Kansei Engineering Approach for Consumer's Perception of the Ketchup Sauce Bottle

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Abstract: Day by day, consumers look into more high quality products to choose and pay more attention to details such as sensual value. To fulfill this essential requirement of consumers, it will be necessary to progressively develop new products with dual nature addressing both functional and emotional needs. Kansei engineering is a successful methodology for gathering and analyzing the relations between consumers' impressions and products' properties. In Iranian food market, different food products with huge variety in type, taste, shape, size, packaging, and so on are available to consumers. A different approach to include consumers' desire and feel is highly appreciated in Iranian food business. Such a strategy will be developed to fulfill customers' feelings in order to attract them to purchase the food product. In Iran ketchup sauce are so much popular. Therefore, ketchup sauce bottle has been selected as a case in current study. 31 Kansei words and 8 different types of sauce bottles with different shapes and function were selected. All experiments were conducted in city of Tehran and 47 people participated in the study, comprising 23 men and 24 women in ages ranging from 20 to 50 years old. 5-point semantic differential scale was considered to determine the relations between products' features and adjectives. The data were analyzed using SPSS software by multivariate statistical techniques such as factor analysis. The expected results and findings can provide a reference to make decisions on the properties of developing new products, which has great impact on future studies.

Keywords: Kansei Engineering, Semantic Differential Method, Factor Analysis, Sauce Bottle, Packaging Design.

1. INTRODUCTION

Todays the product development is shifted from product oriented strategy to consumer oriented

strategy, the consumer's psychological feeling and needs are recognized more invaluable in product development than ever before [Nagamachi, 2002, Norman, 2008]. The affective product design is aimed at determining the relationships between consumers and products and to define the emotive properties that products intend to communicate through their physical attributes [Jiao et. al., 2006]. At present, many product development theories based on consumer were described. Kansei Engineering techniques support affective product design by linking the customer needs mathematically to the technical characteristics of the product [Nagamachi, 2002]. The term Kansei is defined as "a Japanese word which implies a customer's psychological feeling and image regarding a new product" [Nagamachi 1997]. Kansei engineering is, foremost, a product development methodology [Harada1998], but Schütte et al. [2004] also shows how it is possible to use it as an improvement tool for existing products or concepts. Also Schütte [2005] in his paper described the concept of Kansei as closely connected to affective, emotional values of human beings. In the theory of Kansei engineering, the relation of design elements and image word is important and the element is drawn out from the product design to analyze, each element will be discussed. In the design process, because the product properties and all aspects of design elements involve the human subjective feeling, there is no certain standard to judge the correctness of the design and whether the proposal meets the users' feeling. Therefore, this research quantifies users' perceptual cognition with the theories of Kansei engineering technology [Haykin, 2004]. Many studies have proven that Kansei engineering works very well in the engineering field [koleini and Tojoddini, 2010]. Kansei engineering is a comprehensive human-centered technology for developing new products and it has been widely used in automobile, construction machine, electric home appliance, house construction, costume, textile industries clothing fields, packaging and so on [Lu et. al., 2008].

In food business as well as other market sectors, variety of added values by design can be observed. For example, in Iranian food market, different food products with huge variety in type, taste, shape, size, packaging and so on are available to consumers. Among them, sauces, and particularly ketchup sauce, are so much popular. This has made sauce making industry a very lucrative business. Consequently, an endless variety of sauce bottles are seen in Iran food market. Obviously, in this area of design, packaging plays an essential role both in production of needs and attraction of consumers. Normal packaging design concentrates on protection, preservation and distribution of contents. That mostly will cause over focus on packaging content rather than packaging consumers. Therefore, a different approach to include consumers' desire and feel is highly appreciated in Iranian food business. Such a strategy will be developed to fulfill customers' feelings and emotions in order to attract them to purchase the food product. Having this in mind, the purpose of the current study is an attempt to use Kansei engineering to connect the product parameters of the ketchup sauce bottle to the affective values.

