CHAPTER 5

EXPLORATORY STUDY

5.1 Overview

This chapter elaborates the procedure and results of phase III, the Exploratory Study, of the research framework described in Chapter 4. The Exploratory Study was performed to conceptualise emotional responses in website design and determine design requirements to develop website that embeds target emotion. This chapter describes the overall result of Emotion Measurement that includes the pilot study performed to verify the reliability of research instruments for the evaluation purpose in this research. It will describe the stages applied towards acquiring answers to the research questions described in Chapter 1. This phase of research was performed to find evidence to answer questions of whether website emotion can be quantified, the concept of emotion in Website UID, and the design requirements to develop website that embeds target emotion.

This chapter describes the outcome of K.E. adoption by implementing multivariate analysis to the data gathered from the Emotion Measurement procedure. It concludes with proposing a guideline to the design of Kansei Website, a website elicits target emotion.

5.2 Pilot Study

A pilot study was performed to verify the procedure and calculate the reliability of the test instruments, to minimize errors in performing the actual exploratory study. It will also be used to test the subject recruitment strategy for this research case. The

pilot study involves a small scale Emotion Measurement procedure. Ten test subjects were recruited to provide input in the measurement procedure. All of them are Internet users and familiar with online purchase. The 35 valid specimens and the checklist consisting of forty sets of emotional keywords were used as emotion measurement instruments.

Emotion Measurement was performed to quantify test subject's subjective emotional responses towards all specimens. In the study, the specimens were shown one by one to all subjects in a systematic and control manner, and test subjects were required to rate their emotional impression towards the specimen into the checklist. The evaluation results were then calculated into average value to be used in the statistical analysis. Table 5.1 shows sample of the average data.

Table 5.1: Sample of the Average Evaluation Data from Pilot Study.

Emotional keywords	Specimen ID													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Adorable	2.7	2.5	3.8	2.6	3.1	2.6	2.4	3.3	2.6	2.5	3.2	2.8	2.8	2.2
Appealing	2.8	3.0	4.2	2.8	2.9	2.7	2.9	3.7	2.5	3.5	3.3	2.4	2.9	2.2
Beautiful	3.0	3.2	3.8	2.7	3.0	2.2	2.7	3.1	2.2	2.3	3.1	2.8	2.4	2.0
Boring	2.8	2.5	2.1	2.9	2.0	3.0	3.1	2.0	3.3	2.8	2.2	3.2	2.9	3.5
Calm	2.6	3.0	3.7	3.8	3.0	3.6	3.0	2.9	3.3	3.1	3.4	2.1	3.2	4.1
Charming	2.6	2.9	3.8	2.7	3.2	3.0	2.9	3.5	2.2	3.0	3.1	3.0	2.5	2.2
Chic	3.5	3.5	4.1	3.0	3.0	3.1	3.5	3.6	2.3	2.9	3.3	2.6	2.8	2.2
Childish	2.1	1.3	1.4	2.4	4.0	1.9	1.6	1.4	1.3	1.5	1.7	2.0	2.1	3.4
Classic	2.0	1.8	4.0	2.2	1.6	2.7	2.0	2.7	2.6	2.6	3.2	3.0	2.5	2.5
Comfortable	2.9	3.4	4.1	2.9	3.0	3.6	3.0	4.0	3.4	2.6	4.4	2.5	3.6	4.1
Cool	3.2	3.6	3.8	3.0	2.9	2.9	3.6	3.8	3.1	3.5	4.0	2.7	3.6	2.9
Creative	2.8	2.8	3.8	2.3	3.2	2.4	3.1	4.3	3.1	3.6	3.1	3.3	3.0	2.1
Crowded	2.6	3.4	1.1	3.1	3.5	2.4	1.6	3.2	3.0	2.7	2.6	3.9	2.7	1.1
Cute	2.5	2.7	3.3	2.7	3.7	2.5	2.5	3.0	2.6	2.6	3.9	2.6	2.8	2.3
Elegant	2.8	3.2	4.2	2.8	2.6	2.7	2.6	3.2	2.7	3.5	3.3	3.6	2.5	2.4
Feminine	3.3	4.2	4.5	2.7	2.6	2.9	3.6	3.8	2.7	2.1	3.7	3.8	2.1	2.2
Fun	2.3	2.7	2.5	2.1	3.2	2.3	2.4	3.5	2.0	2.4	3.3	2.1	2.7	1.6
Futuristic	2.1	2.7	2.5	1.7	2.8	2.1	2.7	3.6	2.6	3.6	2.5	2.8	2.6	2.1
Gorgeous	2.2	3.1	3.7	2.1	2.5	2.2	2.4	3.6	2.4	2.9	3.1	2.7	2.7	2.1

5.2.1 Analysis and Conclusion

Cronbach's alpha and Principal Component Analysis (PCA) were performed to lend some hypothetical credence that the instruments are reliable and that the research

approach is valid. To assess reliability of instruments, Cronbach's alpha was calculated. Cronbach's alpha values ranged between 0 and 1, where higher values suggest higher internal consistency. A historical benchmark of 0.7 is commonly used to suggest that at least some of the Item measure the same construct.

The analysis yielded Cronbach's alpha of 0.86, which is higher than the commonly used benchmark value of 0.7. The result has enabled this research to provide some hypothetical belief that the instruments are reliable and can be used to perform the intended Emotion Measurement for this research case. The reliability test performed to the later Exploratory Study have resulted Cronbach's alpha of 0.90, which is seen consistently with the pilot study findings.

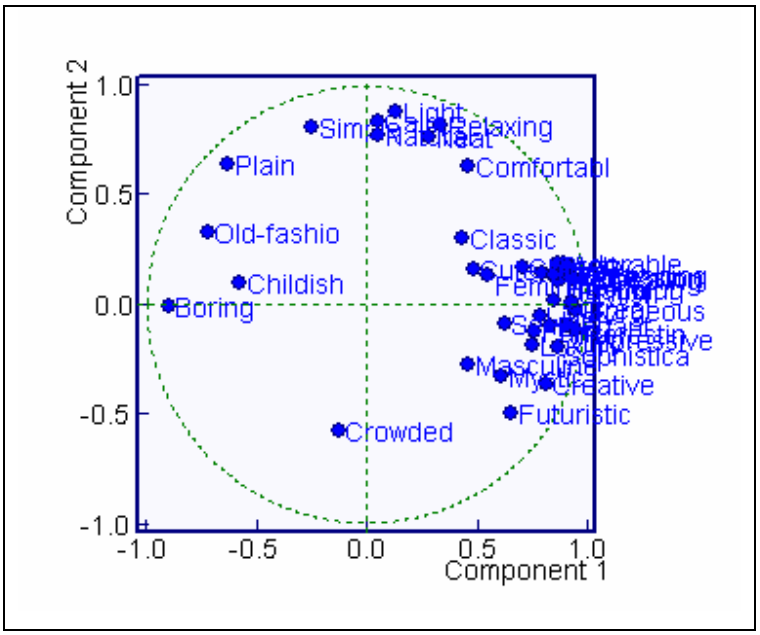

Figure 5.1: PC Loadings for Pilot Study.

To test the subject recruitment strategy, the average evaluation values were then analysed using PCA. PC Loadings were plot to observe the structure of emotion that formed from the evaluation results. Figure 5.1 shows the result of PC Loadings. The result shows that all emotions are well distributed to each axis. The structure of emotion is observable and thus, it shows some hypothetical basis that emotional signature exist in the specimens. The observable distinction of emotion also provides

some hypothetical belief that subjects are sensitive to Website Emotion and that the measurement of emotion is possible.

To support the findings PC Vector was plot to show scores of emotion in relative to specimens. Figure 5.2 shows the result of PC Vector plot.

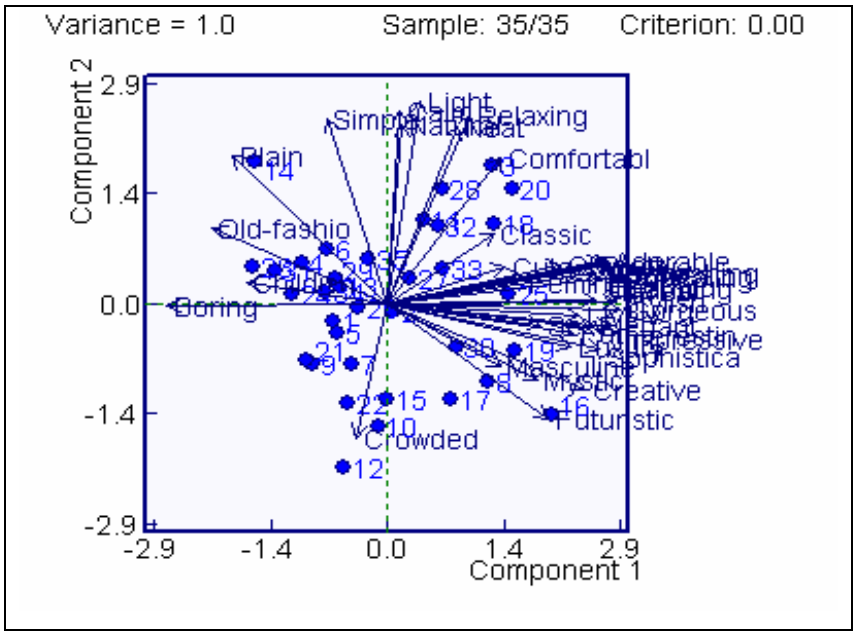

Figure 5.2: PC Vector for Pilot Study.

Result from the PC Vector analysis shows that all specimens are reasonably distributed along the emotion axes. Thus, it can be used to support the hypothetical belief that the specimens to be used in the Exploratory Study embody emotional signature and stimulate emotional responses to the subjects. The analyses of the structure of emotion by population size of 30, 60, 90, and 120 (refer to section 5.4.2.2) have shown similar result of pilot study, thus the population size seems to not affect the overall structure. These analyses provide evidence that observing the structure of emotion by smaller population size is possible.

Cronbach's Alpha and PCA performed in the pilot study has provided hypothetical credence that the instruments and assessment approach used for this research case is valid, and that emotional signature exist and can be quantified in website design.

Thus, base on the result it is probably not too much to conclude the reliability of the research framework.

5.3 Emotion Measurement

Emotion Measurement is performed to explore visitor's emotional responses that formed when visiting a website. This stage includes all the core activities involved in engineering emotion in website design. The instruments and equipments used in the exploratory study can be seen in Table 5.2. The layout out of the experiment setting during exploratory is as shown in Figure 5.3.

Table 5.2: Instruments and Equipments for the Emotion Measurement.

Instruments	Equipment
Checklist (40 emotional keywords)	LCD Screen (resolution: 3000 ANSI lumens, screen size: 8 x 12 feet)
Screenshot of valid specimen (35 specimens)	Computer
Test subject (120 students)	

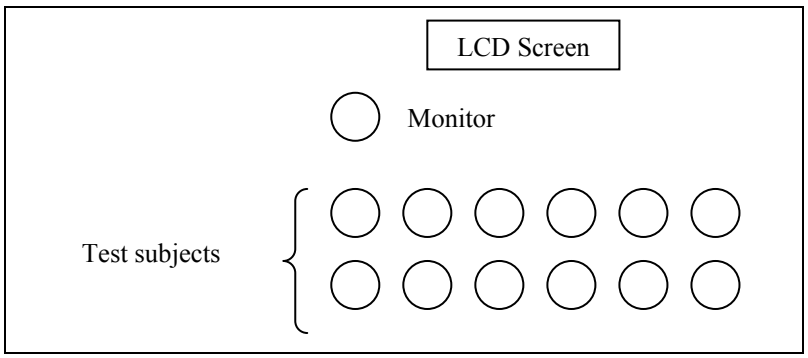

Figure 5.3: Layout Setting.

As shown in the figure, the monitor sits in front of a group of test subjects of which the monitor's role is as moderator. Test subjects were shown screenshots of the websites through the LCD screen.

