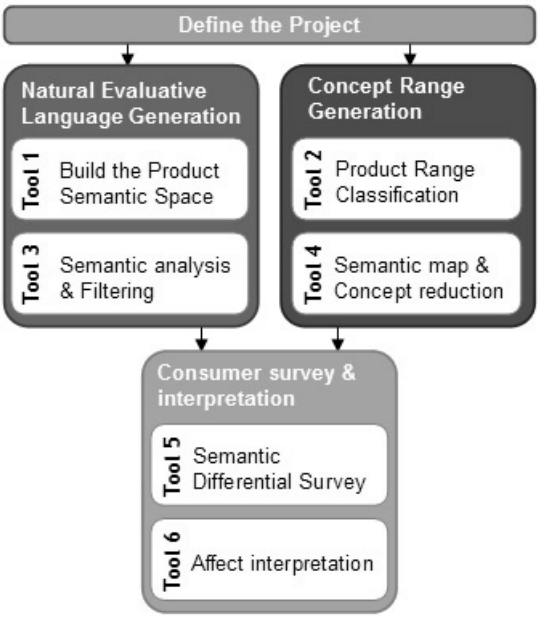

Figure 1: Kansei Engineering Toolkit (Taken from Barnes et al, 2008)

The study being presented in this paper is based in the home appliances (kitchen equipment) sector and not consumer packaging. Thus the applicability of the Kansei Engineering toolkit needs to be understood and so looked at mapping the similarities between the two industries. Both the home appliances market and the consumer packaged goods sector have relatively short product development cycles when compared to other industries such as automotive. In addition, in both sectors the brand of the product is very important and influential in the purchase decision. The products in both sectors are sold direct to the consumer usually through a third party retail outlet or online. Finally, the functionality of the product and the aesthetics of feature play a significant role in product selection. This is true for both kitchen equipment and packaging. Thus we can conclude that, even though the Kansei Engineering Toolkit had been primarily developed for use within the consumer packaged goods sector, there are many similarities with the home appliance market. The comparable relationship between the product and the consumer means that the Kansei Engineering Toolkit could also be suitable to help understand consumer perceptions of kitchen equipment and link them to the main product features and so will be used in this study.

2.1 Using Kano Analysis

The Theory of Attractive Quality (Kano et al, 1984) was developed to challenge the conventional perception of customer satisfaction. Previously to this, consumer satisfaction was seen to be a one-dimensional construct. That is the as the perceived quality increases so does the customer satisfaction, and vice versa. However Kano's work criticised this view and argued that there are 5 different types of product quality. These five different types of quality are described below and shown in Figure 2:

- **Attractive Quality** – these are the product features that consumers often find hard to describe but if they are present are significant contributors of consumer delight.
- **One-dimensional Quality** – the higher the quality of these product features, the more that the consumer will be satisfied.
- **Must-be Quality** - if this product feature is absent, the consumer is unlikely to purchase the product.
- **Indifferent Quality** - the consumer does not care about this product feature.
- **Reverse Quality** - the consumer wants the opposite to the product feature that is provided.

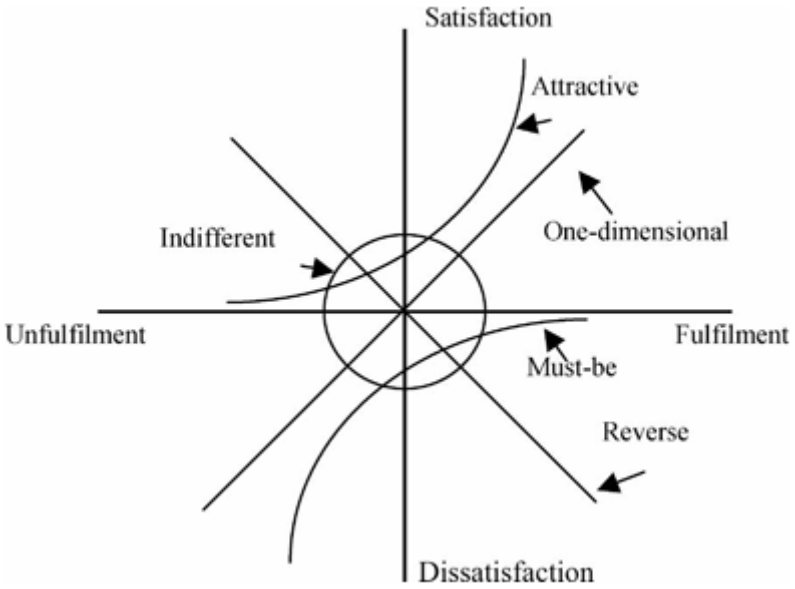

Figure 2: The Kano Model of Quality (taken from Berger et al, 1993)

