

## EXPLORING THE RELATIONSHIP BETWEEN CONSUMERS' EMOTIONAL PERCEPTION AND PRODUCT FORMS: A CASE STUDY ON CAR DESIGN

**Sugoro Bhakti Sutono**

Department of Industrial Engineering, Faculty of Engineering  
Universitas Muria Kudus  
Email: sugoro@umk.ac.id

### ABSTRACT

*Nowadays, there is a need to analyze the relationship between emotions, consumers and product design need. Hence, the objective of this study is to investigate the relationship between Malaysian consumers' emotional or feeling preference, or so-called Kansei perception, on product form of car design via survey. A semantic differential method is employed to measure the subjective response of emotional perception. An independent t-test and factor analysis are carried out to analyze the consumers' perception. The consumers' semantic differential is gathered from a total of 112 subjects, comprising of 56 males and 56 females, whereby the subjects evaluate 12 car designs using 16 Kansei adjective pairs. The results reveal that there no significant differences in perception distribution between males and females for all Kansei impressions. From the factor analysis, it is found that the Kansei impressions on car design can be grouped into three factors which significantly influence the consumers' emotional perception.*

**Keywords:** consumers emotional perception, product form, semantic differential method, car design, kansei engineering.

### 1. INTRODUCTION

The automotive industry is becoming one of the most significant and strategic industries in the Malaysian manufacturing sector. The Malaysian Automotive Association [1] forecasted that there is an increasing trend in market share for automobiles between 2016 and 2020 with a growth of 10.76%. This will be a very challenging period for the automotive industry, in which passenger cars have the biggest market share. Although Proton and Perodua national cars dominate the current Malaysian automotive market, the steady increase of imported European and Japanese cars will eventually result in a decline in national car sales. This reflects that automotive market is extremely competitive and therefore only automobiles with high appeal to consumers will thrive in such a market. A number of manufacturers are moving towards a consumer-oriented approach in automobile design due to increased competition.

It is known that consumers have become more selective in selecting products. The products should not be primarily based on functionality and usability, but should incorporate aesthetic and emotional values as well. Although it cannot be denied that functionality and usability are important attributes of a product, consumers nowadays are searching for something 'more' that makes a difference in quality than what product designers initially think. McDonagh-Philp and Lebbon [2] classified functionality into two types, namely, hard and soft functions. Hard functions pertain to how a product works, what a product does, its construction as well as materials. Soft functions relate to intangible qualities such as aesthetics, emotional bonds, desire, personality, sentimentality, smell, touch and feel. The soft functions of the product need to be considered in designs as they relate to the consumers' satisfaction level. Consequently, an impression elicited by product experience leads to consumers' satisfaction [3–5]. Thus, the aesthetic and emotional values of design are crucial in ensuring the success of the product in competitive markets and should be given emphasis in future product designs [6]. A product should be designed to support consumer needs and make the consumers feel good. Accommodating aesthetic aspects that magnetize the emotions or feelings are extremely crucial in the development of a consumer oriented design. The aesthetic aspects are associated with feelings, emotional response and impression evoked by the product form. According to Bloch [7], a product form will contribute to the success of a product as it is able to provide long-lasting attachment to the product, particularly for aesthetic characteristics and if the product incorporates emotional value [8].

One of the most challenging areas for designers is to investigate the emotional perception and needs of consumers in relation to the product. Hence, there is a need to analyze the relationship between emotions, consumers and product design [9]. Several attempts have been made to accommodate aesthetic aspects when dealing with consumers' emotions and psychological feelings in product design and define the relationship between these variables and the product design. This outstanding method was introduced

by Nagamachi [10], and is known as Kansei engineering. Kansei engineering incorporates the consumers' emotional needs in product development by identifying and quantifying the consumers' emotions, feelings, impressions or perceptions of a product and determining quantitative relationships between these subjective responses and various types of product design. The word *Kansei* is of Japanese origin, which can be literally translated as feeling, image, emotion, affection, sense or impression [11]. Kansei engineering is a methodology that unites Kansei with the engineering discipline, a field in which the development of products that bring happiness and satisfaction to humans is performed technologically, by analyzing human emotions and incorporating them into the product design [12]. Similarly, Schutte [13] defined Kansei engineering as a methodology to explore the people's feelings about a product in a systematic manner and translating them into design parameters.