5.3.1 The Emotion Measurement Procedure

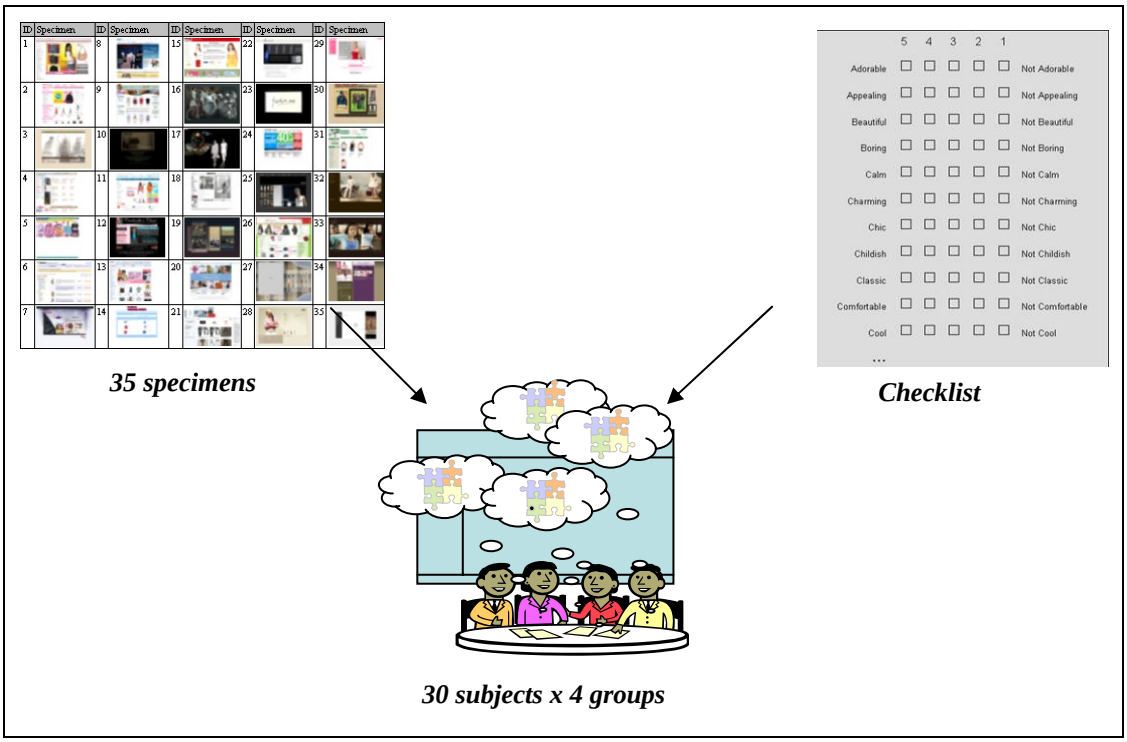

Figure 5.4: The Emotion Measurement Procedure.

Figure 5.4 illustrates the procedure of Emotion Measurement performed in the Exploratory Study. Four Emotion Measurement sessions were held separately for each group. During each session a briefing was given before the test subjects began their evaluation exercise. The thirty five specimens were shown one by one in a large white screen to all test subjects in a systematic and controlled manner. Test subjects were asked to rate their feelings into the checklist according to the given scale. Test subjects were given three minutes to rate their feelings towards each specimen. They were given a break after the fifteenth specimen, to refresh their minds. The order of checklists was also change to eliminate bias. Each Emotion Measurement session took approximately 2 hours to complete.

5.3.2 The Exploratory Data Audit

As described in the earlier procedure, subjects were required to rate their emotional responses into a paper checklist. Limitations in the experimental procedure implicated manual data input, i.e. all data is required to be entered manually into computer after the experiments were completed. A sample set of raw data obtained from subjects can be seen in Table 5.3.

Table 5.3: Sample of Raw Data.

Subject ID: 2																					
Website ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Adorable	3	2	4	2	3	2	3	3	3	3	3	3	2	2	3	4	3	3	3	3	3
Appealing	0	3	4	2	3	2	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3
Beautiful	3	2	4	2	3	3	3	3	3	3	3	3	2	2	3	3	4	2	3	3	3
Boring	4	3	3	4	2	2	3	3	4	4	4	3	4	2	4	3	3	4	3	4	4
Calm	3	3	3	3	3	2	3	3	3	3	3	2	3	4	3	3	3	3	3	4	3
Charming	2	3	4	2	3	3	3	3	3	3	3	3	3	2	4	4	4	2	4	3	3
Chic	3	2	4	2	4	3	2	2	2	2	2	2	2	2	4	3	3	2	3	2	3
Childish	4	2	2	2	4	3	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2
Classic	2	4	3	3	3	5	3	3	4	3	3	3	3	3	3	3	3	3	3	3	3
Comfortable	3	2	3	3	3	2	2	4	4	2	3	3	3	2	3	3	3	3	3	3	3
Cool	3	2	3	2	3	2	3	4	3	2	3	3	2	3	3	3	3	3	3	3	3
Creative	2	2	2	2	3	2	2	3	3	2	3	3	3	2	3	3	3	3	3	3	3
Crowded	3	4	1	3	4	5	3	3	3	4	4	4	4	2	4	4	3	3	3	2	4
Cute	2	3	3	2	2	3	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Elegant	2	3	4	2	2	3	3	3	3	3	3	3	3	2	3	5	3	3	3	3	3
Feminine	3	3	4	3	3	4	3	4	3	3	3	4	3	2	4	4	3	3	3	3	3
Fun	2	3	3	3	3	3	2	3	2	2	3	3	2	3	3	3	4	2	3	3	3
Futuristic	2	2	3	2	2	2	2	3	2	2	2	2	2	2	2	3	3	3	3	2	3
Gorgeous	2	3	4	3	2	2	2	3	3	3	3	3	3	3	3	4	4	3	4	3	4
Impressive	3	2	3	2	3	3	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3
Interesting	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3
Light	3	3	3	2	3	2	3	3	4	2	4	3	3	4	3	3	3	2	3	4	3
Lively	2	3	4	3	3	2	3	2	3	2	3	3	2	2	4	5	4	3	4	4	3
Lovely	2	2	3	3	3	2	2	3	3	2	3	3	2	2	3	4	3	3	3	3	3

The resulting population of data is huge, and thus errors could be predicted. The population of data is calculated as the following:

s: number of specimen

k: number of emotional keywords

r: number of respondent

Total population = *s* x *k* x *r* = *35 x 40 x 120 = 168000*

With the large amount of data, i.e. a total of 168000 data, the input process into computer is highly challenging, time consuming and error-prone. For this reason, the research calculates acceptance sampling to validate the data entry.

Acceptance sampling was performed using Minitab Release 14. Minitab's generated sampling plan indicates that the research will need to inspect 260 data for every 42000 data. From the specimen of 260 data, the research have about 60% chance of accepting the lot when the percent defective is 2.5%, but only about 5% chance of accepting the lot when the percent defective is 5%. Table 5.4 shows the computed acceptance sampling.

Table 5.4 : Computed Calculation on Acceptance Sampling.

Item	Results
Group Size	42000
Acceptance Quality Level (AQL)	1.5
Producer's Risk (α)	0.05
Rejectable Quality Level (RQL or LTPD)	5
Consumer's Risk (β)	0.05

Table 5.5: Computed Calculation on Generated Plans.

Specimen Size: 260 **Acceptance Number: 7**				
Accept lot if defective Item in 260 sample <= 7; Otherwise reject				
Percent Defective	Probability Accepting	Probability Rejecting	AOQ	ATI
1.5	0.956	0.044	1.425	2101.3
5.0	0.050	0.950	0.247	39921.0
Average outgoing quality limit (AOQL) = 1.713 at 2.230 percent defective.				

A generated plan was also computed. Table 5.5 shows the computed calculation of generated plans. From the plan, it is suggested that for each group of 42000 data, 260

or 0.62% data need to be randomly selected. If defect data found is greater than 7 or 2.3% defectives among these 260 data, the entire group should be rejected. For 7 or 2.3% or less defects, the entire group will be accepted for further analysis.

Table 5.6: Data Audit Results.

Group	Data Population	Audit Specimen	Error Count	Error Rate
BM	42000	6800	7	0.1
ER	42000	6800	19	0.3
IT	42000	6800	3	0.0
AD	42000	6800	14	0.2
Total	168000	27200	43	0.2

A data audit was performed according to the generated plan. Specimens were selected randomly from each group. Audit specimen size was set to 6800 per group, which represents approximately 16% data of the whole population. Specimen size were set to higher number than suggested by the generated plan in the acceptance sampling test in the effort to reduce risks in data inspection. This is to enable a higher probability of error found. Table 5.6 summarizes the result of the data audit.

From the result, it can be observed that the defect or error rate found in the specimens for all four groups is less than 2.3% as suggested in the generated plan. The result suggests that the entire groups are valid and can be accepted for further analysis. No group should be rejected, and therefore no corrective action should be taken. Hence, the research concludes to accept the entire group of data recorded by the data entry, and proceeds with the intended data analysis.

5.4 Exploratory Analysis

This stage was performed to conceptualise emotion in website design and analyse the design requirements to develop website that embeds target emotion. Multivariate analyses were performed to find empirical evidence of the success of engineering

emotion in web design. The outcomes from the analyses were used to compose the intended guideline.

The research calculated the average evaluation value obtain from all subjects from the Emotion Measurement procedure. This average data was used in the calculation of the multivariate analyses. A sample of the average data is shown in Table 5.7.

Table 5.7: Sample of the Average Data.

Emotion	Specimen ID														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Adorable	3.21	2.68	3.63	2.52	3.18	2.28	3.16	3.48	2.73	3.30	3.03	3.32	2.75	2.04	3.33
Appealing	3.03	2.73	3.65	2.48	3.13	2.39	3.16	3.45	2.62	3.32	2.93	3.38	2.62	2.11	3.24
Beautiful	3.12	2.95	3.27	2.94	3.05	2.64	3.19	3.37	2.88	3.02	2.98	3.45	2.86	2.66	3.63
Boring	2.45	2.80	2.81	3.32	2.77	3.55	2.63	2.28	3.23	2.70	3.03	2.38	3.33	3.79	2.33
Calm	2.78	2.71	3.52	2.88	2.75	2.62	2.84	3.33	2.81	3.46	2.88	3.16	2.82	2.65	2.99
Charming	3.03	2.68	3.51	2.35	2.79	2.20	2.88	3.28	2.32	3.06	2.66	3.23	2.47	1.87	3.20
Chic	3.38	2.78	3.09	2.43	3.16	2.12	2.71	2.72	2.21	2.32	2.80	2.93	2.36	2.03	3.20
Childish	2.05	1.92	2.15	2.26	3.13	2.03	1.84	1.79	2.07	2.15	2.20	2.20	2.45	2.54	2.11
Classic	2.06	2.17	4.02	2.38	2.26	2.71	2.58	2.61	2.68	3.53	2.39	3.21	2.54	2.32	2.25
Comfortable	3.03	2.98	3.57	3.04	3.11	2.84	3.24	3.61	3.00	3.36	3.62	3.34	3.15	2.83	3.13
Cool	2.98	2.73	3.45	2.48	2.94	2.40	3.23	3.83	2.70	3.83	3.23	3.49	2.84	2.24	2.97
Creative	2.65	2.68	3.07	2.32	2.89	2.23	2.97	3.72	2.81	3.67	2.93	3.81	2.70	1.72	3.21
Crowded	2.30	3.14	1.93	2.58	2.82	2.92	2.02	2.44	3.03	2.13	2.59	2.91	3.11	1.58	2.73
Cute	3.10	2.53	3.34	2.25	3.07	2.13	2.76	2.91	2.28	2.93	2.98	3.24	2.52	2.16	3.07
Elegant	3.00	2.92	4.00	2.28	2.47	2.51	2.91	3.58	2.61	3.38	3.00	4.02	2.52	1.92	3.39
Feminine	3.64	3.66	4.05	2.71	3.26	2.75	3.28	2.96	2.57	2.20	3.53	3.94	2.59	2.11	3.83

In analysing the data, this research performed the analysis according to the flow as described in Table 5.8. Most of the statistical methods presented in the table are widely used in K.E. studies, except for the PLS analysis. PLS is a cutting edge method that was newly introduced to K.E. studies (Ishihara, 2007). The following

sub-section describes PLS and why it is used in the research in engineering emotion in website design. The subsequent sections described in detail the results of each of the types of analysis performed accordingly.