The Kansei Engineering Toolkit described above includes processes for identifying the most significant adjectives from the long list generated (Tool 3: Semantic Analysis and Filtering) and a means of identifying and reducing the relevant product features (Tool 4: Semantic Map and Concept Reduction). However these are far from ideal. Tool 3 applies a set of sematic guidelines to find the right adjectives and then relies on the researcher's judgment to find the most suitable ones. Tool 4 requires the use of a sematic map and the repertory grid technique to identify the features observed by consumers and the features selected the most frequently are carried forward into the next stage. The method does not, however, allow for which features are of most interest to the consumer, or which contribute most (either consciously or unconsciously) to the purchase decision.

Using the Kano model to replace Tools 3 and 4 could overcome these issues. Kano models have been widely used in many different arenas (Löfgren & Witell, 2008) to provide a better view of how consumers evaluate a product and assists companies to focus on the most important attributes to improve. Previous studies have demonstrated that it is possible to categorize the product features

using Kano analysis within a Kansei Engineering study. (Hartono & Chuan, 2011), (Llinares & Page, 2011), (Lanzotti & Tarantino, 2007).

Thus, it is proposed that the study utilises the Kano Model to replace Tools 3 and 4. The method will mean that the consumers will provide the data to a) select the correct adjectival descriptors and b) the identification of the most relevant product features (Figure 3). Each adjective and feature will be classified as one of the five different Kano quality categories. It will be the one–dimensional and the attractive features and adjectives that will be carried forward into the semantic differential study. In this way this Kansei Engineering study will ensure that the most important aspects of the Kitchen equipment for the consumers are being analyzed.

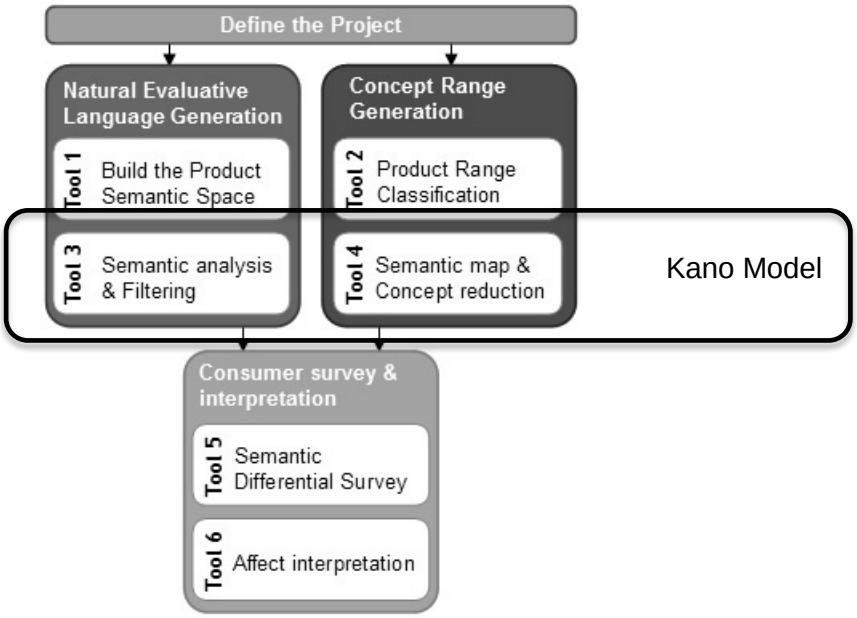

Figure 3: The Kano Model Integrated within the Kansei Engineering Toolkit

3. THE STUDY

This study developed a Kansei-based semantic differential scale and compared the results of using this scale and AttrakDiff to evaluate 10 range hoods (cooker exhaust hoods). A range hood is essential in a Chinese kitchen, where the high heat when frying generates large amounts of oil and smoke. Without it, kitchen surfaces become covered in oil. But effective range hoods can be noisy, and the large size of the hood can create an obstacle in the kitchen. And some customers in the study mentioned that appearance and fashion can be a higher priority than functionality.