A number of studies have been carried out to analyze consumers' preferences based on their emotional needs in various product designs such as telephones [14], mobile phones [15,16], kitchen appliances [17], electronic device in automobiles [18], buildings [19,20], PET bottles [21], office chairs [22] and traditional crafts [23]. In these studies, the semantic differential method [24] was employed to retrieve the consumers' subjective perception on product design. The interactions between emotional perception and product design were evaluated in these studies.

Realizing the importance of Kansei engineering in product design, this study is aimed to investigate the consumers' emotional perception towards passenger car design by means of a survey. The results presented in this paper will be beneficial in future studies to develop emotionally attractive passenger cars, specifically for the Malaysian automotive industry.

This paper is organized as follows. A brief background on the Malaysian automotive industry, Kansei engineering and its relevance to product design, as well as motivation and objective of this study is presented in the 'Introduction' section. The methodology and experimental design adopted in this study are presented in the 'Research Method' section. The findings of this study are presented and discussed in detail in the 'Results and Discussion' section. Finally, concluding remarks are given in the 'Conclusions' section.

## **2. RESEARCH METHOD**

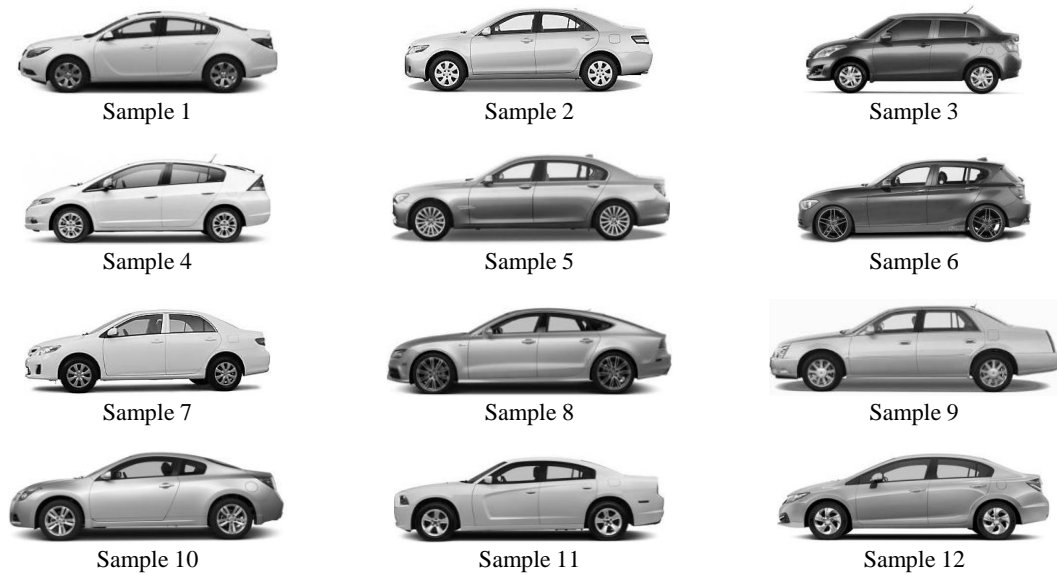
This study aims to investigate the consumers' emotional perception towards various product forms of car using the semantic differential experiment method.

### **2.1 Subjects**

A total of 112 subjects (56 males and 56 females) participate in the subjective evaluation.

### **2.2 Stimuli**

A total of 76 product forms are gathered based on a variety of passenger cars sold in the Malaysian automotive market between year 2011 and early 2016. However, the number of product forms is too large for semantic differential measurements. Hence, representative product forms are selected by consulting three experts having a background in automotive and product design, in which the product forms are evaluated and classified based on the degree of similarity between the products. A total of 12 representative product forms are finally selected as the set of stimuli used to evoke the consumers' emotional perception for the semantic differential survey, as shown in Figure 1.



**Figure 1. 12 Representative Product Samples Used As Set Stimuli**

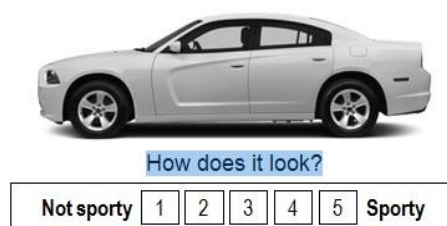
### 2.3 Data Collection

The raw data are collected by means of a questionnaire survey. The questionnaire consists of 12 product forms, whereby each product form contains 16 Kansei adjective pairs to elicit the subjects' emotional perception on a particular product form. The Kansei adjective pairs are listed in Table 1. These adjective pairs are selected by eliminating adjectives gathered from relevant Kansei engineering literature, car magazines and the Internet, based on similarities in the definitions (i.e. synonyms). The selected Kansei adjectives are expected to represent the complete semantic description as much as possible.