Table 5.8: Analysis Flow.

Sequence	Method	Key activity	Outcome
1	Correlation Coefficient Analysis (CCA)	• Identify correlation between emotion	• Concept of emotion
2	PC Analysis (PCA)	• Identify relations between emotion and specimens • Identify design strategy	
3	Factor Analysis (FA)	• Identify significant factors of emotion	
4	Partial least Square Analysis (PLS)	• Translate emotion to design elements • Investigate influence of design elements to emotion	• Design requirements for the development of website that embeds target emotion
5	Cluster Analysis (CA)	• Group emotion that is similar to each other	

5.4.1 Overcoming the Problem of Specimen Size and Multicollinearity

In engineering emotion into design requirements, the analysis method that is generally used to achieve the objective is the Hayashi Quantification Theory Type 1 (QT1) (Nagamachi, 2003). The method has shortcomings when number of variables exceeds specimen size and when multicollinearity exists (Ishihara, 2007). Multicollinearity is the term used in regression analysis to describe problem that occur when there are heavy interactions among variables.

In the case of this research, similar problem exists. To investigate relationships between emotional responses and design elements, the research has to process 249 design elements and 40 emotions over 35 specimens. This complicates the investigation where;

1. Number of design elements largely exceed number of specimens, i.e. 249 against 35. Although QT1 is commonly used, QT1 incorporates dummy variables in its regression model, and simultaneous equation could not be solved when number of variables exceeds the number of specimens (Ishihara, 2007). Nevertheless, the research had attempted to use QT1 method to analyse variables by clustering the data into many groups, minimizing number of variables in each cluster into less than the number of specimens.

2. The research had attempted to cluster data avoiding as much as possible the heavy interaction among variables. Using the clustered data, the research performed QT1 analysis. However, often during QT1 execution, calculations were halted due to the massive interactions. The only solution to this problem was to re-cluster the data. Consequently, the research had divided all data into a total of 16 groups over 40 emotions, totalling to 640 individual groups of data. From the QT1 execution, the research found that, not only the calculation took enormous time to complete, but also there are some design elements that were excluded since it was impossible to include them to any cluster, or even create its own cluster.

Therefore, with the two complex problems the research encountered, the research duly required for a better method to solve the multicollinearity problem. In this research where specimen size and multicollinearity seems to be a big problem (the secondly encountered challenge), PLS analysis is seen to provide proper solution. To better understand the method, the following presents description regarding the PLS (as derived from Ishihara et al. (2007)).

> PLS was developed by Swedish econometrician Herman Wold and co-workers from middle of 1970s. Chemometric is the PLS's most applied field from middle of 1990s. A typical example takes spectrum distributions on huge number of x. In these applications, number of *x* is up to several hundreds and correlations between *x* variables are very high because of the spectrum. On the other hand, *y* takes measured value such as temperature or

PH, and specimen number is tens at most. Common multiple regression can not deal with such data.

PLS uses several latent variables. There are *s* (number of specimens) observations of objective (dependent) variable, which act as vector **y**. There are *p* dimensional explanatory (independent) variables, which act as vector **x**. There are *s* numbers of **x**, which act as matrix **X**. The algorithm given below is based on Miyashita & Sasaki (1995, as in Ishihara 2007).

In the beginning, **w**, covariance vector of **y** and **x** is computed. The **w** is treated like eigenvector in PC analysis. Accordingly, latent variable t_1 is introduced. Output from t_1 ($t_1=\Sigma x_{iemotionk}$, thus $\mathbf{t}_1=\mathbf{X}\mathbf{w}_1$) is regarded as PC Score. Subsequently, l_{11},l_{12}, correlations between **x** and t_1 (these compose vector $\mathbf{l}_1$) are computed. They correspond to PC Loadings (correlation between PC Score and original variable). Next, q_1, relation between $\mathbf{t}_1$ and **y** is computed. The q_1 is the result of single regression analysis (with no bias term), which takes $\mathbf{t}_1$ as an explanation variable and **y** as objective variable. Next, x-t_1-y relation is computed. Correspondingly, second latent variable t_2 is introduced and x-t_2-y relation is computed with the same procedure noted above. This time, y takes the residual of x-t_1-y model, and **X** takes X residual of x-t_1-y model, which obtained by estimation in inverted way (Xnew = X - $t_1 l_1^T$). As a result, relations between two latent variables and y or x are obtained. As a conclusion, we get a regression equation by composing these relations.

The high dimensional of **x** is projected onto smaller dimension orthogonal space. The relation between the projection and *y* is solved with simple regression. Thus, the dimensionality problem (specimen size problem) is solved. The projection procedure is similar to procedure of PC analysis. Since the projection is in linear transformation, regression coefficients can be computed. Thus, correlations between explanatory variables do not cause the

multicollinearity problem. The multicollinearity problem is also eliminated since there is no necessity to solve simultaneous equations.

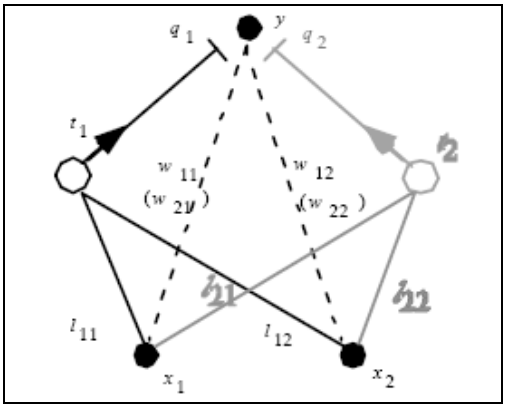

Figure 5.5: The Structure of PLS (Ishihara, 2007).

Therefore, as PLS method eliminates the computing problems caused by the huge number of variables in comparison to specimen size, it offers perfect solution to this research challenge. Thus, this research employed this analysis method in discovering relationships between emotion and design elements. The description of PLS analysis result is discussed in detail in section 5.4.3.

5.4.2 Conceptualising Emotion in Website Design

In order to conceptualise emotion, the research performed Correlation Coefficient Analysis (CCA), PC Analysis (PCA), and Factor Analysis (FA) to determine structure of emotion. The outcomes of these analyses have enabled the research to conclude the concept of emotion in Website UID.

5.4.2.1 Correlations of Emotion

Correlation Coefficient Analysis (CCA) was performed to identify correlations between emotions. Analyses were done using Excel Statistics 2000 for Windows -

Release 2 (Japanese version). The analysis was used to discover similarities of emotional responses towards Website UID, so that more objective emotion could be strategised. To illustrate the result, a sample of CCA is shown in Table 5.9.

Table 5.9: Sample of the Simple Correlation Table.

Simple Correlation	Adorable	Appealing	Beautiful	Boring	Calm	Charming	Chic	Childish	Classic	Comfortable	Cool
Adorable	1.0000										
Appealing	0.9861	1.0000									
Beautiful	0.8438	0.8354	1.0000								
Boring	-0.8794	-0.8608	-0.8549	1.0000							
Calm	0.8440	0.8707	0.6783	-0.6031	1.0000						
Charming	0.9693	0.9746	0.8825	-0.8673	0.8469	1.0000					
Chic	0.7494	0.7029	0.8213	-0.7945	0.4145	0.7792	1.0000				
Childish	-0.0390	-0.0785	-0.1112	0.0894	-0.1329	-0.1040	0.1016	1.0000			
Classic	0.5918	0.6562	0.3665	-0.3186	0.7844	0.6145	0.1342	-0.0193	1.0000		
Comfortable	0.8913	0.9024	0.7233	-0.7013	0.8961	0.8667	0.5489	-0.0976	0.6240	1.0000	
Cool	0.9240	0.9263	0.6870	-0.8058	0.8542	0.8738	0.5157	-0.0801	0.6506	0.9049	1.0000
Creative	0.8003	0.7990	0.6726	-0.8419	0.6288	0.7512	0.4929	-0.0541	0.5457	0.6796	0.8680
Crowded	-0.3650	-0.3842	-0.2106	0.0829	-0.6016	-0.3519	-0.0598	0.0619	-0.4391	-0.4689	-0.4047
Cute	0.9323	0.9088	0.8314	-0.8459	0.7508	0.9092	0.8296	0.1796	0.5127	0.8032	0.8234
Elegant	0.9042	0.9270	0.8404	-0.7807	0.8650	0.9394	0.6571	-0.2220	0.7034	0.8319	0.8483
Feminine	0.7079	0.6868	0.7981	-0.6831	0.4643	0.7523	0.8953	-0.0411	0.2325	0.5709	0.4895
Fun	0.8102	0.7895	0.6902	-0.7822	0.5881	0.7431	0.5975	0.1320	0.3073	0.7709	0.8224
Futuristic	0.7750	0.8094	0.5843	-0.6901	0.7540	0.7586	0.3412	-0.1421	0.6784	0.7255	0.8806
Gorgeous	0.9139	0.9368	0.7698	-0.8107	0.8615	0.9153	0.5569	-0.1962	0.6902	0.8490	0.9265
Impressive	0.9273	0.9405	0.7382	-0.8079	0.8574	0.8997	0.5446	-0.1083	0.6865	0.8678	0.9550
Interesting	0.9414	0.9493	0.7901	-0.8208	0.8691	0.9167	0.6168	-0.0737	0.6050	0.9105	0.9330
Light	0.6741	0.6527	0.5347	-0.5313	0.5879	0.6165	0.5442	0.0293	0.1744	0.7681	0.6047
Lively	0.9463	0.9463	0.8556	-0.8686	0.8108	0.9346	0.7255	-0.0848	0.5115	0.9030	0.8842
Lovely	0.9443	0.9575	0.8826	-0.8541	0.8623	0.9552	0.6955	-0.1216	0.6418	0.8615	0.8772
Luxury	0.8074	0.8531	0.6849	-0.6958	0.8509	0.8338	0.3881	-0.2640	0.7571	0.7792	0.8668
Masculine	0.5843	0.6303	0.3743	-0.4840	0.7040	0.5779	0.0673	-0.1910	0.6432	0.6588	0.7587
Mystic	0.6484	0.6881	0.3838	-0.4665	0.7923	0.6228	0.1303	-0.1290	0.7934	0.6736	0.8040

As evident from the simple correlation table, similarity of emotion can be understood. For instance, the emotion “Adorable” is highly correlated to “Appealing”, “Impressive”, “Interesting”, “Lively” and “Lovely”, “Pretty” and “Stylish”. “Comfortable” is highly correlated with “Refreshing” and “Relaxing”. “Elegant” is highly correlated with “Gorgeous” and “Lovely”. “Sophisticated” is highly correlated with “Stylish” and “Surreal”.

On the other hand, the zero correlation tests show correlation strength between emotions. Two stars (1%) show high correlation to emotion, and one star (.5%) show less correlation to emotion. As Table 5.10 demonstrates, there are many highly correlated emotions. Ideally, CCA can be used to analyse initial data to identify similarities and conclude smaller number of low correlated emotion, to be employed into the checklist for Emotion Measurement procedure. However, the research

decided to employ all emotion as they are considered important to explore visitor's subjective emotion towards the Website UID. Excluding any of the emotion may limit the dimension of emotion in the intended measurement.

Table 5.10: Sample of the Zero Correlation Table.