This paper focuses on the Kansei results. The study took place in Shanghai, China, in conjunction with a Chinese manufacturer of range hoods in October 2015. This paper uses English translations of the scale items that were presented in Chinese (Liu and Bevan, 2016).

3.1 Method

Kansei Engineering is most often used to understand how to design products with attributes that will create positive emotions. In this case study the manufacturer wanted to understand the factors that influenced purchase decisions, so product function and interaction was also important. For this reason, we collected Kansei words relating to both hedonic and pragmatic aspects. The pragmatic words and phrases were not specific product features, but perceptions, such as: “high smoke-gathering efficiency” and “easy to clean”.

The Simplified Kansei Engineering method was applied in the following way:

1. **Identify the type of product and context of use to be evaluated**

   The manufacturer was interested in how customers made a purchase decision for range hoods in the showroom.

2. **Identify the types of customers to be recruited**

   Customers were recruited based on earning a minimum monthly income, an even distribution of age between 30 and 55, a male to female ratio of approximately 4:6, and have purchased a premium brand range hood in the last 2 years.

3. **Identify what information customers would have before making a purchase decision**

   10 customers were interviewed to find out where they obtained information about range hoods, and what information they would have before making a purchase decision. This information was provided in the evaluation session to better simulate the real-life showroom experience. They were also asked which physical features and functions were most important, to provide a basis for selecting a range of products for evaluation.

4. **Gather affective words and phrases**

   Hedonic and pragmatic words and phrases for use as potential Kansei scale items were obtained by reviewing online and printed marketing material (66 items) and from two customer focus groups in the simulated showroom environment that probed customers' affective response to range hoods (81 items). The most relevant 32 hedonic attributes and 34 pragmatic attributes were selected.

5. **Use Kano analysis to reduce the number of words and phrases**

   94 customers were invited to a simulated showroom environment where 10 range hoods with different features were displayed. After examining the range hoods, customers rated the relevance of the 66 hedonic and pragmatic words and phrases to range hoods, using the 5-point Kano scale, and also gave each one an importance rating. Kano analysis was used to select the 17 hedonic and 10 pragmatic words that had high scores for ”more is better” (one-dimensional quality) or ”surprise and delight” (attractive quality) and that were judged as important.

6. **Create a scale to evaluate the products**

   A semantic differential scale was created using the identified hedonic and pragmatic attributes and an additional five more specific sound and display effect attributes of concern to the manufacturer (Table 1).

Hedonic	Pragmatic
Well-integrated	Easy to dismantle
Looks fashionable	Practical and useful
Does everything it is supposed to do	High smoke-gathering efficiency
Compact: gives a feeling of space	Not troublesome
Well-coordinated	Health benefit
Very fine finish	High quality texture/material
Very stylish	Good for health
Smart and delicate	Outside surface easy to clean
Good looking	High suction
Looks high-end	Easy to clean
Unique design	Will extract all the smoke
Firm and reliable	**Sound and display effect**
Looks brand new	The noise of the hood is quiet and relaxing
High tech	The button sound is pleasant
Simple and clean design	The button light is a not dazzling
Humanized	The button light is a refreshing colour
Three dimensional appearance	The information displayed is clear

Table 1: Range hood evaluation scale items

7. Select 10 products for evaluation

The features that had been identified by customers as most important were used to create a product-feature matrix so that products with a representative distribution of features could be used for the evaluation. Each product was rated for the extent to which it possessed a feature (or one of two alternative characteristics) on a scale of 1 to 5. Figure 4 shows the ratings for the 10 most important features.

Feature / Product:	1	2	3	4	5	6	7	8	9	10
High fan power	1	2	2	2	3	4	4	5	5	5
Can clean without unscrewing	1	1	3	3	1	1	1	1	1	1
Dirt-catching joints	2	5	2	2	4	3	2	4	1	4
Large or small size hood	3	4	2	3	4	2	1	1	5	4
Post-sales cleaning service	5	1	5	5	5	1	1	1	5	1
Metal or paint finish	1	1	1	1	1	5	1	1	1	5
Side suction or top suction	3	1	2	3	1	2	3	3	1	1
Large or small suction hole	3	2	3	3	5	1	1	1	2	2
Uses paper lined oil cup	1	5	1	1	1	5	5	5	1	5
Central keypad or side keypad	1	1	1	1	1	5	1	1	5	1

Figure 4: Rating of the extent to which each product possesses each feature

Each of the 10 selected products was accompanied by a poster containing the information about the product that customers would typically have (Figures 5 and 6).