2. METHODOLOGY OF KANSEI ENGINEERING

The most usual methodology of Kansei Engineering includes an evaluation experiment followed by statistical analysis of the obtained data. In summary, the implementation involves three steps included: first step- selection of Kansei words, collecting and choosing adjectives, second step- the Kansei evaluation experiment, which is a subjective evaluation of customer perceptions of various products and product samples using a questionnaire that contains Kansei words, and third step- statistical analyses of data from the evaluation experiment. If we know what combination of the product properties results in a high score among the descriptive words, we should be able to

produce a guideline for emotional interface design of the new product.

2.1. Kansei measurement process

Since Kansei is the state of consumer's internal sensation, the measurement process can be very challenging. Kansei Engineering provides diverse method to measure consumer's sensation, in particular biological signals such as brain waves by electroencephalogram (EEG signal), muscular activity measurement by electromyography (EMG signal), eye movement and subjective evaluation or self-reporting system such as different emotional scale, semantic differential scale or free labeling system. In the field of subjective evaluation and in specific to measure consumer's emotion, mainly words that describe the emotional expression have been used.

2.2. Semantic differential method

A popular scaling device for the quantification of subjective consumer's emotion is the semantic differential method developed by Osgood [1957]. The purpose of the semantic differentials technique is to supply a quantitative support that allows having an objective measurement of a product psychological meaning to a customer. This requires descriptive scales with adjectives to establish the similarity or discrepancy degree among the various issues. The semantic differential usually takes the form of a 5- or 7-point scale. In this study, a five point semantic differential was employed. Five point scales are commonly used in consumer research, mainly because researchers suspect these scales tend to be more easily understood by respondents than scoring systems using more points. Figure 1 shows the Kansei checklist developed was organized in a 5-point semantic differential scale and consists of 31 Kansei words.

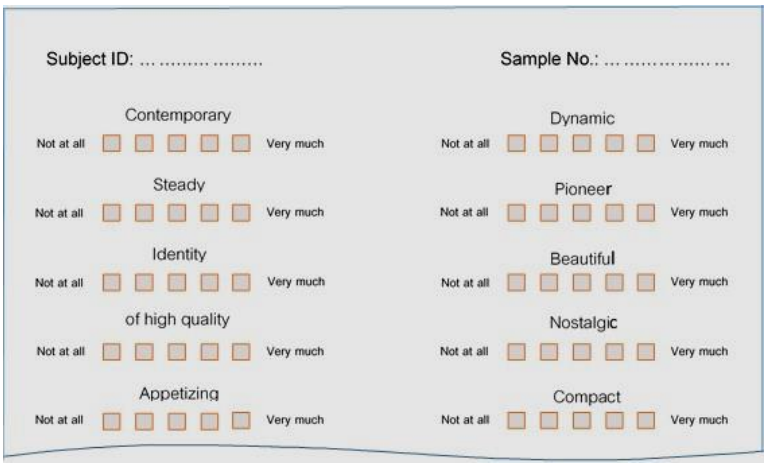

Figure 1: The sample Kansei checklist

2.3. Product samples

From comparison among all types of products from the company and other makers, samples are collected. Then 8 different types of sauce bottles in term of the feeling that they evoke, with different shapes and functions were used to map properties from within the product domain. These product samples belonged to seven different food products companies. Figure 2 shows collected used samples in this study.

Figure 2: Eight sauce ketchup bottle samples used in the Kansei experiment after selection

2.4. Participants

All experiments were conducted in city of Tehran, Iran and 47 people participated in the study, comprising 23 men and 24 women in ages ranging from 20 to 50 years old. Subjects were asked to answer questioners based on their feelings about each of the samples which placed in front of the subject and has been operationally tested.