**Table 1. Kansei adjective pairs used in this study**

<i>No.</i>	<i>Kansei adjective pairs</i>	<i>No.</i>	<i>Kansei adjective pairs</i>
1	Elegant – not elegant	9	Cute – not cute
2	Stylish – not stylish	10	Sporty – not sporty
3	Youthful – oldish	11	Formal – not formal
4	Sleek – not sleek	12	Grand – not grand
5	Modern – not modern	13	Streamlined – not streamlined
6	Powerful – not powerful	14	Classic – not classic
7	Rugged – not rugged	15	Bold – plain
8	Spacious – confined	16	Masculine – feminine

The questionnaire consists of two sections. The first section is designed to collect demographic data of the subjects such as gender, age and occupation. The second section comprises of a series of questions, whereby the subjects are requested to evaluate each product form by rating the Kansei adjective pairs on a 5-point Likert scale [24]. It shall be highlighted that there are a total of 12 product forms and 16 Kansei adjective pairs. In the semantic differential measurement, a score of 1 indicates that the subject has a negative perception towards a product form such as 'not sporty' for instance, as shown in Figure 2. In contrast, a score of 5 indicates that the subject has a positive perception towards a product form, which in this case will be 'sporty'.



**Figure 2. Example Of Semantic Differential Questionnaire: 'Not Sporty – Sporty' Adjective Pair**

## 2.4 Data Analysis

Inferential statistical analysis is carried out on the data using independent sample *t*-test. The purpose of this analysis is to analyze the trend of the consumers' emotional perception based on gender. A statistical significance level  $\alpha < 0.05$  from the Levene's test for equality of variances is taken as the criterion to reject the null hypotheses ( $H_0$ ). Rejection of  $H_0$  means that there are no significant differences in variance between the groups with respect to emotional perception. Following this, the data are analyzed using factor analysis to generate the Kansei structure. The Kansei structure shows the classification of Kansei adjective pairs into several factors, as well as their corresponding factor loadings. The number of factors is determined based on the criterion that the eigenvalues must be greater than 1. The proportion of variance is determined after Varimax rotation, which explains the factor contribution. Finally, the data are analyzed for sampling adequacy and reliability. The adequacy of the samples is analyzed by Kaiser-Meyer-Olkin (KMO) statistic, whereas the reliability of internal consistency between the Kansei adjective pairs is analyzed based on Cronbach's alpha.

## 3. RESULTS AND DISCUSSION

### 3.1 Distribution Of Emotional Perception

Inferential statistical analysis is performed upon gathering the data from the semantic differential survey. The goal of this analysis is to observe the trend in the subjects' emotional perception. The results are presented in Figure 3, and it can be observed that the male subjects generally prefer the adjectives 'stylish', 'modern', 'powerful', 'streamlined' and 'elegant' for passenger designs. The female subjects, however, are prone towards the adjectives 'powerful', 'modern', 'masculine', 'stylish' and 'streamlined'. It is evident that the only similarities between male and female subjects are the adjectives 'modern', 'sporty' and 'sleek'.

An independent *t*-test is employed to test the distribution of the subjects' emotional perception. The results of the *t*-test are presented in Table 2, based on gender. The results reveal that all *p*-values exceed 0.05, which indicate that there no significant differences between genders for the subjects' emotional perception. For instance, it can be seen for the Kansei adjective 'elegant' that the *t*-test fails to reveal a statistically reliable difference in mean between males and females, whereby male and female subjects have a mean of 3.62 and 3.52, respectively. It is found for this Kansei adjective that  $t(110) = 1.443$ ,  $p = 0.152$  and  $\alpha = 0.05$ .

Even though there are no significant differences as indicated by the *p*-values, it can be observed from the mean values that the males are more prone towards the emotional perception 'elegant', 'stylish', 'youthful', 'cute' and 'streamlined' compared with females. The females, however, favour more towards the emotional perception 'powerful', 'rugged', 'spacious', 'formal', 'grand', 'classic', 'bold' and 'masculine' compared with males. The males and females exhibit the same mean values for the emotional perception 'sleek', 'modern' and 'sporty'.

