Empirical Comparison of AHP and Conjoint Analysis on Training Attributes in the Gaming Industry in Macau SAR

Koo Leung Chee

Abstract: Casual comparison of the analysis results from AHP and Conjoint Analysis suggests that they are rather similar. Both approaches portray the importance (utility) scores of selected attributes of a product or service. This empirical study was conducted among 149 respondents from a large company in Macau, SAR. 90 were students of an Associate Degree programme in a Community College and 59 were management trainees. They were all briefed on how the methodologies of AHP and Conjoint Analysis work, before they complete the survey instrument on an anonymous basis. The main training attributes were developed during a course assignment. The six important training attributes identified by the respondents are: learning environment, training methods and contents, quality of trainers, cost effectiveness, continuous improvement through feedback, and recognition of qualification. The aim of this study is to compare the similarities and contrast the differences between AHP and Conjoint Analysis. As both AHP and Conjoint Analysis are gaining popularity among researchers, this empirical study helps provide useful insights to those who would be interested in using one or either or both of these research tools.
Key Words: Analytic Hierarchy Process (AHP); Conjoint Analysis; utility scores; training attributes; Macau SAR

Introduction

It is of paramount importance for service providers to understand the preference of choices attached by respective customer groups on various product (or service) attributes. An attribute is defined as characteristics or qualities that describe an object (Babbie, 2001). The relative weightings of importance for each of these attributes provide useful cues to explain why different people make different decisions on alternative choices. According to Saaty (1994), the decision making process has the following steps:

- Structure a problem with a model that shows the key elements and their relationships;
- Elicit judgments reflecting knowledge, feeling, or emotions;
- Quantify those judgments with meaningful numbers;
- Calculate the priorities of the elements of the hierarchy;
- Synthesize these results to ascertain an overall outcome; and
- Analyze sensitivity to changes in judgment.

In order to understand the similarities and differences of AHP and Conjoint Analysis, their basic characteristics are discussed.

Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process (AHP), developed by Saaty, uses a hierarchical approach to organize data for making decisions. It is about breaking a problem down and then

Koo, Leung Chee (2004) "Empirical Comparison of AHP and Conjoint Analysis on Training Attributes in the Gaming Industry in Macay SAR" Conference Proceedings of the International Conference on Gaming Industry and Public Welfare, 6-10th October, Beijing

aggregating the solutions of all subproblems into a conclusion. It is based on the innate human ability to make sound judgments about small problems (Hemaida and Kalb, 2001). The method must include and measure all important tangible and intangible, quantitatively measurable, and qualitative factors (Saaty, 1980). It is relatively simple to understand and easy to implement. AHP uses a series of paired comparisons in which the respondents judge about the relative dominance of two items (Clinton, et al., 2002; Murtaza, 2003; Yeh, et al., 2001). In AHP, the eigenvalue decomposition is applied to a matrix of numerical judgments with regard to a set of alternatives, yielding a set of priorities indicating the underlying preferences for the alternatives (Hahn, 2003). Murtaza (ibid.) reports that there are four essential steps for AHP approach, viz.:

- Reducing the problem into a hierarchy of interrelated decision elements (factors and alternatives);
- Collecting input data by pair-wise comparison of decision elements;
- Using the eigenvalue method to estimate the relative weights of decision elements, and
- Aggregating the relative weights to arrive at a set of ratings for decision making.

Analytic Hierarchy Process (AHP) can help solve selection and decision-making problems. It has been widely applied in many areas, e.g. marketing, finance, education, public policy, economics, medicine, sports, transport, technological choice, resource allocation, organization planning, etc. (Cheng and Li, 2003; Asahi et al., 1995). Stewart et al., (2001) report that utility is a measure of desirability or satisfaction and provides a uniform scale to compare and/or combine tangible and intangible criteria, whereas a utility function is a device which quantifies the preferences of the decision maker by assigning a numerical index to varying extent of satisfaction of a particular criterion. AHP can be used to determine the importance weightings of selection criteria (Cheung et al., 2001). According to Forman and Gass (2001), the AHP is a methodology for structuring, measurement, and synthesis. It converts individual preferences into ratio-scale weights that are combined into linear additive weights for the associated alternatives. AHP has three basic functions: (i) structuring complexity into hierarchical homogeneous clusters of factors; (ii) measuring on a ratio scale; and (iii) synthesizing the multitude of factors in a hierarchy.

Six important training attributes were identified and agreed among the 90 Associate Degree students who also participated in expressing their views via the AHP and conjoint analysis concurrently. The six important training attributes are:

A = Learning environment
B = Training methods and contents
C = Quality of trainers
D = Cost effectiveness
E = Continuous improvement through feedback
F = Recognition of qualification

A simple matrix can be constructed to calculate the utility scores. For simplicity purpose, the following scoring scheme is adopted. When X is compared to Y, and X is considered to be much more important than Y, a score of 10 is assigned to X. When X is considered to be slightly better than Y then a score of 5 is assigned to X. When X and Y are perceived to be equally important then a score of 1 is assigned to X. When X is considered slightly less important than Y, a score of 1/5 (or 0.2) is assigned to X.