2.5. Data analysis

In general, the average value of the Kansei responses for each samples are well distributed where the values are above and below the value three, which is the neutral response point. This indicates that subject's Kansei are well distributed to both negative and positive value. Statistical procedures using mathematical and nonmathematical methods have been developed for use in Kansei studies [Nagamachi, 2001], however the use depends on the context. On the other hand, in order to give a concrete support to designers, Kansei engineering needs integration with quality and statistical tools [Nagamachi and Matsubara, 1997]. When a large amount of variables is simultaneously collected, the interest may be to determine how the answers of a study may be grouped. To this aim, compared to the other techniques such as variance analysis or multiple regression, factor analysis has the advantage that all the involved variables play the same role. This analysis method is a statistical data reduction technique employed to explain variability among observed random variables, in terms of fewer unobserved random variables named factors. This reduction is possible because the attributes are related. Applying a factor analysis to the collected responses on a given questionnaire, it is possible to group responses with common meaning, reducing the number of required indicators to explain all the responses. The rating given to any one attribute is partially the result of the influence of other attributes. The observed variables are modeled as linear combinations of the factors. Its proper application implies the interrelation analysis between variables (using statistical covariance and correlations) to determine a new smaller set of variables than the original set [Santesmases, 1997]. It should be noted that the reduction is possible without the loss of an important part of the reliability in the original data.

3. RESULTS AND DISCUSSION

In this study to reveal the reliability and effectiveness of questionnaire survey, reliability analysis is conducted. A high value of reliability coefficient means the questionnaire survey is stable, namely, the consistency of survey results conducted in different durations. The Cronbach's alpha of the Kansei checklist was calculated to measure the internal consistency. The analysis yielded an overall Cronbach's alpha value of 0.948, which is higher than the common benchmark value of 0.7.

This confirms the reliability of the Kansei checklist. The participants' Kansei responses were then computed to determine the average response and the range for each sample. Using factor analysis the number of semantic adjectives is reduced and also categorized. To confirm if exploratory factor analysis is a suitable statistical technique to analyze our data, the Kaiser-Meyer-Olkin (KMO) measure of sample adequacy and Bartlett's Test of sphericity has been used (Table 1). The value of KMO statistic was 0,950, which means that the sample size is suitable for factor analysis. Sheskin [2007] refers that KMO statistic should be 0.6 or greater. Bartlett's Test has a p-value less than 0, 0001 showing that there are significant bivariate correlations between some of the variables.

Table 1: Kaiser-Meyer-Olkin and Bartlett's Test

KMO Measure		0.9500
	Approx. Chi-Square	6034.813
Bartlett's Test	df	465
	Sig.	0.0000

Using factor analysis in order to find psychological structure of Kansei space, the detail of Kansei space were investigated with average value of evaluation results. Table 2 only shows first five component result of factor analysis after varimax rotation. Varimax, which was developed by Kaiser [1958], is the most popular rotation method that simplifies the interpretation of variables. This is because, after a varimax rotation, each original variable tends to be associated with one of factors, and each factor represents only a small number of variables. In addition, the factors can often be interpreted from the opposition of few variables with positive loadings to few variables with negative loadings.

Table 2: Contribution and cumulative contribution table

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.538	43.672	43.672	6.887	22.215	22.215
2	1.557	5.023	48.694	3.88	12.516	34.731
3	1.416	4.568	53.262	3.73	12.033	46.764
4	1.193	3.847	57.109	3.118	10.058	56.822
5	1.132	3.65	60.759	1.221	3.938	60.759

In Table 2, it is evident that the first factor explains 43.672% of the data which represents majority of main factor contribution and have dominant effect on Kansei words. The second, third, fourth, and fifth factor explains 5.023%, 4.568%, 3.847%, and 3.650% of the data, respectively. The first factors alone represent 43.672% of the variability while four factors explain 60.759% of the variability. Inclusion of the forth factor is deemed considerable, and therefore the first five factors could explain most of the data. The proportion of variability explained by the sixth factor and above is minimal (3.077, 2.871, 2.779, etc., respectively) and they can be eliminated as being insignificant. The following table shows partial result of factor analysis in ascending order.