Figure 5: Example of a top suction range hood

Figure 6: Example of a side suction range hood

8. Customers use the scale to evaluate the products

Customers were recruited to evaluate the products in a showroom-like environment. Data was obtained from 113 customers who rated them in a counterbalanced order using the 32 scale items and a Chinese translation of AttrakDiff (Hassenzahl, 2001, 2003), as well as additional items, including their willingness to buy. One of the reasons for this large number of items was to provide a basis for comparing the Kansei and AttrakDiff data. This created rather long session times of up to 2 hours, so each customer was accompanied by a facilitator who inputted the data.

Valid data was obtained from 102 customers: 5 customers did not evaluate all the products, and the facilitators reported that 6 other customers were not taking the task seriously.

9. Factor analysis to identify the Kansei factors

The scale item and AttrakDiff data were factor analyzed (principal components with varimax rotation) to identify the Kansei and AttrakDiff factors. The most meaningful results were obtained with four Kansei factors and two AttrakDiff factors. The ratings for each product on each factor were calculated.

3.2 Results

From factor analysis of the Kansei ratings of 10 hoods by 102 people, the four factors shown in Table 2 were identified: a hedonic factor and pragmatic factors related to user interface quality, smoke extraction quality and ease of cleaning. They explained 70% of the variance: 28% for the hedonic factor, and a total of 43% for the pragmatic factors.

The highest loading items on each scale are shown in Tables 3 and 4. All the scales had high levels of Chronbach's alpha (Table 2), indicating good internal consistency, although for the hedonic scales with α>0.95, some items are probably redundant (Streiner, 2003).

Table 2: Variance explained by each factor, Chronbach's alpha for the scales, and correlation of the scales with willingness to buy (WTB)

Factors	Variance Explained	α	Correlation with WTB
1. Hedonic	28%	.96	0.48
2. User interface	16%	.90	0.38
3. Smoke extraction	14%	.91	0.43
4. Design quality	12%	.87	0.49
Combined pragmatic	43%	**4.**	0.48
Total	70%	**5.**	**6.**

Table 3: Items with highest loadings on the hedonic factor

Hedonic factor	Loading
Looks Fashionable	0.86
Good Looking	0.84
Looks High End	0.80
Smart and Delicate	0.78
Unique design	0.77
Very Fine Finish	0.77
Looks Brand New	0.74
High Tech	0.71
Three Dimensional Appearance	0.70
Very Stylish	0.68

Table 4: Items with highest loadings on the pragmatic factors

Pragmatic factors	Loading
User interface quality	
The button light is a refreshing color	0.76
The button light is not dazzling	0.75
The button sound is pleasant	0.71
The information displayed is clear	0.66
The noise of the hood is quiet and relaxing	0.58
Not troublesome	0.51
Smoke extraction quality	
Will extract all the smoke	0.80
High smoke gathering efficiency	0.79
High suction	0.79
Health benefit	0.63
Firm and Reliable	0.58
Ease of cleaning quality	
Easy to Clean	0.80
Easy to Dismantle	0.78
Outside Surface Easy to Clean	0.65

Ratings for each product

Customers were asked which product they would most like to buy, and Figure 7 shows the products arranged in order of preference, together with the number of customers who said that they prioritized fashion and beauty over removing the oil smoke thoroughly. The same order is used in Figures 8 and 9.

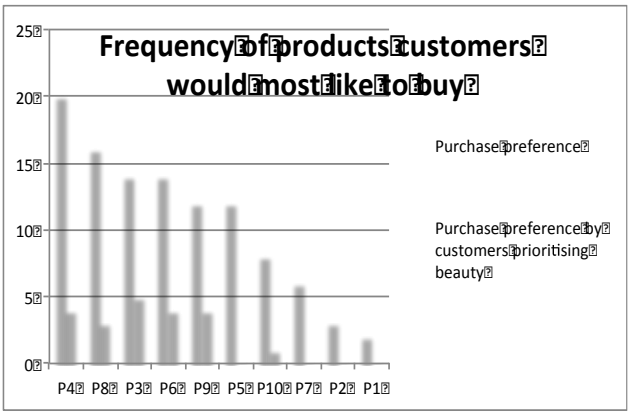

Figure 7: Frequency of products that customers said that they would most like to buy.