Zero correlation	Adorable	Appealing	Beautiful	Boring	Calm	Charming	Chic	Childish	Classic	Comfortable	Cool
Adorable	-										
Appealing	**	-									
Beautiful	**	**	-								
Boring	**	**	**	-							
Calm	**	**	**	**	-						
Charming	**	**	**	**	**	-					
Chic	**	**	**	**	*	**	-				
Childish								-			
Classic	**	**	*		**	**			-		
Comfortable	**	**	**	**	**	**	**		**	-	
Cool	**	**	**	**	**	**	**		**	**	-
Creative	**	**	**	**	**	**	**		**	**	**
Crowded	*	*			**	*			**	**	*
Cute	**	**	**	**	**	**	**		**	**	**
Elegant	**	**	**	**	**	**	**		**	**	**
Feminine	**	**	**	**	**	**	**			**	**
Fun	**	**	**	**	**	**	**			**	**
Futuristic	**	**	**	**	**	**	*		**	**	**
Gorgeous	**	**	**	**	**	**	**		**	**	**
Impressive	**	**	**	**	**	**	**		**	**	**
Interesting	**	**	**	**	**	**	**		**	**	**
Light	**	**	**	**	**	**	**			**	**
Lively	**	**	**	**	**	**	**		**	**	**
Lovely	**	**	**	**	**	**	**		**	**	**
Luxury	**	**	**	**	**	**	*		**	**	**
Masculine	**	**	*	**	**	**			**	**	**
Mystic	**	**	*	**	**	**			**	**	**

The correlation between emotions from this CCA can be used to roughly describe the semantic structure of subject's emotion. Detail structure of emotion can be confirmed with Factor Analysis.

5.4.2.2 The Structure of Emotion

The research performed PC Analysis (PCA) using JUSE-StatWorks/V3.0. In the research, PCA was performed to reduce 40 axes of emotion, to much smaller number two or three number of axis. This is to enable the research to understand the structure of emotion clearly and the description of subjects responds is much constructive. PCA is also used to help identify space in overlapping positive values in each

component, which can be used to strategise new target concept of website design from the perspective of emotion. Figure 5.6 shows result of variance contribution.

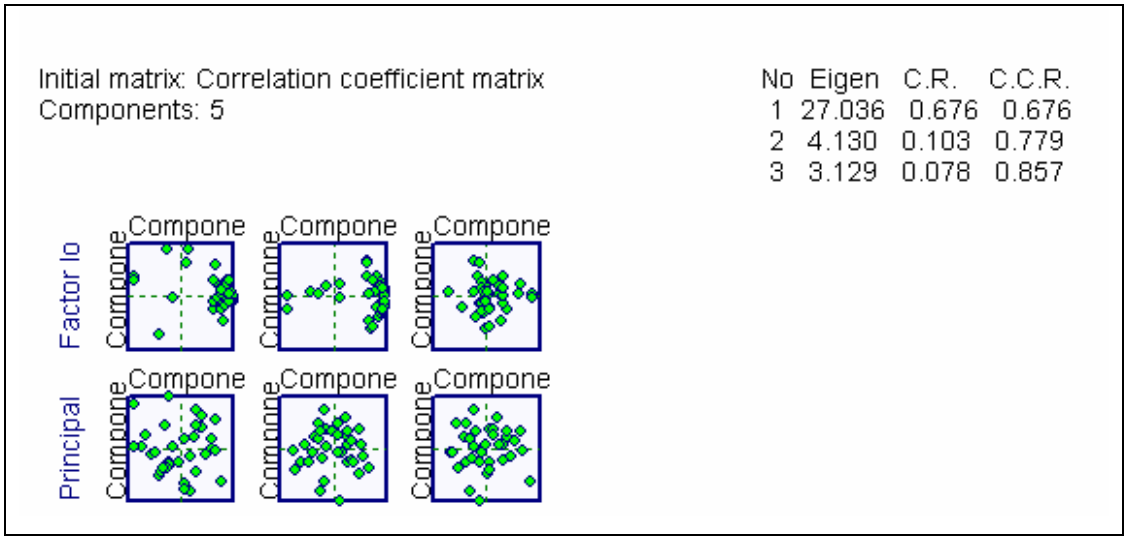

Figure 5.6: PCA Contribution Table.

As can be seen from the figure, the first principal component (PC) has variance (eigenvalue) 27.036 and accounts for 67.6% of the total variance. It should be noted that the interpretation of PC is subjective (Bartholomew, 2002; Ishihara et al., 2004). For instance, one could think of the first PC as representing an overall structure of emotion, others could think of including more PC.

The second PC has variance of 4.130 and accounts for 10.3% of the data variability. The first two PCs represent 77.9%, while the first three represents and 85.7% of the total variability. Thus, most of the data structure can be captured in two or three PCs. This shows that the structure of emotions is highly influenced by the first two or three PCs. The remaining PCs account for a very small proportion of the variability and are probably unimportant. This means that they have very less influence to the structure of emotion and probably can be ignored.

The decisive number of PC is explored in further PCA to analyse further the structure of emotion. Three types of PCA were calculated in finalizing number of PC. They are:

i. **PC Loading**, which is used to analyse semantic space of emotion to show how much the evaluation of emotion affects variables.

ii. **PC Score**, which is used to determine relationship between emotion and websites specimens.

iii. **PC Vector**, which is used to visualize direction and strength of emotion over the structure of emotion, and determine a new concept of Website UID.

Since the variance of the first three PCs, i.e. PC1, PC2 and PC3, seems to represent most of the structure of emotion, the research investigates the strength of their contributions in order to determine influence to specimen and to conclude number of PC, which is also called determinants. Accordingly, the research investigates the structure of emotion over PC1 & PC2, PC1 & PC3, and PC2 & PC3. The following sub-sections discuss detail of the results.

A. PC1 and PC2

PCA were calculated for PC1 and PC2 to identify strength and influence of the two components to the structure of emotion, determine relationship between emotion and specimen, and direction of strategy for future concept of website design from the perspective of emotion. Figure 5.7 shows result of **PC Loading** for PC1 and PC2.

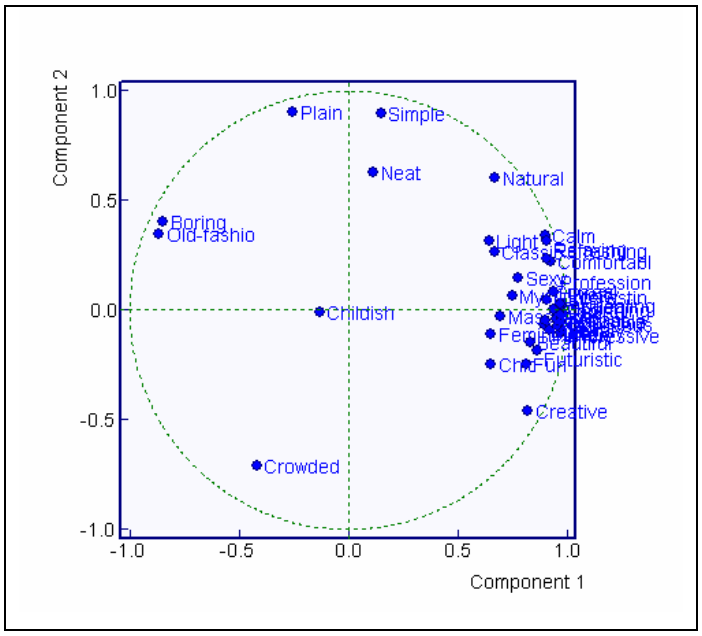

Figure 5.7: PC Loading for PC1 & PC2.

From the figure, a good distribution of variables to both axes can be observed, which proves that the measurement was successful. It is evident from the plot that the emotion that produced large negative first PC Loadings (x-axis) are such as "Elegant", "Gorgeous", and "Stylish". The dense area of the left hand side of the chart is corresponding to such emotion. On the other hand, emotions that produced large positive PC Loadings are “Boring” and “Old-fashioned”. Thus, the research labels this PC as the axis of “Attractiveness”. It is expected that websites with lower scores on this component are likely to have higher sense of attraction and conversely.

In the second PC Loadings (y-axis), emotions that have positive large loadings are "Plain" and “Simple”. Emotion that has negative PC Loading is "Crowded". Thus, the research labels this PC as the axis of "Simplicity”. Websites with a high score on this component is likely to have high characteristic of simplicity and conversely.

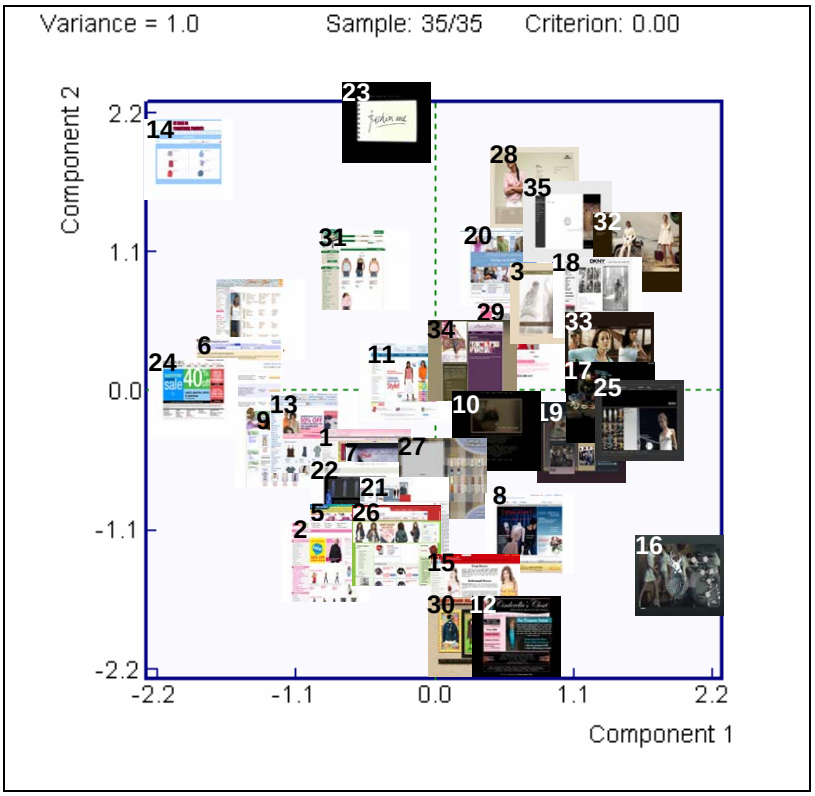

Figure 5.8: PC Score for PC1 & PC2.

Figure 5.8 shows result of PC Score, which made possible the visualization of specimen which holds strong emotion. Those located at the edge of the corresponding space of emotion, have strong meanings. For example, it can be concluded that specimen no. 24 which is located at the very left edge, indicates very much "not attractive". Specimen no. 14, at the upper-left, is "not attractive" and "simple". Specimen no.16, 25 and 32 are at the very right edge, which indicates "attractive". Specimen no. 12, 30 and 15 are at the bottom-right space, which indicates “attractive” and "crowded".

Specimen in "not attractive" category, for instance specimen no. 24 and 14 seems to have small size pictures, consist of more text, observable empty spaces, and no modelling on clothing. On the contrary, specimen like specimen no. 16, 32 and 25 are having large size picture, very less empty space, less text and model is used to demonstrate clothing. Also, specimens with darker backgrounds are mostly considered as "attractive" but "complex".

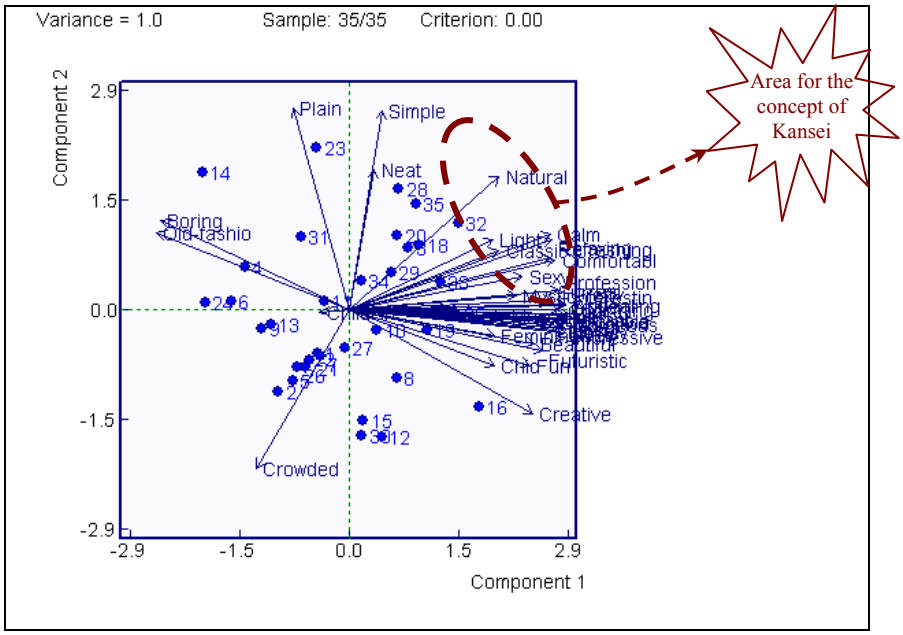

Figure 5.9:PC Vector for PC1 & PC2.