Although there are differences in the mean values, the differences are found to be within a small range. Thus, it can be deduced that the trend in emotional perception is similar for both males and females when it comes to passenger car designs.

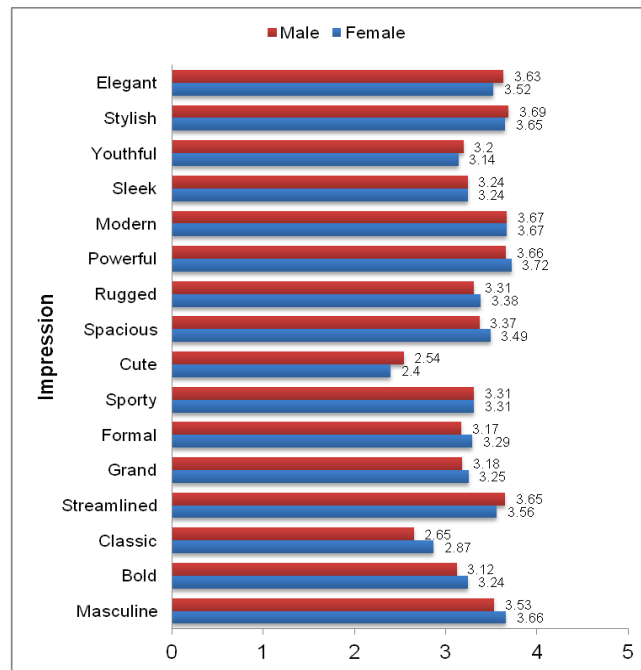


Figure 3. Subjects' Emotional Perception Towards Car Design Based On Gender

Table 2. *t*-test for Kansei adjective based on gender

<i>Kansei adjective</i>	<i>Mean</i>	<i>t-value</i>	<i>p-value</i>
Elegant	M = 3.63, F = 3.52	1.443	0.152
Stylish	M = 3.69, F = 3.65	0.474	0.636
Youthful	M = 3.20, F = 3.14	0.817	0.416
Sleek	M = 3.24, F = 3.24	-0.188	0.851
Modern	M = 3.67, F = 3.67	0.105	0.917
Powerful	M = 3.66, F = 3.72	-0.690	0.492
Rugged	M = 3.31, F = 3.38	-0.695	0.489
Spacious	M = 3.37, F = 3.49	-1.536	0.128
Cute	M = 2.54, F = 2.40	1.186	0.238
Sporty	M = 3.31, F = 3.31	0.090	0.929
Formal	M = 3.17, F = 3.29	-1.697	0.093
Grand	M = 3.18, F = 3.25	-0.901	0.369
Streamlined	M = 3.65, F = 3.56	0.863	0.390
Classic	M = 2.65, F = 2.87	-1.864	0.065
Bold	M = 3.12, F = 3.24	-1.383	0.170
Masculine	M = 3.53, F = 3.66	-1.449	0.150

Note:  
M: Male; F: Female

### 3.2 Results Of Factor Analysis

Factor analysis is performed using the data gathered from the survey in order to determine the subjects' emotional perception on passenger car designs. The results of the factor analysis after maximum variance of orthogonal (varimax) rotation are presented in Table 3. The Kansei adjective pairs are classified into three factors, which account for 39.04%, 37.08% and 20.45% of the explained variance, respectively. It is interesting to note that Factors 1 and 2 denote more than half of the variability or percentage of variance. This shows that both factors contribute a majority of the factor contribution, indicating that these factors have a dominant effect on Kansei adjectives. When Factor 3 is included, the proportion of variance increases to explain most of the factor contribution. From Table 3, it can be seen that the total cumulative percentage of three factors represent 96.57% of the total explained variance, which indicates that the three factors extracted from factor analysis are quite acceptable. Consequently, the proportion of variance explained by the remaining factors can be considered insignificant, with a value less than 3.43%. The KMO (Kaiser-Meyer-Olkin) statistic is found to be 0.818, as shown in Table

3. In terms of sampling adequacy, a KMO statistic of over 0.5 indicates that the data is adequate in order to proceed with a satisfactory factor analysis. Since the KMO statistic is 0.818 (which exceeds a value of 0.5), this indicates that the sampling of consumers' emotional perception is adequate for factor analysis. The Cronbach's alpha value is determined to be 0.908, with a range between 0.889 to 0.928 for the 16 Kansei adjective pairs, as shown in Table 3. Cronbach's alpha is a coefficient of internal consistency, and is used as an internal consistency estimate of the reliability of scores in a construct. Indicators with unsatisfactory values will be deleted based on a reliability indicator of 0.7 [25–27]. The results show that the Kansei adjective pairs have a Cronbach's alpha value greater than 0.7. This indicates that all items of the Kansei construct are indeed reliable.