When X is reckoned as much less important than Y, a score of 1/10 (or 0.1) is assigned to X. A particular attribute is compared in turn with all the other attributes in this manner and all the comparison scores are aggregated to reflect the importance of that particular attribute. This approach is repeated with all the attributes. The respective relative utility scores are then calculated for each attribute. These relative utility (or importance) scores for each respondent are unique and add up to 100. These respective importance scores bear a high degree of similarity with those calculated by use of conjoint analysis.

As an illustration, the following data represent the perception of the first respondent (labeled as P1) in the current survey. Instead of using the following matrix approach, a questionnaire can be designed and the scores can be easily computed. For n attributes, there will be n(n – 1)/2 possible pairs of comparisons. In this case we have 6(6 – 1)/2 or 15 pairs of comparisons. Accordingly, a 15-item questionnaire would suffice to replace the use of matrix. For this particular illustrated example, the scores are bolded (see Appendix 2: AHP) and the scores are re-represented in the following matrix.

Table 1: Illustrative example of calculation of AHP importance scores for Respondent P1

	A	**B**	**C**	**D**	**E**	**F**	Subtotal	Relative utility scores	Importance ratings
A	0	0.2	0.1	0.2	5	0.1	**5.6**	(5.6*100)/76.7 =	**7.30**
B	5	0	1	1	1	1	**9**	(9*100)/76.7 =	**11.73**
C	10	1	0	5	10	1	**27**	(27*100)/76.7 =	**35.20**
D	5	1	0.2	0	5	0.2	**11.4**	(11.4*100)/76.7 =	**14.86**
E	0.2	1	0.1	0.2	0	0.2	**1.7**	(1.7*100)/76.7 =	**2.22**
F	10	1	1	5	5	0	**22**	(22*100)/76.7 =	**28.68**
Total:							**76.7**		100

For this particular respondent, the importance scores of the six training attributes are depicted in the last column of the table above. These scores can be compared to those that would be computed from conjoint analysis (see Figure 1)

Conjoint Analysis

Conjoint analysis is a technique to find out how consumers trade off different attributes of a product or service (Jansson, Bointon and Marlow, 2003). Gustafsson et al. (1999) proposed the following steps for conducting a conjoint analysis:

1. Determine the research problem and objectives and estimate the amount of available resources;
2. Decide on the sampling approach;
3. Select a survey format;
4. Determine the relevant attributes and the levels of each attribute;
5. Configure attributes and levels into individual concepts;
6. Design the data collection instrument;
7. Conduct the survey;
8. Analyze the data;
9. Validate the results, both internally and externally; and

10. Interpret the results and draw conclusions.

Conjoint analysis is a technique for measuring trade-offs concerning preferences and intentions to buy. It can simulate situations in which consumers may react to changes in current product or to new products (Green et al., 2001). Conjoint analysis can be used to segment a market based on customer preferences (Koo, Tao, and Yeung, 1999).

Conjoint analysis has practical applications in a wide spectrum of diverse areas, and has been applied in various specific business sectors e.g. wood furniture (Anderson, et al., 2004; credit card (Kara et al. 1994); grocery and candy products, life insurance, retailing (Toombs and Bailey 1995); health club service retailers (Amirani and Baker 1995), eggs (Ness and Gerhardy 1994); property (Levy 1995) wine (Gil and Sanchez 1997); financial service (Arias 1996); and beef retailing (Hobbs 1996). Green et al. (2001) reported that after 30 years of development and application, conjoint analysis has survived the test of time. Additionally, it is also applied in fields as tourism, entertainment, health maintenance, gambling, and legal disputes.

This research uses conjoint analysis to measure utilities of various training attributes. Knowing which utility cues are most important to a particular customer group, the service provider can set priority and determine what should be improved in order to serve them better. They can also make predictions about consumers' purchase intentions (or choice decisions) in response to changes to these utility cues. Using these utilities in conjunction with other customer information (e.g. demographics, psychographics) the service provider can more effectively segment the market (Amirani and Baker 1995). This marketing philosophy can be applied equally well in serving internal customers (i.e. the trainees for the training department). The service provider (i.e. the training department in this context) can determine where improvement emphases should be made, and, where necessary, trade-off some attributes against the others.

Traditional research techniques in assessing consumer preference tend to treat each attribute independently and very little information on how consumers are likely to make a favourable or unfavourable buying decision is unearthed using these techniques. In reality, consumers do not consider each attribute of a product singly and independently when making a choice. Instead they consider the whole range of product attributes in totality. The conjoint based approach can help understand how customers trade off one product attribute against another. Conjoint analysis which engages the respondents in a more realistic judgement stance than do other research methods, can better predict the overall consumer preference through aggregating the utility scores of all individual product attributes (Levy 1995). It has become a popular method for identifying and understanding the combined effects of product attributes on preferences for a product (Hobbs 1996). It enables not only the assessment of product attributes in a multi-cue setting, but also the quantification of the effect in terms of utility scores. The incorporation of customised set of attributes for different respondents enables the impact of different product attributes to be analysed in the context of cues directly relevant to particular market segments (Diamantopoulos et al. 1995).

Conjoint analysis is also known as "trade-off analysis" or "utility analysis". Two basic assumptions are made in conjoint analysis (Gil and Sanchez 1997). Firstly, a product /

service can be described as a combination of levels of a set of attributes. Secondly, these attribute levels determines consumers' overall evaluation of the product / service.