Figure 5.9 shows result of **PC Vector**, which visualize the relationship between specimen and emotion over PC1 & PC2. The chart enables the display of 35 specimen axes against 40 emotion axes in 2 dimensional spaces. It is evident in the chart that most specimen are very well distributed to all emotion vectors and have high influence to emotion. Therefore, it can be concluded that the first and second PC are very important determinants in Website UID. The result has also showed weight in large PC1 and PC2 value. The dotted circle indicates the area. This is the area where new concept of design should be roughly identified and proposed to be considered as new strategy to build innovative website design. Figure 5.7, 5.8 and 5.9 have provided evidence that determining the structure of emotion over the first and second principle component is essential.

B. PC1 and PC3

PCA was also calculated for PC1 and PC3 to identify strength and influence of the two components in the structure of emotion, determine relationship between emotion and specimen, and direction of strategy for future website design.

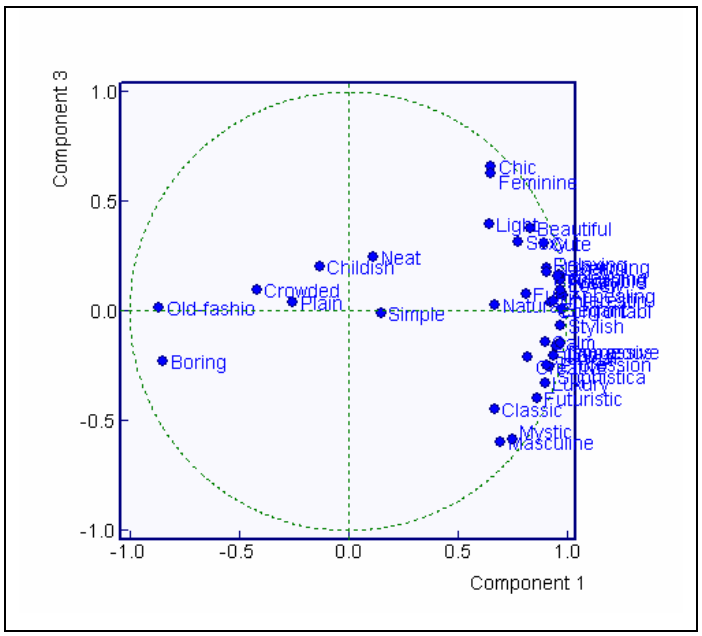

Figure 5.10: PC Loading for PC1 & PC3.

Figure 5.10 shows **PC Loadings** for PC1 and PC3. As evident from the figure, the structure of emotion in the first PC can be clearly observed. Emotion that produced large positive first PC Loadings (x-axis) are such as "Elegant", "Gorgeous", and "Stylish". The dense area of the right hand side of the chart is corresponding to such emotion. On the other hand, emotion that produced large negative second PC Loadings are "Boring" and "Old-fashioned". Therefore, this PC can be represented as the axis of "Attractiveness". Specimen with higher score on this component is likely to have higher sense of attraction and conversely.

However, the structure of emotion in the third PC is vague. The variance is very small and dimension of data structure is difficult to be captured. Therefore, discovering determinants of emotion over PC 1 and 3 is probably meaningless.

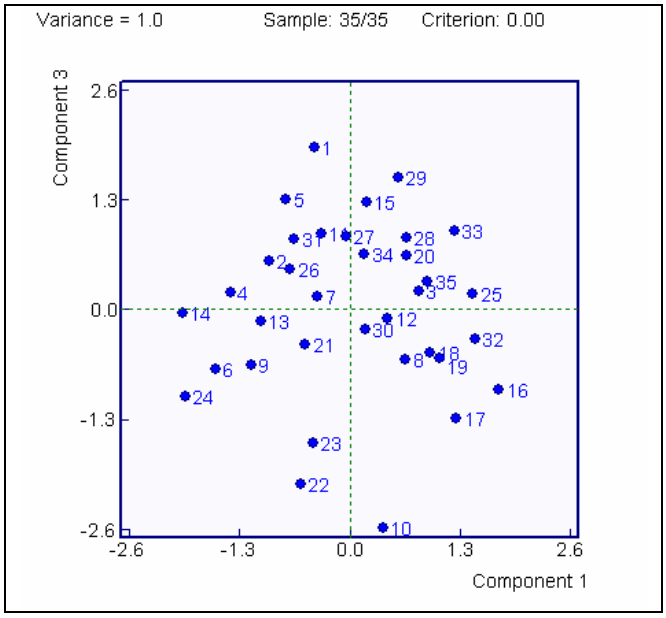

Figure 5.11: PC Score for PC1 & PC3.

Figure 5.11 shows **PC Score** of specimen in PC1 and PC3. It should be noted that the purpose of this PCA is to identify strength of specimen's emotional signature. As evident from the figure, websites are concentrated to centre space and structure of specimen is indistinguishable. Specimen's emotions are difficult to discriminate and none can be specifically presumed as holding strong emotion. Furthermore, most specimens seem to have weak influence to emotion. Therefore, visualizing specimen's emotion by first and third PC is also probably meaningless.

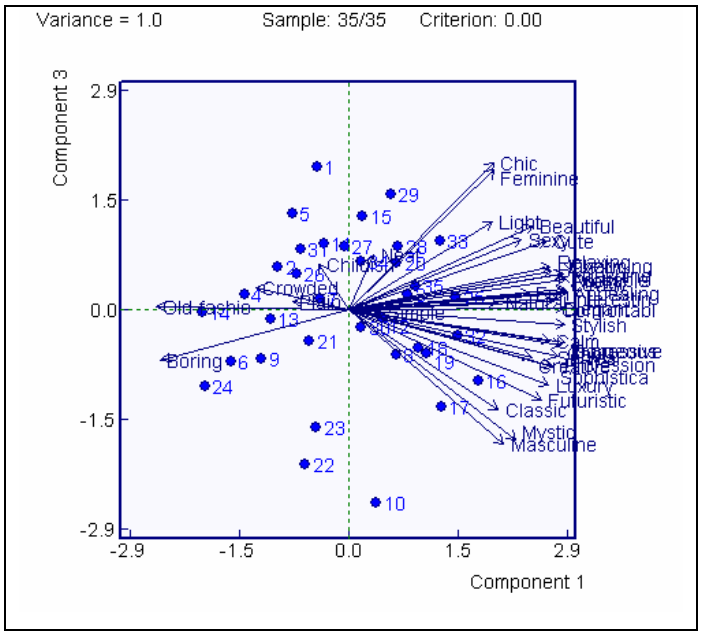

Figure 5.12: PC Vector for PC1 & PC3.

Figure 5.12 shows **PC Vector** over PC1 and PC3. The vector figure enables the display of specimen axes, i.e. 35 axes, against emotion axes, i.e. 40 axes, in the first and third PC. The vector chart shows that most specimens are having weak emotion and probably insignificant. Figure 5.10, 5.11 and 5.12 have provided evidence that analysing the structure of emotion over the first and third PC is meaningless.

C. PC2 and PC3

PCA was calculated for PC2 and PC3 to identify strength and influence of the two components in the structure of emotion, determine relationship between emotion and specimen, and direction of strategy for future innovative website design.

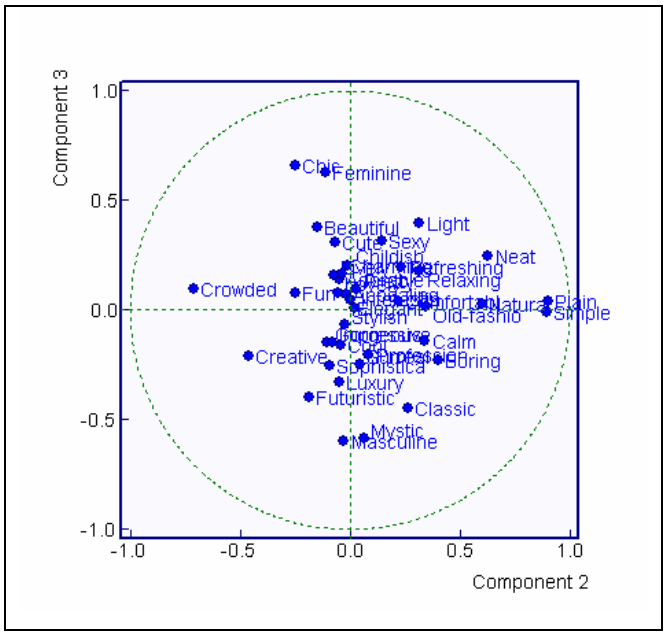

Figure 5.13: PC Loading for PC2 & PC3.

Figure 5.13 shows result of **PC Loading** for PC2 and PC3. As evident from the figure, the structure of emotion in the second and third PC is indefinite. The variance is very small and dimension of structure is almost impossible to capture. The space cannot recognize the difference of emotion and therefore, discovering determinants of emotion over PC2 and PC3 is probably meaningless.

Figure 5.14 shows **PC Score** of specimen in PC2 and PC3. It should be noted that the purpose of visualizing PC Score is to identify strength of specimen's emotion. As evident from the figure, specimens are concentrated to centre space and distinguishing specimen structure is probably impossible. Specimen's emotions are difficult to discriminate and mostly hold weak emotion. Therefore, visualizing specimens and emotion over the second and third PC is probably pointless.

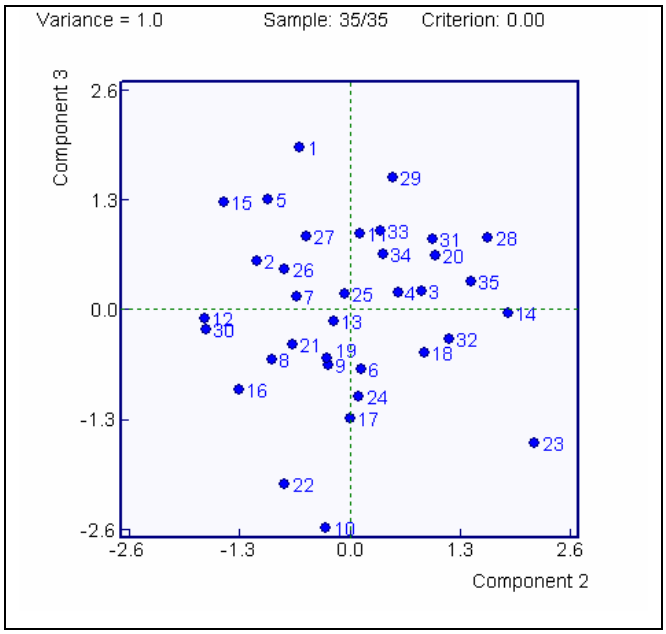

Figure 5.14: PC Score for PC2 & PC3.