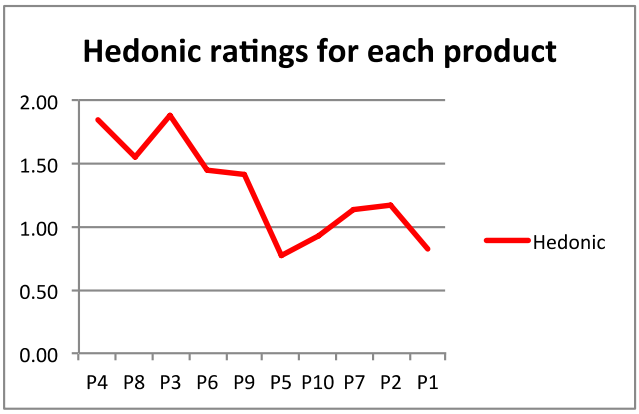

Figure 8: Hedonic ratings for each product.

We calculated a hedonic scale value and a pragmatic scale value for each hood. Figure 8 shows the ratings for each product on the hedonic scale. The ratings are generally consistent with purchase preference (although the reasons for the willingness to buy P5 despite low ratings could be investigated).

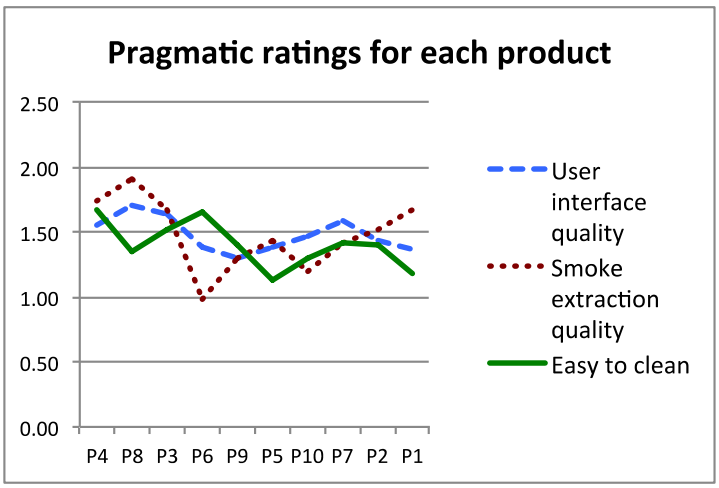

Figure 9: Pragmatic ratings for each product (scale +3 to -3)

Figure 9 shows the ratings for each product on Kansei items for the pragmatic factors shown in Table 4. Although the differences between products are smaller, the differences for all the factors are significant (at p= <.001). The Ease of cleaning quality factor shows the same pattern as Hedonic quality, while User interface quality and Smoke extraction quality are more varied.

Although the hedonic and pragmatic factors have similar correlations with willingness to buy (Table 3), it is apparent that there is more agreement between customers on which products have desirable hedonic properties than which products have desirable pragmatic properties. Thus despite a correlation between pragmatic factors and willingness to buy on an individual level, there is a lack of agreement between customers about which pragmatic properties are more desirable and about the criteria for each pragmatic property. For this reason there were also no clear correlations between Kansei factors and the identified product features. Further analysis of the data may reveal distinct groups of customers, differentiated by their preferences, which could show clearer relationships between Kansei scale ratings and product features.

6.1 AttrakDiff results

The results obtained from the Kansei scales were compared with the results obtained from using the existing AttrakDiff scale (Bevan et al, 2016). The objective was to find out to what extent specifically constructed Kansei scales reveal more information about a product than a more generic, prestructured instrument, such as AttrakDiff? In summary, the conclusions were:

a) *Would using the AttrakDiff attributes as general Kansei attributes add value to the Kansei Engineering analysis?*

In the Simplified Method, the type 1 'highest level Kansei' items are replaced by a focus on brand values. It was hypothesised that including AttrakDiff attributes in a combined analysis might fill this gap and strengthen the Kansei analysis. But including the items did not change the factor structure and did not make the factors any easier to interpret. From this perspective, addition of AttrakDiff to Kansei did not provide any additional benefit.

b) *How would the conclusions derived from use of the Kansei Engineering scale compare with use of the AttrakDiff scale?*

A scale composed of a subset of AttrakDiff items provided at least as good an evaluation of hedonic quality as a scale based on the identified Kansei items, although the AttrakDiff scale provides less detailed, product-specific feedback. As would be expected, Kansei Engineering identifies more product-specific pragmatic factors and individual scale items are also easier to interpret. So using Kansei factors and AttrakDiff to evaluate products provide different benefits.