The attraction of using conjoint analysis is that it asks the respondents to make choices between products defined by a unique set of product attributes in a way resembling what they normally do - by trading off features, one against the other. When asked which attributes they would like, most customers will choose everything on the wish list. Conjoint can establish the relative values of particular attributes and identifies the trade-offs the customers are likely to make in choosing a product and service and the price they are willing to pay for it (Toombs and Bailey 1995). The relative importance of each attribute can be calculated as the utility-range (i.e. difference between the highest and the lowest utility for that attribute) divided by the sum of utility ranges of all attributes (Okechuku 1993). Conjoint analysis produces two important results (Levy 1995):

- **Utility of attribute:** *Is is a numerical expression of the value consumers place in an attribute level. It represents the relative "worth" of the attribute. Low utility indicates less value; high utility indicates more value.*
- **Importance of attribute:** *It can be calculated by examining the difference between the lowest and highest utilities across the levels of attributes.*

According to Ness and Gerhardy (1993), conjoint analysis helps identify consumer segments with similar preferences. Arias (1996) suggests that the conjoint-based method of preferential segmentation outperforms other techniques in that it provides a higher level of intra-group homogeneity and inter-group heterogeneity as far as the most preferred product / service design is concerned.

Approaches to Conjoint Analysis

There are two general approaches to data collection for conjoint --- the two-factor-at-a-time trade-off method and the multiple factor full-concept method. The two-factor-at-a-time trade-off method is now seldomly used. The full-concept is more realistic as all factors are considered and evaluated at the same time.

In the full-concept (or full-profile), the respondents are asked to rank or score a set of profiles according to their preference. On each profile, all factors of interest are represented and a different combination of factor levels (i.e. features) appears. The factors are the general attribute categories of the product / service such as colour, size, or price. The factor levels (i.e. product / service features) are the specific values of the factors such as red, small, and expensive. The possible combination of all factor levels can become too large for respondents to rank or score in a meaningful way. The full-concept approach in SPSS Categories Conjoint uses fractional factorial designs, which uses a much smaller fraction of all possible alternatives. This reduced size subset (orthogonal array) considers only the main effects and the interactions are assumed to be negligible.

The SPSS Conjoint procedure can calculate utility scores (or part-worths) for each individual respondent and for the whole sample. These utility scores, analogous to regression coefficients, can be used to find the relative importance of each factor. SPSS permits the use of simulation profiles to represent actual or prospective products to estimate or predict market share of preference.

Research Design

The first step of the research design is to identify the key training attributes as perceived by the respondents. They were all briefed about the AHP and the conjoint analysis. The questionnaire was anonymous to ensure frank and candid replies. Various training attributes were identified by brainstorming technique as a class assignment. After some clarification discussions and screening exercises, six attributes were agreed. The size of the respondents (i.e. 149) is adequate and representative of the population of 5000 employees. Assuming the participants are randomly selected, the error of this study is about 7.9 % at 95% confidence level (http://www.chartwellsystems.com/sscalc.htm#terminology). According to Akaah and Korgaonkar (1988), sample sizes below 100 are typical for conjoint analysis. Thus the sample size of this study is adequate. It is believed that the findings of this study can be easily generalized to a wider context, i.e. the gaming industry in Macau, SAR.

The followings are the training attributes (factors) and their respective factor levels:-

Factors	**Factor levels**
Learning environment	- Excellent - Average - Poor
Training methods and contents	- Good - Average - Poor
Quality of trainers	- Good - Average - Poor
Cost effectiveness	- High - Average - Low
Continuous improvement through Feedback	- Very Good - Average - None
Recognition of qualification	- Recognized by society and Company - Recognized by Company - Not being recognized

There are altogether (3 x 3 x 3 x 3 x 3 x 3) or 729 possible combinations of profiles that can be rated by the respondents. To alleviate this mammoth task, the SPSS helps produce a parsimonious orthogonal array of 18 profiles. In order to ascertain the prediction power of the model two holdout cases (i. e. combination profiles 19 and 20) were added at the end of the conjoint profile list (Appendix 1: Conjoint). For comparison purpose the utility scores computed by conjoint analysis of the first respondent (coded as P1) is shown below:

Figure 1: Conjoint analysis result of Respondent P1

```
Importance   Utility(s.e.)  Factor

      +--+                  LEARNING ENVIRONMENT
 7.45  I  I   4.1111(2.2695)     I-        Excellent
      +--+ -2.2222(2.2695)    -I         Average
         I -1.8889(2.2695)     I         Poor
         I
   +-----+                  TRAINING METHODS AND CONTENTS
   I17.25I   9.4444(2.2695)     I--       Good
   +-----+ -5.2222(2.2695)    -I         Average
         I -4.2222(2.2695)    -I         Poor
         I
+---------+                 QUALITY OF TRAINERS
I29.02    I 15.7778(2.2695)     I----     Good
+---------+ -8.8889(2.2695)   --I         Average
         I -6.8889(2.2695)   --I         Poor
         I
  +------+                  COST EFFECTIVENESS
  I20.39 I   8.7778(2.2695)     I--       High
  +------+  -.2222(2.2695)     I         Average
         I -8.5556(2.2695)   --I         Low
         I
        ++                  CONTINUOUS IMPROVEMENT VIA FEEDBACK
 3.92    II   1.1111(2.2695)     I         Very Good
        ++ -2.2222(2.2695)    -I         Average
         I   1.1111(2.2695)     I         None
         I
 +-------+                  RECOGNITION OF QUALIFICATION
 I21.96  I   5.7778(2.2695)     I-        By Society & Company
 +-------+   6.4444(2.2695)     I--       By Company
         I -12.222(2.2695)  ---I         Not being recognized
         I
           48.5556(1.6048) CONSTANT

Pearson's R   =  .980                  Significance =  .0000
```