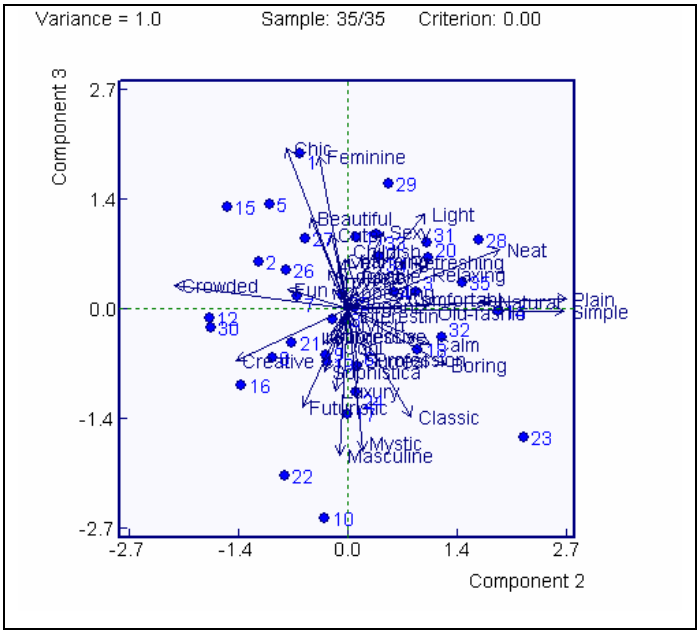

Figure 5.15: PC Vector for PC2 & PC3.

Figure 5.15 shows **PC Vector** that shows relationship between specimen number and emotion over PC2 and PC3. The figure enables the display of 35 specimen axes against 40 emotion axes over the second and third PC. The vector chart shows that the structure of specimens and emotion are indistinguishable. This means that the

space cannot recognize the structure of emotion. Figure 5.13, 5.14 and 5.15 have provided evidence analysing the structure of emotion over the second and third principle component is meaningless, and therefore should be ignored.

D. PCA by Population Size, Educational and Gender Background

In addition to all the above PCA, the research also performed PCA to different population size, educational background and gender to explore the structure of emotion that formed in different specimen size, background and gender. Table 5.11, 5.12 and 5.13 summarizes the respective results.

Table 5.11: Differences in the Structure of Emotion with Population Size.

Population Size	1st axis	2nd axis
30	Attractiveness	Masculine-Feminine
60	Attractiveness	Masculine-Feminine
90	Attractiveness	Masculine-Feminine
120	Attractiveness	Masculine-Feminine

Table 5.12: Differences in the Structure of Emotion with Educational Background.

Educational Background	1st axis	2nd axis
Architecture, Building, Planning & Survey	Complexity	Artistic
Business	Attractiveness	Masculine-Feminine
Engineering	Attractiveness	Masculine-Feminine
IT	Attractiveness	Masculine-Feminine

Table 5.13: Differences in the Structure of Emotion with Gender Background.

Gender	1st axis	2nd axis
Female	Attractiveness	Masculine-Feminine
Male	Attractiveness	Masculine-Feminine

The result shows that structure of emotion from different data populations and gender backgrounds are similar. From the result, the research concluded that the size of data population and gender background used in the research instruments does not affect the structure of emotion in Website UID. However, in educational background, although most of them produced similar result, there was slight difference structure. Though minimal, it may call for further research to understand if there are variations in design requirements should a website is designed for a particular social group. The research has also found that the structure of emotion formed by the Architecture, Building, Planning and Survey students was very much different from others. This would be another factor that is interesting to explore.

These results provide useful knowledge to the research involving K.E. adoptions, particularly in deciding subject demography and specimen size. Further elaboration regarding this result can be found in the research publications.

5.4.2.3 Concluding the Components

As evident from the overall result of PCA, it can be concluded that the first PC has a very strong influence to specimens because it has many positive emotion. On the other hand, the second PC has a weak contribution because only few emotion found in positive and negative space. However, analysing the third principle component is meaningless since the structure of emotion is mostly unrecognisable. In all arguments, negative value can be ignored because it has no meaning in the bigger picture, and in determining new concept of website design.

Finally, from the PCA the research could conclude that the structure of emotion on Website UID is influence by two components, which could be represented as attractive and simple axes. In addition, blending and balancing these two components are determinants for a new concept of website design.

5.4.2.4 The Concept of Emotion

The research discovered the concept of emotion by the use of Factor Analysis (FA). The research used Excel Statistic 2000 for Windows, Release 2, to perform the analysis. FA was performed to find significant factor of emotion in order to determine the concept of emotion in Website UID. The result is also used to refine the outcome of PCA. Table 5.14 shows result of FA after varimax rotation.

Table 5.14: Factor Contribution Table.

Factors	Variance	Contribution	Cumulative Contribution
Factor1	16.09262	40.23%	40.23%
Factor2	12.29421	30.74%	70.97%
Factor3	3.427578	8.57%	79.54%
Factor4	1.856272	4.64%	84.18%
Factor5	1.810882	4.53%	88.70%
Factor6	0.923415	2.31%	91.01%
Factor7	0.370649	0.93%	91.94%
Factor8	0.250962	0.63%	92.57%

Varimax rotation, which was originated by Kaiser (1958), is the most popular rotation method that simplifies the interpretation of variables. In the table, it is evident that the first factor explains 40.23% of the data and the second factor explains 30.74% of the data. Both factors represents majority of factor contributions. This shows that Factor1 and Factor2 have dominant influence to emotions. The first

two factors together represent 70.97% of the variability while three factors explain 79.54% of the variability. Thus, the research has considered to include the third factor to increase proportion that represents most of the data. The proportion of variability explained by the fourth factor and the rest are minimal (4.64, and less) and they probably can be ignored as they can be considered as insignificant.

Table 5.15 shows factor loading results after varimax rotation. The table shows factor results in ascending order, which enable the observation of the structure of emotion. Variables that have high score are perceived as significant factors in website design. The research set approximately 0.7 as the reference score, and cross-check with the result of CCA was performed to make conclusions. In concluding factors, other variable that designer would consider as important and have a clear image on the emotion, even though the score is slightly lower, can also be included as a concept (Nagamachi, 2003).

It is evident from the table that Website Emotion is structured by 5 factors. The first factor consists of “Mystic”, “Futuristic”, “Masculine”, “Luxury”, “Sophisticated”, “Surreal”, “Impressive”, “Gorgeous”, “Cool” and “Professional”. The research labels this factor of emotion as the concept of “Exclusiveness”. The second factor consists of “Feminine”, “Chic”, “Beautiful”, “Cute”, “Sexy”, “Charming”, “Adorable” and “Elegant”. The research labels this factor of emotions as the concept of “Gracefulness”. The third factor consists of “Simple” and “Plain”. The research labels this factor of emotions as the concept of “Easiness”. The fourth factor consists of “Light”, and the research label this factor of emotion as the concept of “Lightness”. The fifth factor consists of “Neat” and “Natural”, and the research label this factor of emotion as the concept of “Orderliness”. In labelling each factor group, the research followed the common practice performed in K.E. to select representative words which one would feel could effectively describe the factor group (Nagamachi, 2003; Ishihara, 2005). The same procedure is also practiced in card-sorting method, where labelling set of words depends on what one would think could represent the group (Nielsen, 2004; Maurer & Todd, 2004). No right or wrong judgment in the selection of words that could be considered to represent a group of words.

Table 5.15: Factor Loadings for Emotions.

Variable	Factor 1	Variable	Factor 2	Variable	Factor 3	Variable	Factor 4	Variable	Factor 5	Variable	Factor 6
Old-fashion	-0.63658	Boring	-0.7165	Crowded	-0.75621	Old-fashion	-0.32332	Crowded	-0.14751	Sexy	-0.27922
Boring	-0.48494	Old-fashion	-0.56005	Creative	-0.38735	Classic	-0.31312	Futuristic	-0.07346	Professional	-0.21828
Crowded	-0.32642	Plain	-0.20683	Fun	-0.18822	Boring	-0.25308	Childish	-0.04615	Luxury	-0.20931
Plain	-0.24056	Crowded	-0.12096	Beautiful	-0.14024	Crowded	-0.14023	Creative	-0.0353	Natural	-0.18019
Childish	-0.12587	Masculine	-0.03035	Chic	-0.12356	Plain	-0.09611	Surreal	-0.03482	Elegant	-0.17607
Neat	-0.08089	Childish	-0.00303	Futuristic	-0.07561	Elegant	-0.0845	Sophisticated	-0.03047	Sophisticated	-0.16462
Simple	0.074309	Simple	0.01272	Lively	-0.04504	Feminine	-0.02387	Mystic	-0.0239	Pretty	-0.1374
Chic	0.074429	Neat	0.071114	Masculine	-0.03517	Luxury	-0.01355	Chic	-0.01935	Gorgeous	-0.12886
Feminine	0.076863	Mystic	0.07129	Gorgeous	-0.02233	Mystic	0.0029	Boring	-0.00458	Masculine	-0.10923
Light	0.207687	Classic	0.163249	Lovely	-0.0181	Sophisticated	0.016201	Sexy	0.003378	Stylish	-0.08885
Sexy	0.331522	Futuristic	0.280862	Luxury	-0.00631	Childish	0.025722	Feminine	0.016585	Beautiful	-0.07192
Beautiful	0.374761	Natural	0.330482	Sophisticated	-0.00083	Simple	0.036659	Stylish	0.018739	Calm	-0.06293
Natural	0.441406	Luxury	0.371082	Impressive	0.000483	Sexy	0.040067	Cool	0.027831	Futuristic	-0.05094
Cute	0.496071	Creative	0.396901	Feminine	0.001229	Calm	0.046655	Fun	0.053902	Lovely	-0.05033
Refreshing	0.531366	Surreal	0.403716	Childish	0.031075	Neat	0.058611	Gorgeous	0.059308	Charming	-0.04773
Relaxing	0.542049	Professional	0.422046	Adorable	0.050591	Lovely	0.07234	Impressive	0.070253	Relaxing	-0.04356
Fun	0.584514	Calm	0.43233	Cool	0.050606	Beautiful	0.079377	Adorable	0.07352	Neat	-0.02651
Charming	0.608486	Cool	0.452857	Cute	0.052333	Charming	0.099585	Cute	0.079857	Feminine	-0.02508
Lively	0.609006	Sophisticated	0.454403	Charming	0.053124	Natural	0.103452	Appealing	0.08061	Refreshing	-0.02103
Adorable	0.634559	Fun	0.485034	Appealing	0.070557	Gorgeous	0.114726	Masculine	0.080931	Mystic	-0.01844
Pretty	0.644852	Impressive	0.499061	Stylish	0.075091	Creative	0.117443	Charming	0.086472	Impressive	-0.01071
Comfortable	0.651799	Light	0.516554	Elegant	0.07626	Stylish	0.118513	Luxury	0.089728	Comfortable	-0.00588
Elegant	0.654266	Comfortable	0.517832	Pretty	0.078092	Pretty	0.121952	Elegant	0.111059	Lively	-0.00444
Lovely	0.670698	Gorgeous	0.535256	Interesting	0.080639	Cute	0.122288	Simple	0.120313	Appealing	0.003724
Appealing	0.684715	Interesting	0.575072	Professional	0.101728	Chic	0.131613	Classic	0.138663	Interesting	0.009151
Interesting	0.715587	Stylish	0.593335	Mystic	0.144576	Futuristic	0.142613	Old-fashion	0.163216	Surreal	0.015131
Calm	0.746448	Refreshing	0.601365	Surreal	0.152432	Surreal	0.144429	Interesting	0.166216	Cool	0.017896
Stylish	0.759938	Relaxing	0.659823	Old-fashion	0.173046	Professional	0.151593	Pretty	0.1834	Simple	0.029741
Creative	0.777329	Lively	0.677778	Comfortable	0.194254	Appealing	0.167841	Professional	0.191414	Boring	0.032627
Classic	0.794316	Appealing	0.682461	Refreshing	0.204192	Relaxing	0.194902	Plain	0.197953	Crowded	0.040466
Professional	0.805803	Pretty	0.689458	Sexy	0.272922	Impressive	0.202914	Lively	0.201622	Adorable	0.046115
Cool	0.811333	Lovely	0.690027	Classic	0.275441	Masculine	0.211368	Lovely	0.207907	Creative	0.055077
Gorgeous	0.812754	Elegant	0.703414	Boring	0.308598	Adorable	0.21181	Beautiful	0.239447	Classic	0.063075
Impressive	0.822734	Adorable	0.713039	Light	0.313839	Cool	0.284239	Relaxing	0.247409	Light	0.066423
Surreal	0.846445	Charming	0.763686	Neat	0.319281	Interesting	0.308149	Light	0.274663	Plain	0.066736
Sophisticated	0.848426	Sexy	0.787619	Calm	0.339163	Comfortable	0.320447	Calm	0.302602	Chic	0.131081
Luxury	0.878831	Cute	0.794058	Relaxing	0.348516	Lively	0.328505	Comfortable	0.328556	Old-fashion	0.144072
Masculine	0.899118	Beautiful	0.816958	Natural	0.424887	Refreshing	0.390941	Refreshing	0.354777	Fun	0.222652
Futuristic	0.913165	Chic	0.93916	Plain	0.839005	Fun	0.49998	Natural	0.604973	Cute	0.276694
Mystic	0.941857	Feminine	0.948707	Simple	0.9241	Light	0.610599	Neat	0.738318	Childish	0.633318

As evident from the result of FA, the concept of emotion in Website UID is structured by five factors; Exclusiveness, Gracefulness, Easiness, Lightness and Orderliness. These five factors altogether explains 88.70% of the total data, and thus influence highly to the design of website that embeds target emotion.