7. DISCUSSION

7.1 Correlation with willingness to buy

The results showed a modest correlation of 0.48 between hedonic ratings and willingness to buy, as confirmed by the higher hedonic ratings given to the most preferred products to purchase (Figures 7 and 8). The products with higher hedonic ratings were also the ones that were most preferred by customers prioritizing beauty over functionality (Figure 7). This confirmed to the manufacturer the importance of designing products that had a high hedonic rating.

Although a hedonic scale based on AttrakDiff items had the same correlation of 0.48 with willingness to buy (Bevan et al, 2016), the Kansei scale has the advantage that the scale items (Table 3) are more specifically related to range hood design characteristics, so inspecting scores for individual scale items can help explain a particularly high or low overall hedonic score.

The combined pragmatic ratings showed the same correlation of 0.48 with willingness to buy, but there was more diversity in customer preferences, resulting in smaller overall differences between products (Figure 9). So while the perceived Ease of cleaning, Smoke extraction quality and User interface quality have an important influence on the purchase decision, it appears that customers do not judge these qualities in a consistent way. For example some hoods sucked air around a central plate to create a "wind wall" to isolate the fumes. But some customers mentioned that they thought that the central plate would block the air intake, and thus reduce the smoke extraction. This presents a challenge to the manufacturers to convey to the customers the intended benefits of their unique design features.

There were no distinct patterns of preferences related the demographic variables, but it is possible that with further research it might be possible to differentiate groups of users with preferences for particular types of design features (for instance: modern/traditional, compact/large or

discreet/showy). Without this grouping, it was not possible to obtain one of the potential benefits of Kansei Engineering, which is to find out how particular features create specific hedonic responses.

7.2 Reuse of the scale

The identified Kansei scales can be used by the manufacturer to evaluate future range hoods, and compare them with other manufacturers' range hoods. Kansei scales are designed to evaluate a specific type of product in a specific context of use: in this case making a purchase decision for range hoods. While the pragmatic scale is specific for the features of range hoods, the hedonic scale is also likely to be applicable to other kitchen equipment that generates similar emotions.

Alternatively, as noted, the identified subset of AttrakDiff has a high correlation with willingness to buy, and would have wider applicability as it uses more general questions.

7.3 Could the same method be used outside China?

The method used in China was based on the procedure that had previously been developed by the second author in the UK, as an adaptation of the Kansei Engineering Toolkit for the packaging industry. When the method was first piloted in China, some adjustments were made:

- One of the benefits of using Kano analysis is that large amounts of data can easily be collected by an online survey. However the third author judged that in China data would be more reliable if collected face-to-face. This had the advantage that participants could be familiarized with features of different range hoods, but made the study expensive to carry out. Thus the results do not provide evidence of the appropriateness of using a remote Kano evaluation for complex products.
- The procedure developed in the UK used about 10 items in the evaluation scale in order to keep the session time for evaluating 10 products to one hour. In China in order to compare the value of different scale items a total of 60 items were used. To minimize session times and maintain the interest of participants, each participant was accompanied by a facilitator who entered all the answers. Using facilitators is more expensive, but for more complex products, 10 items may not be sufficient, which could make self-administered session times unacceptably long.

8. CONCLUSIONS

The results of the case study demonstrated that a simplified form of Kansei Engineering can be used to identify both the hedonic and pragmatic affective responses to kitchen equipment such as range hoods.

It was also helpful to introduce the Kano model as it demonstrated very clearly the key features and attributes that contributed to the consumer satisfaction. From the resulting consumer satisfaction scale, the manufacturer received a useful tool to evaluate the user's affective responses that could potentially influence the users' purchase decision after inspecting or using a kitchen product. This makes future applications of Kansei Engineering much more streamlined and cost effective, saving time and resource for the manufacturer. Yet because the research has been done using this approach, they have confidence that the results will be relevant to their consumers going forward.

The study showed that whilst AttrakDiff can be used as a quick evaluation tool to compare the emotional response to products, Kansei Engineering provides more detailed and relevant data to support design.

Future work will seek to optimize the Simplified Kansei Engineering Method to identify the most cost-effective number of participants and words and phrases to use in the evaluation to reliably identify the Kansei factors.

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BIOGRAPHY

Short biography of author 1 (100 words max) (leave blank for reviewing)

Short biography of author 2 (100 words max) (leave blank for reviewing)