The importance scores of the six training attributes calculated from AHP and conjoint analysis for this particular respondent and the mean scores of all 149 respondents are compared as below:

Table 2: Comparison of AHP and Conjoint importance scores

Training attributes	AHP importance scores for respondent P1	Conjoint importance score for respondent P1	**AHP importance scores for 149 respondents**	**Conjoint importance scores for 149 respondents**
U1- LEARNING ENVIRONMENT	7.30	7.45	**6.96**	**16.50**
U2- TRAINING METHODS AND CONTENTS	11.73	17.25	**20.24**	**15.65**
U3- QUALITY OF TRAINERS	35.20	29.02	**24.93**	**19.89**
U4- COST EFFECTIVENESS	14.86	20.39	**14.36**	**14.82**
U5- CONTINUOUS IMPROVEMENT VIA FEEDBACK	2.22	3.92	**14.56**	**14.70**

U6- RECOGNITION OF QUALIFICATION	28.68	21.96	**18.96**	**18.44**

Prima facie evidence from the above table suggests that the AHP and Conjoint importance scores match quite well for the individual respondent P1. However, on a collective basis for the 149 respondents, the mean importance scores between AHP and Conjoint approaches under pair sampled t-test, differ significantly in learning environment, training methods & contents and quality of trainers.

Table 3: Paired samples t-test on importance scores

Paired Samples Test for importance scores calculatred from AHP and Conjoint

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	CJ1U Learning Environment - U1 Learning Environment	9.4500	8.5672	.7066	8.0535	10.8465	13.374	146	.000
Pair 2	CJ2U Training methods & Contents - U2 Training Method & Contents	-4.6312	9.0779	.7487	-6.1109	-3.1514	-6.185	146	.000
Pair 3	CJ3U Quality of Trainers - U3 Quality of Trainers	-4.8870	10.5329	.8687	-6.6040	-3.1701	-5.625	146	.000
Pair 4	CJ4U Cost effectiveness - U4 Cost Effectiveness	.4364	10.7746	.8887	-1.3200	2.1927	.491	146	.624
Pair 5	CJ5U Continuous improvement via feedback - U5 Continuous Improvement	.1521	9.4051	.7757	-1.3810	1.6852	.196	146	.845
Pair 6	CJ6U Recognition of qualification - U6 Recognition of training qualification	-.5203	11.7885	.9723	-2.4419	1.4013	-.535	146	.593

A bivariate correlation analysis was performed among the importance scores calculated from AHP and conjoint respectively. The correlation between the respective importance scores as calculated by AHP and conjoint are 2-tailed significant (see Table 4 below). This result provides some empirical evidences that AHP and conjoint analysis would yield similar importance score fluctuation patterns among the six training attributes. In this respect, the two research approaches bear some degree of similarity. As AHP is much simpler and easier to perform than conjoint analysis, this empirical study would support a wider application of AHP.

Table 4: Correlation Coefficients between AHP and Conjoint (CJ) utility scores

	AHP-U1	AHP-U2	AHP-U3	AHP-U4	AHP-U5	AHP-U6
CJ-U1	.2767	-.1235	.0493	-.1472	.0019	.0030
	(147)	(147)	(147)	(147)	(147)	(147)
	P= .001	P= .136	P= .553	P= .075	P= .982	P= .971
CJ-U2	-.1120	.2476	-.0250	-.0152	-.0483	-.0482
	(147)	(147)	(147)	(147)	(147)	(147)
	P= .177	**P= .003**	P= .764	P= .855	P= .561	P= .562
CJ-U3	.0372	.0722	.4095	-.1998	-.1106	-.2409
	(147)	(147)	(147)	(147)	(147)	(147)
	P= .654	P= .385	**P= .000**	P= .015	P= .182	P= .003

CJ-U	-.0928	-.0670	-.1862	.3444	.0825	-.0832
	(147)	(147)	(147)	(147)	(147)	(147)
	P= .263	P= .420	P= .024	**P= .000**	P= .320	P= .317
CJ-U5	-.1215	.0449	-.0553	.0898	.1749	-.1132
	(147)	(147)	(147)	(147)	(147)	(147)
	P= .143	P= .589	P= .506	P= .279	**P= .034**	P= .172
CJ-U6	.0041	-.0905	-.1409	-.0817	-.0735	.3549
	(147)	(147)	(147)	(147)	(147)	(147)
	P= .961	P= .275	P= .089	P= .325	P= .376	**P= .000**

However, conjoint analysis yield other useful information that the AHP cannot produce. The utility values for each factor level are calculated. This information is useful for the service provider to perform a trade-off analysis by varying the factor levels for different customer segments. This helps the concerned decision maker to scientifically determine the best product attribute mix and do the cost benefit analyses for various improvement scenarios. Additionally, the use of holdout cases help establish the strength of prediction of the conjoint utility scores. The Pearson correlation coefficients for the predicted values of the two hold out cases with the original values assigned by the respondents are 0.58 (2-tailed significance p=0.000) and 0.19 (2-tailed significance p =0.022) respectively.