Table 3: The Factor loading of the 29 adjective using five factors

	Adjectives	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
13	Attractive	**0.733**	0.24	0.241	0.225	-0.012
5	Beautiful	**0.722**	0.159	0.386	0.111	0.065
17	Stimulator	**0.673**	0.329	0.107	0.147	-0.097
19	Hearty	**0.658**	0.369	0.228	0.21	0.049
3	Pioneer	**0.634**	0.2	0.316	0.222	-0.004
25	Funny	**0.625**	0.292	0.061	0.329	-0.109
31	Enlivening	**0.615**	0.262	0.087	0.4	-0.053
2	Contemporary	**0.612**	-0.109	0.339	0.384	-0.007
1	Dynamic	**0.602**	0.252	0.333	0.236	0.046
27	Encourager	**0.591**	0.383	0.161	0.381	0.02
23	Friendly	**0.597**	0.456	0.137	0.168	0.012
15	Delicious	**0.568**	0.52	0.152	0.026	0.078
22	Formal	**0.554**	0.102	0.455	-0.019	-0.082
10	Appetizing	**0.553**	0.326	0.268	0.341	0.02
16	Fresh	**0.521**	0.103	0.377	0.349	-0.139
6	Identity	0.191	**0.742**	0.127	0.208	-0.012
7	Nostalgic	0.206	**0.692**	0.106	-0.004	-0.045
14	Truthful	0.282	**0.659**	0.296	0.216	0.036
28	Dependency	0.379	**0.498**	0.217	0.114	-0.18
8	High quality	0.239	**0.485**	0.351	0.436	0.088
12	Communicative	0.208	**0.456**	0.314	0.452	-0.058
9	Compact	0.233	0.108	**0.666**	0.103	-0.198
18	Handy	0.114	0.243	**0.658**	0.155	-0.063
26	Flexible	0.207	0.174	**0.644**	0.146	-0.056
11	Pretty color	0.485	0.11	**0.607**	-0.023	0
30	Useful	0.179	0.226	**0.544**	0.466	0.088
4	Steady	0.219	0.385	**0.465**	0.46	0.131
20	Unique	0.336	0.202	0.2	**0.688**	-0.059
21	Different	0.467	0.123	0.059	**0.653**	-0.02
24	Hurried	-0.096	0.046	-0.093	-0.348	**0.707**
29	Brittle	0.055	-0.072	-0.089	0.228	**0.73**

The bold numbers indicate the groups of associates with factors 1-5.

The structure of Kansei words is observable in the analysis result. It is evident from the Table 3 that sample ketchup sauce bottle Kansei are structured by 5 factors. The first factor consists of attractive, beautiful, stimulator, hearty, pioneer, funny, enlivening, contemporary, dynamic, encourager, friendly, delicious, formal, appetizing, and fresh. This Kansei space could be represented as ‘aesthetic’. The second factor consists of identity, nostalgic, truthful, dependency, of high quality, and communicative. This Kansei space could be represented as ‘personality’. The third factor consists of compact, handy, flexible, pretty color, useful, and steady, and therefore it could be represented as ‘operational’ Kansei space. The fourth factor consists of unique, different, and therefore could be represented as ‘unique’ Kansei space. The fifth factor consist of hurried and brittle, and could be represented as ‘brittle’ Kansei space. The result demonstrates that ketchup sauce bottle samples are structured by five factors; aesthetic, personality, operational, unique and brittle. These five factors altogether explains 60.759% of the total data. As a result from the present study case it has been shown that it is possible to have a mechanism to identify, among various object designs, a design proposal which is closer to satisfy the subjective requirements which is wanted to externally be shown by the object. The purpose of this study is to examine the relationship between visualization of appearance properties of the ketchup sauce bottle and users'

impressions of it. With Kansei engineering, it is possible to determine what the ketchup sauce bottle properties obtained from existing samples, result in a high score among the affective value words. The main advantages of conducting a Kansei engineering study is revealing the users feelings or affectivity towards the design. Analyzing and generalizing these affective interactions, can get a better idea about the user's impression towards the design of ketchup sauce bottle. Also our study shows that Kansei design which has a power of interpretation of people's emotion and feeling is possible to create pleasure with products in our daily lives. Because it focuses on human behaviors including emotional actions and responses.