Additionally, as also evident from the result, the first and second factors explain 70.97% of data variance. Thus, the two factors, i.e. Exclusiveness and Gracefulness are very important concepts of emotion. This suggests that websites should include these two concepts in order to achieve optimum result. Easiness, Lightness and Orderliness are also important but have weak influence. Hence, these concepts are suggested to be used as supporting elements in the design of website that embeds target emotion.

In comparison to PCA, FA shows more detailed result. PCA shows the big picture of the structure of emotion, where it has shown that the first PC (Attractiveness) has very strong influence to emotion, and the second principle component (Simplicity) has weak influence. FA has detailed out the structure of emotion, where it determined significant factors of emotion. Hence, the structure of emotion resulted by PCA is refined by the identification of the concept of emotion in FA.

5.4.3 The Requirement Analysis

In analysing design requirements, Partial Least Square (PLS) analysis was performed to identify relationships of emotion and design elements. Additionally, Cluster Analysis (CA) was performed to investigate the cluster of Website Emotion, which is to be used as supporting means in the use of the design requirements to develop website that embeds target emotion

5.4.3.1 Partial Least Squares (PLS) Analysis

The PLS analysis was performed using SAS JMP version 7. PLS, in order to discover relationships between emotion and website design elements. It is also used to discover influence of design elements in each emotion, the best and worst value for each design elements, and the kind of emotion elicited by each specimen.

In the research, three sets of data were used for this analysis, and they were:

1. The dependent (objective) variables, *y*, i.e. the 40 sets of emotional responses by 120 subjects.
2. The specimen, *s*, i.e. 35 websites.
3. The independent (explanatory) variables, *x*, the design elements.

The investigation of design elements in the earlier phase of this research has resulted 77 design elements and 249 values. For PLS analysis purposes, all these elements were converted into dummy variables. A sample of the converted data is shown in Table 5.16.

Table 5.16: Sample of the Converted Dummy Variables.

Specimen ID	Design elements							
	BgColour White	BgColour Black	BgColour DkBrown	BgColour LtBrown	BgColour Grey	BgColour LtBlue	BodyBgSt Picture	BodyBgSt Texture
1	1	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0
3	0	0	0	1	0	0	0	0
4	1	0	0	0	0	0	1	0
5	1	0	0	0	0	0	0	0
6	1	0	0	0	0	0	0	0
7	1	0	0	0	0	0	1	0
8	1	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0	0
10	0	1	0	0	0	0	0	0
11	1	0	0	0	0	0	0	0
12	0	1	0	0	0	0	0	0
13	1	0	0	0	0	0	0	0
14	1	0	0	0	0	0	0	0
15	1	0	0	0	0	0	0	0
16	0	0	0	0	1	0	0	0

Result of the average data, e.g. 'Adorable' data was then appended to the next column after the last column of design elements. This research has 40 predictors and therefore the analysis was repeated 40 times, exchanging the 40 predictors into the last column. Instance from the result for the emotion 'Adorable' can be found in Table 5.17.

Table 5.17: Percent of Variation Explained for Adorable.

Number	X	X	Cumulative X	Y	Y	Cumulative Y
1	7.231		7.231	83.21		83.21
2	7.06		14.29	9.884		93.09
3	5.791		20.08	4.375		97.46
4	4.12		24.2	1.781		99.24
5	5.764		29.97	0.403		99.65
6	4.635		34.6	0.251		99.9
7	3.776		38.38	0.072		99.97
8	3.09		41.47	0.018		99.99
9	2.318		43.79	0.008		100
10	3.782		47.57	0.002		100
11	3.159		50.73	0.001		100
12	2.317		53.05	0		100
13	2.771		55.82	0		100
14	2.905		58.72	0		100
15	2.891		61.61	0		100

As evident from the table, the default number of latent variables, i.e. three, resulted 97.46% of the variation. Thus, the research concludes that the three latent variables are sufficient to explain the total variance. The rest of the variables account for a very small proportion of the total variability and are probably unimportant. This shows that they have very less influence to the variable and probably can be ignored.

Table 5.18 shows a sample of the coefficient score calculated by PLS analysis. The research analysed the result of PLS coefficient score to discover relations between emotion and design elements. The following sub-sections describe how the use of these scores enables the identification of how the combinations of design elements influence emotion.

Table 5.18: Sample of the PLS Coefficient Score.

Category	Emotion					
	Adorable	Appealing	Beautiful	Boring	Calm	Charming
BodyBgColour-White	-0.0365510	-0.03699	-0.01674	0.024457	-0.02534	-0.0355
BodyBgColour-Black	0.0065448	0.011992	-0.01374	-0.00265	0.028478	0.005989
BodyBgColour-DkBrown	0.0604354	0.067045	0.018645	-0.03459	0.034535	0.062087
BodyBgColour-LtBrown	0.0132480	0.011571	-0.00476	0.006006	0.017753	0.021147
BodyBgColour-Grey	0.0293157	0.036547	0.050832	-0.044	0.006308	0.033964
BodyBgColour-LtBlue	0.0214068	0.004199	0.01559	-0.01155	-0.01207	0.005272
PageMenuShape-Curve	0.0005942	-0.01064	0.006802	-0.00788	-0.00697	-0.01168
PageMenuShape-Sharp	-0.0122160	-0.00199	-0.02235	0.021834	0.006232	-0.00213
PageMenuShape-Mix	0.0286988	0.024137	0.042154	-0.03895	-0.00256	0.026368
PageStyle-Frame	0.0340362	0.025436	0.027154	-0.03955	0.005176	0.005524
PageStyle-Table	-0.0420300	-0.03508	-0.02236	0.04195	-0.01811	-0.01117
PageOrientation-BC	-0.0447260	-0.04155	-0.03098	0.026269	-0.03299	-0.0298
PageOrientation-Content	0.0326846	0.037362	0.004381	0.011088	0.024659	0.034727
PageOrientation-Header	-0.0546260	-0.05817	-0.03232	0.037364	-0.03451	-0.06225
PageOrientation-HF	0.0157878	0.015311	0.026275	-0.01806	0.00773	0.014688
PageOrientation-HSplit	0.0228924	0.02168	0.004236	-0.01846	0.016584	0.022154
PageOrientation-VSplit	0.0189942	0.034075	0.030549	-0.02336	0.016852	0.028757
PageOrientation-Plain	0.0241808	0.019132	0.007982	-0.01443	0.015297	0.005532
DominantItem-Pict	0.0467300	0.048044	0.030602	-0.04358	0.014746	0.050762
DominantItem-Adv.	-0.0296800	-0.03225	-0.01741	0.019399	-0.00744	-0.02078
DominantItem-Text	-0.0561230	-0.04549	-0.02663	0.050166	-0.00284	-0.04293

A. Calculating PLS *Range* to Determine Design Influence

In order to determine influence of design elements to emotion, PLS *Range* for each emotion were calculated. The calculation of *Range* enables the identification of design influence, the good design and bad design.

Range was calculated using maximum and minimum value, where

$$Range = PLS_{Max} - |PLS_{Min}|$$

Mean of *Range* was calculated, where

$$\overline{Range} = \frac{1}{n}\sum_{i=1}^{n} Range_i$$

Each emotion has means of *Range*, and if the mean value of a design element is larger than $\overline{Range}$, the item is considered to have good influence in design. *Range* for every design element's value that is bigger than $\overline{Range}$ implies best fit value which highly influences user's emotion in Website UID.

Table in Appendix 6 shows sample of the calculated *Range* for each design elements and value in respective emotion. The table contains a column entitled 'Design Element', which lists down the design elements identified in earlier phase of this research. The second column, 'Value', is the value of the identified elements. The third column shows the score of each value. From each value, largest positive PLS score indicates elements leading to good design, and largest negative value shows elements leading to bad design.

In the table, each of maximum and minimum score is highlighted respectively. Maximum score shows best fit value of design elements that influence emotion, and minimum score shows the worst value of design elements to influence the emotion. For instance, best body background colour that leads to the emotion 'Adorable', is 'Dark Brown'; body background colour that must be avoided in designing 'Adorable' website is 'White'. Best dominant element to include in designing 'Adorable' website is 'Picture'; dominant element that must be avoided in designing 'Adorable' website is 'Text'. The rest of the interpretation follows. The fourth column lists the *Range* for each design elements in each emotion.

Tables in Appendix 7 shows sample of results of the influential design elements, which have *Range* bigger than $\overline{Range}$ in each emotion. The results are sorted in

descending order to illustrate sequence of dominant design elements for each emotion. To demonstrate the result, the following Table 5.19 provide some sample of the result.

Table 5.19: A Sample of the Influence of Design Elements to Emotion.

Design INFLUENCE No.	Adorable		Appealing	
	Design Element	Range	Design Element	Range
1	Page Colour	0.11488	Header Bg Colour	0.12338
2	Product Display Style	0.10644	Face Expression	0.12216
3	Header Menu Bg Colour	0.10612	Header Menu Bg Colour	0.12077
4	Left Menu Font Colour	0.10370	Product Display Style	0.10646
5	Header Bg Colour	0.10218	Body Bg Colour	0.10574
6	Face Expression	0.10024	Page Colour	0.10091
7	Body Bg Colour	0.10015	Left Menu Font Colour	0.10085
8	Dominant Item	0.09980	Picture Style	0.09771
9	Header Font Size	0.09651	Page Orientation	0.09182
10	Main Text Existence	0.08813	Dominant Item	0.09141
11	Main Bg Colour	0.08587	Main Text Existence	0.08811

The result suggests that to design 'Adorable' website, designer must set priorities to design elements according to the high influence, i.e. 'Page Colour', 'Product Display Style', 'Header Menu Background Colour', 'Left Menu Font Colour', and so forth. On the other hand, to design 'Appealing' website, designer must set priorities to design elements according to the high influence, i.e. 'Header Background Colour', 'Face Expression', 'Header Menu Background Colour', and so forth.

Tables in Appendix 8 shows sample of the *Range* score for each design elements in each emotion, which illustrates the difference of scores for each emotion. The table shows the difference of scores in each design elements within certain emotion.

B. Website and Emotion

PLS analysis also enabled the identification of website that best fit to certain emotion. Tables in Appendix 9 illustrates the sample of result of PLS score for each emotion in relation to each specimen website. In the table, largest positive value indicates specimen that best fit to the emotion. On the other hand, largest negative value indicates most unfit specimen to the emotion. This result enables the research to discover and visualize which specimen is highly related to which emotion. The result as demonstrated in Appendix 9 provides clues in designing Kansei Website. For example, it is evident that the best fit specimen which evoked 'Adorable' emotion is specimen no. 16. The best fit specimen that induced 'Classic' emotion is specimen no.18. Table 5.20 provides the summary of specimen and the implied emotion identified form the PLS scores.