Comparison of importance scores between the trainee group and the student group

It would be useful to find out whether there are differences in importance scores among the six training attributes between two different demographic groups of respondents. In this study, two types of respondents can be discerned. One group is the Associate degree students in the Community College, and the other group is the management trainees taking in-house training programme in the Performance Improvement Department (i.e. Training Department) of the Company. Independent samples t-tests are performed among the utility scores between the two groups. Figures 2 to 4 depict those situations where significant differences at 0.05 level exist.

Figure 2: t-tests for independent samples of Type of respondents on QUALITY OF TRAINERS using Conjoint importance scores

Variable	Number of Cases	Mean	SD	SE of Mean
CJ3U Quality of Trainers				
Management Trainees	59	21.8207	8.476	1.104
MMC Students	90	18.6217	7.612	.802

Mean Difference = 3.1990

Levene's Test for Equality of Variances: F= .779 P= .379

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Equal	2.40	147	**.018**	1.334	(.562, 5.836)
Unequal	2.34	114.66	.021	1.364	(.496, 5.902)

In Figure 2, the importance scores for Management trainees (21.82) is significantly higher than of the MMC students (18.62). This is reasonable as the trainees hope to gain more during their training periods whereas the MMC students have had finished their in-house occupational training and are relatively less concerned with the training attribute of quality of trainers.

Figure 3: t-tests for independent samples of Type of respondents on COST EFFECTIVENESS using Conjoint importance scores

Variable	Number of Cases	Mean	SD	SE of Mean
CJ4U Cost effectiveness				
Management Trainees	59	12.9125	6.378	.830
MMC Students	90	16.0724	9.721	1.025

Mean Difference = -3.1599

Levene's Test for Equality of Variances: F= 4.104 P= .045

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Equal	-2.20	147	.029	1.434	(-5.994, -.326)
Unequal	-2.40	147.00	**.018**	1.319	(-5.767, -.553)

Figure 3 suggests that Management Trainees are less concerned with training attribute of cost effectiveness (12.91) as compared to the MMC students (16.07). This is the case as they are the beneficiaries of the training service provided by their employer.

Cost effectiveness may imply cost reduction in their minds. On the other hand, the MMC students are not enjoying the training facilities at the time they complete the survey forms and they are logically more concerned with cost effectiveness of the training function.

Figure 4: t-tests for independent samples of Type of respondents on QUALITY OF TRAINERS using AHP importance scores

Variable	Number of Cases	Mean	SD	SE of Mean
U3 Quality of Trainers				
Management Trainees	59	27.6563	10.696	1.392
MMC Students	88	23.0982	10.628	1.133

Mean Difference = 4.5581

Levene's Test for Equality of Variances: F= .150 P= .699

t-test for Equality of Means

Variances	t-value	df	2-Tail Sig	SE of Diff	95% CI for Diff
Equal	2.54	145	.012	1.793	(1.014, 8.102)
Unequal	2.54	123.98	.012	1.795	(1.004, 8.112)

Similarly, the importance scores for quality of trainers, calculated from AHP are significantly different between the Management trainees and the MMC students.

Conclusion

The empirical evidence suggests that a fair amount of similarity does exist between the utility scores computed from AHP and from conjoint analysis. The use of AHP is to some extent justified and supported by this empirical research finding. The comparison in AHP is on pair-by-pair comparison basis. Namely, the attributes are considered singly and independently. In the case of conjoint analysis, the preference decision is by weighting the utilities of all product attributes together. This conjoint approach resembles of course more the reality. The availability of holdout cases (i.e. cases that are not used in the calculation of utility values and importance scores) can test how good the model is in predicting scenarios not used to develop the conjoint utility formula. The conjoint analysis also provides opportunity to conduct trade-off evaluation. Different attributes can be substituted to determine the overall utility value of a specific combination of various attributes.

Although both AHP and conjoint are powerful research tools, they have to be used with caution. If some important product attributes are omitted in the first place then no matter how well and accurate subsequent analyses are, the results can still be misleading.

Conjoint analysis can generate more useful information than the AHP. However the use of conjoint analysis is far more complicated and it requires the help of statistical packages.

Further researches are recommended to compare the results of AHP and conjoint analysis in other settings. The training attributes and their respective factor levels can be further refined.

Finally, the important attributes for training in the gaming industry as revealed by this empirical study, using conjoint analysis, in descending order of importance are as follow (with details of all factor levels in Appendix3):-

- Quality of trainers (mean importance score of 19.89)
- Recognition of qualification (18.44)
- Learning environment (16.5)
- Training methods and contents (15.65)
- Cost effectiveness (14.82)
- Continuous improvement via feedback (14.70)

It is suggested that in future researches the respondents should also be asked to indicate their perceived satisfaction level of the service received against the various attributes concurrently. A performance gap can then be ascertained (operationally defined as the difference between the importance scores and satisfaction scores). The larger the performance gap is the more urgent it is for the service provider to improve on that particular attribute.