4. CONCLUSION

This paper presents an exploratory extension of the Kansei engineering method which includes an in depth study of the customer experience. Also the current study has highlighted the need for instructional designer to refocus on the often neglected affective aspects of a design. It is noted from the literature [Wilson, 2005] that instructional designer have often put affective factors into secondary position and overlooked its role in promoting effective and engaging learning. The research explores the implementation of Kansei engineering in the effort of embedding emotional signature in our product design. Factor analysis was performed to identify factors, Kansei word's structure, association between Kansei responses and design elements, and determine specimen's Kansei. Factor analysis demonstrates that the first factors explain most of data, i.e. aesthetic, represent 43.672% of data. This means that this first factor is very important Kansei space. It suggests that all ketchup sauce bottle samples should have this factor in order to gain good business appeal. However the second, third, fourth, and fifth factors, personality and operational, are also important but have weak influence. Therefore, these four factors are suggested to be used as background/supporting features in good ketchup sauce bottle samples design. Finally, the results from this study have made it possible for the study to produce a guideline for emotional interface design of the ketchup sauce bottle. Since Kansei is highly dependent on the specific characteristics of any culture, the results of this study of our product may not produce universally accepted features.

REFERENCES

Harada, A., (1997). The Framework of Kansei engineering. Report of modeling the evaluation structure of Kansei, 49-55.

Haykin S. (2004). Neural Network: A Comprehensive Foundation. 2rd Edition. Beijing: Chine Machine Press.

Jiao J., Zhang Y., and Helander, M. (2006). A Kansei mining system for affective design, Expert Systems with Applications. Expert Systems with Applications 30 (4), 658-673.

Kaiser, H.F. (1958). The varimax criterion for analytic rotation in factor analysis. *Psychometrika, 23*(3), 187-200.

Koleini Mamaghani, N., Tajoddini, M., (2010). Design with emotional approach by implementing Kansei engineering- case study: design of kettle. International Conference on Kansei Engineering and Emotion Research, March. 2-4, Paris.

Lu, H., Chen Y. and Wang, Y. (2008). Knowledge-based customers. Desirability acquisition of clothing. 4th International Conference on Natural Computation (ICNC), Jinan, China, 94-98.

Nagamachi M. (2002). Kansei engineering as a powerful consumer-oriented technology for product development. Applied Ergonomics, 33 (3), 289-294.

Nagamachi, M. (1997). Kansei engineering: The framework and methods. Kaibundo Pub. Co. Japan, 1–9

Nagamachi, M. (2001). Workshop 2 on Kansei engineering. In: Proceedings of the Int. Conf. on Affective Human Factors Design, CAHD 2001. June 26–29, 2001, Singapore; Asian Academic Press, London.

Nagamachi, M., Matsubara, Y. (1997). Hybrid Kansei Engineering System and design support. International Journal of Industrial Ergonomics, 19, 81- 92.

Norman D. (2008). Preface. In: Schifferstein, Hekkert, editors. Product experience. San Diego CA: Elsevier.

Osgood, C. E.; Suci, G.J.; Tannenbaum, P. F., (1957). The Measurement of Meaning, Urbana, Ill: University of Illinois Press. ISBN: 0252745396.

Santesmases Mestre M. (1997). Diseño y análisis de encuestas en investigación social y de mercados. 1ª edición. Ediciones Pirámide. S.A. Madrid, España.

Schu¨tte, S., Eklund, J. Axelsson J., and M. Nagamachi. (2004). Concepts, methods and tools in Kansei engineering. Theor Issues Ergon Sci, 5(3), 214–232.

Schütte, S., Schütte, R., Eklund J.; (2005). Affective Values of Lift Trucks - An Application of Kansei Engineering. In Proceedings of WMOD Conference. Italy.

Sheskin, D. J., (2007). Handbook of Parametric and Nonparametric Statistical Procedures, 4 rd Ed., Boca Raton, Fl: Chapman & Hall/CRC. ISBN: 1584888148.

Wilson, B.G. (2005). Broadening our foundation for instructional design: Four pillars of practice. Educational Technology, 45(2), 10-15.

BIOGRAPHY

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