Table 5.20: Website and Emotion.

Specimen ID	Emotion
1	Chic
2	Crowded
14	Boring, old-fashion
16	Impressive, Gorgeous, Futuristic, Luxury, Pretty, Interesting, Lovely, Professional, Creative, Appealing, Adorable, Lively, Mystic, Sophisticated, Cute, Beautiful, Fun, Surreal
17	Cool, Masculine, Calm
18	Classic
20	Light, Natural, Neat
23	Simple, Plain
25	Sexy , Elegant, Feminine
27	Childish
32	Relaxing, Charming
33	Stylish, Refreshing, Comfortable

The result has enabled the research to provide a set of example as a reference in designing Kansei Website.

5.4.3.2 Clustering the Website Emotion

In addition to the above presented analysis, the research explores classification of Website Emotion by the use of Custer Analysis (CA). The aim of CA is to group emotion in such a way that those allocated to a particular group are close together. It should be noted that CA is a descriptive method and its success or otherwise is to be determined by whether or not it produces meaningful clusters (Bartholomew et al., 2002). The research used the agglomerative hierarchical method, i.e. to take distances measured to somewhere near to the centre of the cluster, to determine cluster of emotion. The similarity is assessed according to Euclidean distance, the straight line differences between the points, as the distance metric. The resulting cluster would be useful as a guide to the look of Website UID in producing Kansei Website.

The research plot the distance scale of emotional responses onto a horizontal dendrogram, as it is often easier to interpret (Bartholomew et al., 2002; Kogan, 2006). In concluding the cluster of emotion, 11-point solution using dissimilarity method was used, as it is believed to produce meaningful clusters. The dendrogram is shown in Figure 5.16.

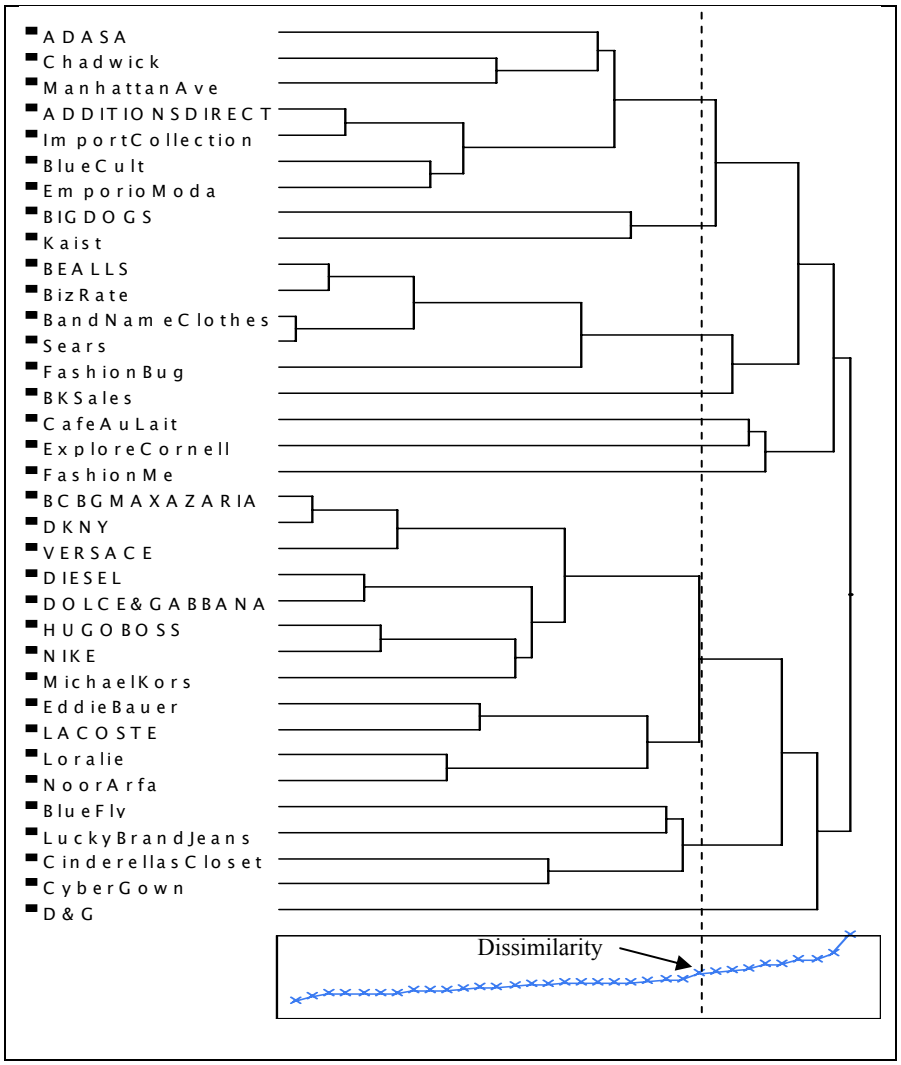

Figure 5.16: Dendrogram for the Hierachical Clustering of Emotion.

To illustrate the result, the research established visualization of the cluster to provide easy reference in the design process of Kansei Website. In each cluster, the emotion with high evaluation value that corresponds well to the plot of the PC Loading is selected as a representative emotion of the cluster. The following figures present some example of the denoted clusters.

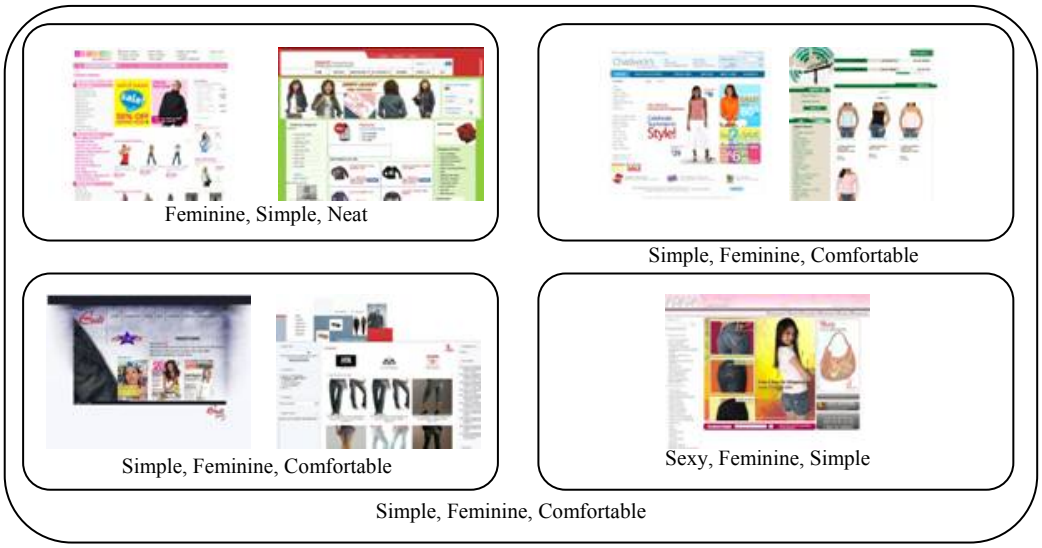

Figure 5.17: Cluster 1 - Simple, feminine, comfortable.

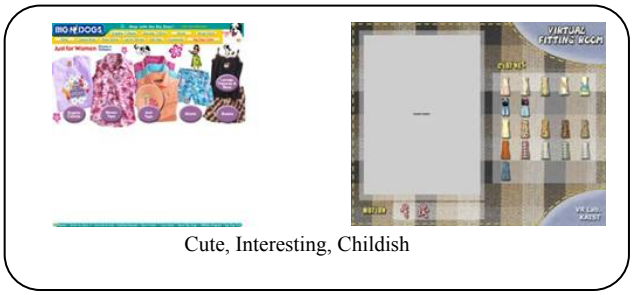

Figure 5.18: Cluster 2 - Cute, interesting, childish.

Figure 5.19: Cluster 5 - Cool, impressive, masculine.

Figure 5.20: Cluster 9 - Refreshing, simple, natural.

Figure 5.21: Cluster 11 - Impressive, gorgeous, futuristic.

The clusters show designs of websites that elicit different kind of emotion from the experiment. In designing website that is targeted to elicit the intended emotion, these results are suggested to be used as a reference to support the guideline.

5.5 Proposing Kansei Web Design Guideline©

All the above analyses have enabled the research to develop a proposed Kansei Web Design Guideline©, a guideline to the design of Kansei Website. Results of structure of emotion from FA and PCA were used to conceptualise emotion, and result from PLS Scores were used to compose the design requirement. The design requirements included in the guideline were from the elements that have highest influence in eliciting target emotion.

Table 5.21 shows sample of the result of the proposed guideline. A complete set of the guideline is provided in Appendix 10.

Table 5.21: Sample from the proposed Kansei Web Design Guideline©.

Factor No.	Concept Of Emotion	Element Of Emotion	Design Element							
			Body Bg Colour	Body Bg Style	Page Shape	Page Orienta-tion	Dominant Item	Page Colour	Page Size	. . .
1	EXCLUSIVENESS	MYSTIC	Black	Colour Tone	N/S	Plain	Picture	Black	Medium	
		FUTURISTIC	Black	Colour Tone	Sharp	Plain	Picture	Grey	Small	
		. . .								
2	GRACEFULNESS	FEMININE	Light Blue	Texture	Sharp	Footer	Picture	Pink	Small	
		CHIC	Light Blue	Texture	Sharp	Footer	Picture	Colour-ful	Small	
		. . .								
. . .										

To effectively utilize the guideline, audience especially designers are advised to select the best combination possible from a concept of emotion, that may comprise of one or more element of emotion. It should be noted that it is important to blend designer's creativity with the guideline to ensure the success of Kansei product (Nagamachi, 2003), in this research case Website UID. To illustrate example of the guideline, design elements for the emotion 'Mystic' should be interpreted as;

(i) Body background colour should be in 'Black',
(ii) Body background style should be 'Colour Tone',
(iii) Page shape should be 'Not Specific',
(iv) Page Orientation should be 'Plain',
(v) Dominant item should be 'Picture'.

The rest of the interpretation follows. Nevertheless, the success of the development of Kansei Website relies on two factors, which are the idea which was implied from the result of emotion evaluation, and combination of designer's technical expertise. In the design process, the guideline should be referred, and technical specifications must be considered by web design expert.

5.6 Summary

This chapter has described in detail the outcome of Exploratory Study and application of several statistical methods. The research has successfully conceptualised emotion in website designed using the results obtained from CCA, PCA and FA. The result of the analyses also provides empirical evidence that answer the research questions described in Chapter 1. With the empirical evidence, the research have discovered that website emotion can be quantified, identified design elements that compose the external appearance of a website from user's view-point, discovered evidence that user's emotional responses can be translated into website design requirements, and that user's emotional responses can be classified according to composition of website design elements.

In conclusion, this chapter has described how this research achieve its objectives, which are to propose a methodology to measure and engineer emotion in Website UID, to provide evidence that emotional signature exists in Website UID through an empirical study, and to investigate the structure of emotion in Website UID, the significant factors, and the influence of design elements to emotion.

Finally, the result has enabled the research to propose:

- Kansei Web Design Guideline©, a guideline to the design of Kansei Website.

Also, as a supporting scheme to the guideline, clusters of emotion for all specimens were also analysed. The cluster provides useful and interesting clue in the process of designing Kansei Website.

Whilst the main anticipated outcome is constructively analysed, the research explore the differences of structure of emotion that formed by different population size, educational and gender background. The result provides useful knowledge to the study involving K.E. adoption in determining subject demography and population size.

The success of the measurement and engineering of emotion in this research phase could be used to provide hypothetical credence that the constructed method to measure and engineer emotion in Website UID in this research case as described in Chapter 4 is valid, thus also provide hypothetical belief that the developed Kansei Design Model described in the chapter is valid. All of these results are summarized neatly towards the end of this chapter, and validation of the proposed guideline is provided in the following Chapter 6.