Appendix 1: Conjoint

Please rate the combinations of different training situations (1 to 99), with “1” representing worst combination, ... , and “99” representing the best possible combination.
(The numbers in brackets are scores assigned by Respondent P1)

Combination 1 [68]

Learning environment	Average
Training methods and contents	Poor
Quality of trainers	Good
Cost effectiveness	High
Continuous improvement through feedback	None
Recognition of qualification	Recognized by the Society and the company

Combination 2 [30]

Learning environment	Excellent
Training methods and contents	Good
Quality of trainers	Poor
Cost effectiveness	Low
Continuous improvement through feedback	None
Recognition of qualification	Not being recognized

Combination 3 [98]

Learning environment	Excellent
Training methods and contents	Good
Quality of trainers	Good
Cost effectiveness	High
Continuous improvement through feedback	Very good
Recognition of qualification	Recognized by the Society and the company

Combination 4 [50]

Learning environment	Average
Training methods and contents	Average
Quality of trainers	Poor
Cost effectiveness	High
Continuous improvement through feedback	Very good
Recognition of qualification	Recognized by the company

Combination 5 [60]

Learning environment	Poor
Training methods and contents	Good
Quality of trainers	Good
Cost effectiveness	Average
Continuous improvement through feedback	Very good
Recognition of qualification	Not being recognized

Appendix 1: Conjoint

Combination 6 [38]

Learning environment	Excellent
Training methods and contents	Poor
Quality of trainers	Average
Cost effectiveness	High
Continuous improvement through feedback	Average
Recognition of qualification	Not being recognized

Combination 7 [40]

Learning environment	Excellent
Training methods and contents	Poor
Quality of trainers	Average
Cost effectiveness	Average
Continuous improvement through feedback	Very good
Recognition of qualification	Recognized by the company

Combination 8 [40]

Learning environment	Poor
Training methods and contents	Poor
Quality of trainers	Poor
Cost effectiveness	Average
Continuous improvement through feedback	Average
Recognition of qualification	Recognized by the Society and the company

Combination 9 [60]

Learning environment	Average
Training methods and contents	Good
Quality of trainers	Average
Cost effectiveness	Average
Continuous improvement through feedback	None
Recognition of qualification	Recognized by the company

Combination 10 [50]

Learning environment	Excellent
Training methods and contents	Average
Quality of trainers	Poor
Cost effectiveness	Average
Continuous improvement through feedback	None
Recognition of qualification	Recognized by the Society and the company

Appendix 1: Conjoint

Combination 11 [40]

Learning environment	Average
Training methods and contents	Average
Quality of trainers	Good
Cost effectiveness	Average
Continuous improvement through feedback	Average
Recognition of qualification	Not being recognized

Combination 12 [30]

Learning environment	Poor
Training methods and contents	Average
Quality of trainers	Average
Cost effectiveness	High
Continuous improvement through feedback	None
Recognition of qualification	Not being recognized

Combination 13 [20]

Learning environment	Average
Training methods and contents	Poor
Quality of trainers	Poor
Cost effectiveness	Low
Continuous improvement through feedback	Very good
Recognition of qualification	Not being recognized

Combination 14 [60]

Learning environment	Poor
Training methods and contents	Good
Quality of trainers	Poor
Cost effectiveness	High
Continuous improvement through feedback	Average
Recognition of qualification	Recognized by the company

Combination 15 [60]

Learning environment	Poor
Training methods and contents	Poor
Quality of trainers	Good
Cost effectiveness	Low
Continuous improvement through feedback	None
Recognition of qualification	Recognized by the company

Combination 16 [30]

Learning environment	Poor
Training methods and contents	Average
Quality of trainers	Average
Cost effectiveness	Low
Continuous improvement through feedback	Very good
Recognition of qualification	Recognized by the Society and the company

Appendix 1: Conjoint

Combination 17 [40]

Learning environment	Average
Training methods and contents	Good
Quality of trainers	Average
Cost effectiveness	Low
Continuous improvement through feedback	Average
Recognition of qualification	Recognized by the Society and the company

Combination 18 [60]

Learning environment	Excellent
Training methods and contents	Average
Quality of trainers	Good
Cost effectiveness	Low
Continuous improvement through feedback	Average
Recognition of qualification	Recognized by the company

Combination 19 [50]

Learning environment	Excellent
Training methods and contents	Poor
Quality of trainers	Average
Cost effectiveness	Low
Continuous improvement through feedback	None
Recognition of qualification	Recognized by the Society and the company

Combination 20 [60]

Learning environment	Average
Training methods and contents	Poor
Quality of trainers	Good
Cost effectiveness	Average
Continuous improvement through feedback	Average
Recognition of qualification	Recognized by the company