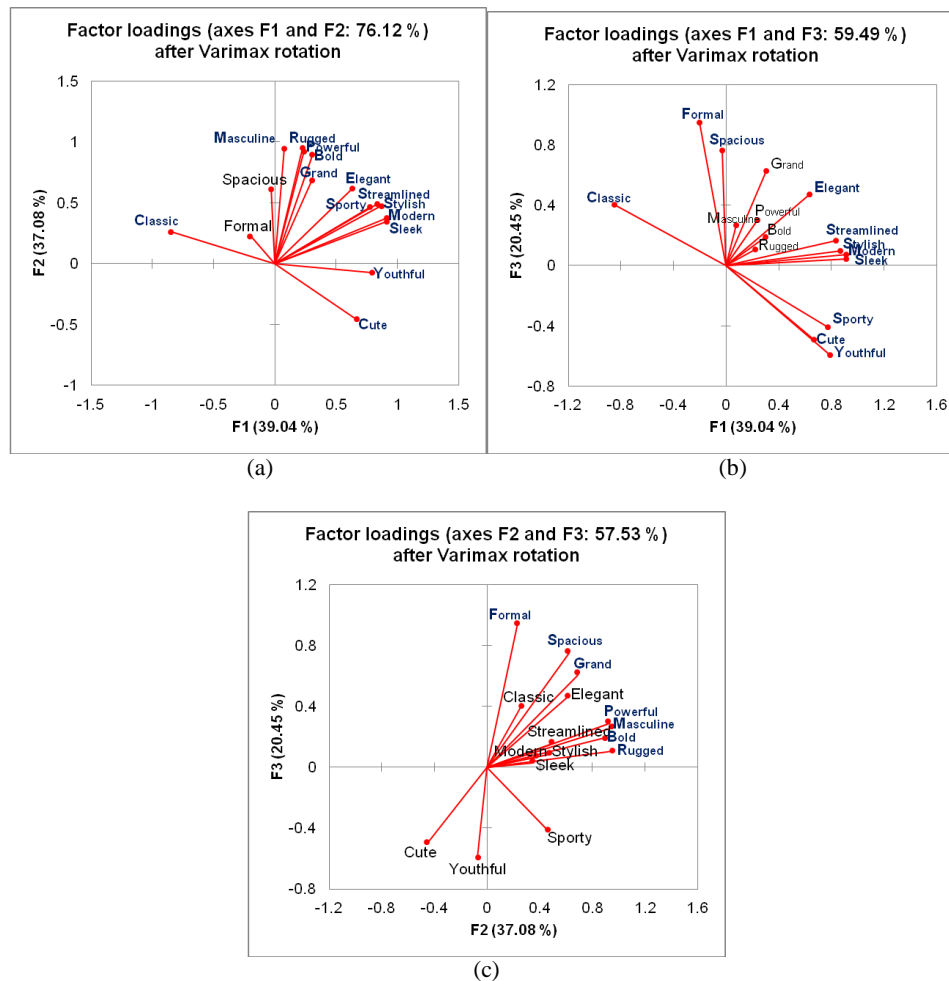
**Table 3. Factor loadings for 16 Kansei adjective pairs for three factors**