Appendix 2: AHP

		Much more important	Slightly more important	Equally important	Slightly less important	Much less important
1	“Learning environment” and ”Training methods and contents” being compared, I feel ”Learning environment” is:	1	2	3	**4**	5
2	“Learning environment” and ”Quality of trainers” being compared, I feel ”Learning environment” is:	1	2	3	4	**5**
3	“Learning environment” and ”Cost effectiveness” being compared, I feel ”Learning environment” is:	1	2	3	**4**	5
4	“Learning environment” and ”Continuous improvement through feedback” being compared, I feel ”Learning environment” is:	1	**2**	3	4	5
5	“Learning environment” and ”Recognition of qualification” being compared, I feel ”Learning environment” is:	1	2	3	4	**5**
6	“Training methods and contents” and ”Quality of trainers” being compared, I feel ”Training methods and contents” is:	1	2	**3**	4	5
7	“Training methods and contents” and ”Cost effectiveness” being compared, I feel ”Training methods and contents” is:	1	2	**3**	4	5
8	“Training methods and contents” and ”Continuous improvement through feedback” being compared, I feel ”Training methods and contents” is:	1	2	**3**	4	5
9	“Training methods and contents” and ”Recognition of qualification” being compared, I feel ”Training methods and contents” is:	1	2	**3**	4	5
10	“Quality of trainers” and ”Cost effectiveness” being compared, I feel ”Quality of trainers” is:	1	**2**	3	4	5
11	“Quality of trainers” and ”Continuous improvement through feedback” being compared, I feel ”Quality of trainers” is:	**1**	2	3	4	5
12	“Quality of trainers” and ”Recognition of qualification” being compared, I feel ”Quality of trainers” is:	1	2	**3**	4	5
13	“Cost effectiveness” and ”Continuous improvement through feedback” being compared, I feel ”Cost effectiveness” is:	1	**2**	3	4	5
14	“Cost effectiveness” and ”Recognition of qualification” being compared, I feel ”Cost effectiveness” is:	1	2	3	**4**	5
15	“Continuous improvement through feedback” and ”Recognition of qualification” being compared, I feel ”Continuous improvement through feedback” is:	1	2	3	**4**	5

Appendix 3: Conjoint summary of all 149 respondents

```
 Averaged
Importance   Utility        Factor

  +-------+                 LEARNING ENVIRONMENT
  I16.50 I   5.4068             I---       Excellent
  +-------+    .3721            I          Average
         I  -5.7789          ---I          Poor
         I
  +-------+                 TRAINING METHODS AND CONTENTS
  I15.65 I   5.2312             I---       Good
  +-------+  1.2267             I-         Average
         I  -6.4579         ----I          Poor
         I
+---------+                 QUALITY OF TRAINERS
I19.89   I   6.5365             I----      Good
+---------+   .5723             I          Average
         I  -7.1089         ----I          Poor
         I
   +------+                 COST EFFECTIVENESS
   I14.82I   4.3576             I--        High
   +------+  -.4836             I          Average
         I  -3.8740           --I          Low
         I
   +------+                 CONTINUOUS IMPROVEMENT VIA FEEDBACK
   I14.70I   4.4079             I--        Very Good
   +------+   .6473             I          Average
         I  -5.0552          ---I          None
         I
 +--------+                 RECOGNITION OF QUALIFICATION
 I18.44  I   4.7021             I---       By Society & Company
 +--------+  2.4974             I-         By Company
         I  -7.1995         ----I          Not being recognized
         I
            52.3046         CONSTANT

Pearson's R   =  .990                  Significance =  .0000
```

References:

http://www.chartwellsystems.com/sscalc.htm#terminology

Akaah I., and P. K. Korgaonkar (1988) **"A conjoint investigation of the relative importance of risk relievers in direct marketing"** *Journal of Advertising Research*, August - September

Amirani S., and J. Baker (1995) **"Quality cues and retail target market strategy: a conjoint-based application"** *International Journal of Retail & Distribution Management* Vol 23 No. 5 pp. 22-31

Anderson, R. C., and Hansen, E. N. (2004) **"The impact of environmental certification on preferences for wood furniture: A conjoint analysis approach"** *Forest Products Journal* Vol. 54, No. 3, pp. 42-50

Arias J. T. G. (1996) **"Conjoint-based preferential segmentation in the design of a new financial service"** *International Journal of Bank Marketing* 14/3 pp30-32

Asahi, T., D. Ture, and B. Shneiderman (1995) **"Using Treemaps to Visualize the Analytic Hierarchy Process"** *Information Systems Research* 6:4 pp. 357-375

Babbie, Earl (2001) ***The Practice of Social Research*** 9th ed., Wadsworth, a division of Thomson Learning Inc.

Cheng, E. W. L., and H. Li, (2003) **Utility of consistency measure in the analytic hierchy process"** *Construction Innovation*, 3: pp. 231-247

Cheung, S.O., T.I. Lam, M.Y. Leung, and Y.W. Wan (2001) **"An analytical hierarchy process based procurement selection method"** *Construction Management and Economics,* 19, pp. 427-437

Clinton, B. D., S.A. Webber, and J. M. Hassell (2002) **"Implementing the Balanced Scorecard Using the Analytic Hierarchy Process"** *Management Accounting Quarterly*, Spring, Vol. 3, No. 3 pp. 1-11

Diamantopoulos A., B. B. Schlegelmilch, and J.P. Du Preez (1995) **"Lessons for pan-European marketing? The role of consumer preferences in fine-tuning the product-market fit"** *International Marketing Review* Vol.12 No. 2 pp 38-52

Forman, E. H. and S. I. Gass (2001) **"The Analytic Hierarchy Process – an exposition"** *Operations Research* Vol 49, No. 4, July-August, pp. 469-486

Gil J. M. and M. Sanchez (1997) **"Consumer preferences for wine attributes: a conjoint approach"** *British Food Journal* 99/1 pp 3-11

Green, P. E., A. M. Krieger and Y. Wind (2001) **"Thirty Years of Conjoint Analysis: Reflections and Prospects"** *Interfaces* 31:3 Part 2 of 2, May-June pp. S56-S57

Gustafsson, A., F. Ekdahl, and B. Bergman (1999) **"Conjoint analysis: a useful tool in the design process"** *Total Quality Management*, Vol., 10, No. 3, pp. 327-343

Hahn, E. D. (2003) **"Decision Making with Uncertain Judgments: A Stochastic Formulation of the Analytic Hierarchy Process"** *Decision Sciences*, Vol. 34 No. 3, Summer, pp. 443-466

Hemaida, R. S. and Kalb, E. (2001) **"Using the Analytic Hierarchy Process for the Selection of First-Year Family Practice Residents"** *Hospital Topics: Research and Perspectives on Healthcare* Vol. 79 No. 1 Winter, pp. 11-15

Hobbs J. E. (1996) **"A transaction cost analysis of quality, traceability and animal welfare issues in UK beef retailing"** *British Food Journal* 98/6 pp. 16-26

Jansson, C., Bointon, B., and Marlow, N. (2003) **"An exploratory conjoint analysis of consumers' aesthetic responses of Point-of-Purchase materials"** *International Review of Retail, Distribution and Consumer Research* 13:1 January, pp. 59-76

Kara A., E. Kaynak, and O. Kucukemiroglu (1994) **"Credit Card Development Strategies for the Youth Market: The Use of Conjoint Analysis"** *International Journal of Bank Marketing* Vol. 12 No. 6 pp. 30-36

Koo, L. C. (1999) **"Conjoint Analysis"** in *The Industrial Engineering Applications and Practice: Users' Encyclopaedia International Journal of Industrial Engineering* ISBN 0-965499-0-X

Koo, L. C., Tao, Fredrick K. C., and Yeung, John, H. C. (1999) **"Preferential segmentation of restaurant attributes through conjoint analysis"** *International Journal of Contemporary Hospitality Management* 11/5 pp. 242-250

Levy D. S. (1995) **"Modern marketing research techniques and the property professional"** *Property Management* Vol. 13 No. pp. 33-40

Murtaza, M. B. (2003) **"Fuzzy-AHP Application to Country Risk Assessment"** *American Business Review*, June, pp. 109-116

Ness M. R. and H. Gerhardy (1994) **"Consumer Preferences for Quality and Freshness Attributes of Eggs"** *British Food Journal* Vol. 96 No. 3 pp. 26-34

Norusis M.J. (1993) ***SPSS for Windows Base System User's Guide Release 6.0*** SPSS Inc., Chicago

Okechuku C. (1993) **"The Importance of Product Country of Origin: A Conjoint Analysis of the United States, Canada, Germany and the Netherlands"** *European Journal of Marketing* Vol. 28 No. 4 pp. 5-19

Saaty,T. L. (1980) ***The analytic hierarchy process*** New York, McGraw-Hill

Saaty, T. L. (1994) **"How to Make a Decision: The Analytic Hierarchy Process"**

Interfaces 24: 6 Nov. – Dec. pp.19-43

SPSS (1994) ***SPSS Categories 6.1*** SPSS Inc Chicago, 209 pages

Stewart, R. A., and M. Sherif (2001) **"Utilizing the balanced scorecard for IT/IS performance evaluation in construction"** *Construction Innovation,* 1: pp. 147-163

Toombs K., and G. Bailey (1995) **"How to redesign your organization to match customer needs"** *Managing Service Quality* Vol. 5 No. 3 pp 52-56

Yeh, Jong-Mau, Borwen Kreng and Chinho Lin (2001) **"A consensus approach for synthesizing the elements of comparison matrix in the Analytic Hierarchy Process"** *International Journal of Systems Science* Vol. 32, No. 11, pp. 1353-1363

以‘ 分析階層程序’ 與‘ 聯合分析’
替澳門特別行政區博彩行業培訓屬性的經驗比較

顧良智

摘要：分析階層程序(AHP)與聯合分析Conjoint Analysis的初步比較是頗為相似的。兩種研究方法都會把產品或服務屬性的重要程度(價值) 顯示出來，這次經驗研究是由澳門一家大企業的149名員工參與，其中90位在社區大學修讀副學士學位，59位是該公司的管理見習生。在填寫有關不記名問卷前，所有被訪者皆會學有關分析階層程序與聯合分析簡單運作的概念，而培訓的主要屬性是在上課時厘定，它們是：學習環境、培訓方法及內容、導師質素、成本效益、接受回饋不斷改進、培訓資歷被認可程度。是次研究目的是要用實際經驗數據比較分析階層程序與聯合分析共同點與差異處，由於兩種方法均日漸受到研究員所普及使用，這項研究會提供一些具洞察力的結果給打算採用這兩種或其中一種研究方法之人士參考。

關鍵詞：分析階層程序(AHP); 聯合分析; 價值分數; 培訓屬性; 澳門

Koo, Leung Chee (2004) "Empirical Comparison of AHP and Conjoint Analysis on Training Attributes in the Gaming Industry in Macay SAR" Conference Proceedings of the International Conference on Gaming Industry and Public Welfare, 6-10th October, Beijing