<i>No.</i>	<i>Kansei adjective pairs</i>	<i>Factor 1</i>	<i>Factor 2</i>	<i>Factor 3</i>	<i>Cronbach's alpha</i>
4	Sleek – not sleek	<i>0.915</i>	0.343	0.041	0.898
5	Modern – not modern	<i>0.912</i>	0.372	0.074	0.894
2	Stylish – not stylish	<i>0.868</i>	0.473	0.096	0.928
14	Classic – not classic	<i>-0.847</i>	0.258	0.402	0.915
13	Streamlined – not streamlined	<i>0.837</i>	0.487	0.166	0.892
3	Youthful – oldish	<i>0.792</i>	-0.071	-0.593	0.901
10	Sporty – not sporty	<i>0.775</i>	0.463	-0.409	0.893
9	Cute – not cute	<i>0.666</i>	-0.458	-0.493	0.923
1	Elegant – not elegant	<i>0.632</i>	0.610	0.472	0.897
7	Rugged – not rugged	0.221	<i>0.954</i>	0.108	0.898
16	Masculine – feminine	0.077	<i>0.946</i>	0.266	0.892
6	Powerful – not powerful	0.241	<i>0.918</i>	0.302	0.899
15	Bold – plain	0.301	<i>0.898</i>	0.191	0.893
12	Grand – not grand	0.303	<i>0.684</i>	0.625	0.889
11	Formal – not formal	-0.201	0.226	<i>0.947</i>	0.916
8	Spacious – confined	-0.030	0.612	<i>0.764</i>	0.903
<i>Final statistics</i>					
	Eigenvalue	6.25	5.93	3.27	
	Percentage of variance	39.04	37.08	20.45	
	Cumulative percentage	39.04	76.12	96.57	
	KMO (Kaiser-Meyer-Olkin)			0.818	
	Cronbach's alpha			0.908	

Note:

*Values in italic correspond to the groups of Kansei adjectives related to Factors 1–3.*

Furthermore, Table 3 shows the factor loading score for each Kansei adjective pair in a descending order. Adjective pairs with high factor loading scores are perceived as significant factors in passenger car design. A variable must have a factor loading score greater than 0.60 in order to qualify as a significant factor, based on the criterion recommended by Hair et al. [28]. The results reveal that the 16 emotional perceptions of car design are structured by three factors, which explain 95.67% of the total data. The first factor consists of 9 impression adjective pairs, whereas the second and third factors consist of 5 and 2 impression adjective pairs, respectively. The impression adjectives 'sleek', 'modern', 'stylish', 'classic', 'streamlined', 'youthful', 'sporty', 'cute' and 'elegant' belong to the first factor, whereas the impression adjectives 'rugged', 'masculine', 'powerful', 'bold' and 'grand' belong to the second factor. The impression adjectives 'formal' and 'spacious' make up the third factor. The results of the factor loadings after varimax rotation for the three factors are depicted in Figure 4. It can be seen that the first (F1) and second (F2) factors represent 76.12% of the data, as shown in Figure 4(a). These factors contain the Kansei adjectives 'sleek', 'modern', 'stylish', 'classic', 'streamlined', 'youthful', 'sporty', 'cute', 'elegant', 'rugged', 'masculine', 'powerful', 'bold' and 'grand'. Figure 4(b) shows that the first (F1) and third (F3) factors represent 59.49% of the data, whereas the second (F2) and third (F3) factors represent 57.53% of the data, as shown in Figure 4(c). It can be seen that F1 and F3 consist of the Kansei adjectives 'sleek', 'modern', 'stylish', 'classic', 'streamlined', 'youthful', 'sporty', 'cute', 'elegant', 'formal' and 'spacious' while F2 and F3 consist of the Kansei adjectives 'rugged', 'masculine', 'powerful', 'bold', 'grand', 'formal' and 'spacious'.



**Figure 4. Visualization Of Factor Loadings Of Kansei Adjectives After Varimax Rotation: (a) Factor 1 (F1) and Factor 2 (F2), (b) Factor 1 (F1) and Factor 3 (F3), and (c) Factor 2 (F2) and Factor 3 (F3)**

#### 4. CONCLUSION

An investigation of Malaysian consumers' emotional perception towards passenger car designs is presented in this paper. A semantic differential survey is carried out to determine the emotional perception of 112 consumers, comprising of 56 males and 56 females. Statistical analyses are performed to investigate the relationship between the consumers' emotional perception (aesthetic and emotional attributes) and passenger car design. The *t*-test reveals that there are no significant differences between genders for all Kansei adjectives. The results indicate that the consumers generally prefer the adjectives 'powerful', 'modern', 'stylish', 'streamlined', 'masculine' and 'elegant' when it comes to passenger car design. The mean values from the *t*-test show that male consumers prefer car designs that are 'stylish' whereas female consumers generally prefer car designs that are 'powerful'. However, both male and female consumers exhibit the same preference for 'modern' car designs. Results from the factor analysis show that the Kansei adjectives can be classified into three factors, in which each factor contains groups of significant variables.

The findings of this study will be beneficial for future studies to develop emotionally attractive passenger cars, specifically for the Malaysian automotive industry. It shall be highlighted however, that this study is constrained within a specific number of subjects, which is assumed to be representative of the actual market segment.

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