

# AN EVALUATION AND AN APPLICATION OF USING CANONICAL CORRELATION ANALYSIS IN MARKETING RESEARCH<sup>1</sup>

Çiğdem ŞAHİN BAŞFIRINCI<sup>2</sup>

## ABSTRACT

In this study, in which extent canonical correlation has been used in marketing area was investigated. For this reason, papers using canonical correlation analysis and published on marketing journals indexed by SSCI and between the period of 1997-2008 were searched. Results have shown that canonical correlation is not a widely used technique in marketing literature. In order to understand the potential as well as difficulties of canonical correlation analysis, a further discussion were also presented. Finally, as an example of canonical correlation analysis in marketing area, methodology and findings of a study were presented.

**Keywords:** Canonical Correlation, Marketing Research

**JEL Classification:** M31, M39

## PAZARLAMA ARAŞTIRMALARINDA KANONİK KORELASYON ANALİZİNİN KULLANIMINA İLİŞKİN BİR DEĞERLENDİRME VE ÖRNEK BİR UYGULAMA

### ÖZET

Bu çalışmada kanonik korelasyon analizinin pazarlama alanındaki kullanımına ilişkin bir inceleme yer almaktadır. Bu amaca yönelik olarak, SSCI tarafından indexlenen pazarlama dergileri taranmış ve 1997-2008 yılları arasında kanonik korelasyon analizi kullanan makaleler incelenmiştir. Araştırma sonuçları, kanonik korelasyon analizinin pazarlama literatüründeki kullanımının yaygın olmadığını ortaya koymaktadır. Bu bağlamda, çalışmada kanonik korelasyon analizinin pazarlama araştırmalarında kullanılması açısından mevcut potansiyelini ve de olası güçlüklerini içeren bir tartışma yer almaktadır. Çalışmada, son olarak kanonik korelasyon analizinin pazarlama alanında kullanımına bir örnek niteliğindeki bir araştırmaya metodolojisi ve bulguları ile yer verilmiştir.

**Anahtar Kelimeler:** Kanonik Korelasyon Analizi, Pazarlama Araştırmaları

**JEL Sınıflandırması:** M31, M39

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<sup>2</sup> Assistant Professor Dr., Karadeniz Technical University, cbasfirinci@ktu.edu.tr

## 1. Introduction

Rapid diffusion of personal computers and increasing availability of computer programs has facilitated multivariate techniques' application to marketing research. Jagdish Sheth expressly stated the significance of this change and the growing popularity of multivariate analysis in marketing research in his article named "The Multivariate Revolution in Marketing Research".

According to Sheth (1971), the rapid diffusion of multivariate analysis in marketing was due to a number of reasons. First of all, marketing area is more advanced than other social sciences such as political science in terms of validity and usefulness of information collected and multivariate methods allow using large scale data. Secondly, hence the market place is a complex phenomenon; a simple input output approach does not seem to provide satisfactory answers to marketing problems. A multitude of factors intervene between the marketing activities of companies and market responses. So, attempts are constantly made to examine intervening factors and how they mediate between marketing activities and market responses. This has resulted in the collection of information which corresponds to the complexity of the phenomenon (p.13).

Because the marketing research tasks takes place in uncontrollable environment and also a set of different factors can play significant roles in one or more results, as one of the multivariate analysis techniques, canonical correlation analysis has a rich potential in terms of marketing research.

Since its introduction to marketing research by Green, Halbert, and Robinson (1966), canonical correlation has been used in numerous studies. Interpretational aids have been suggested by Stewart and Love (1968), Alpert and Peterson (1972), Lambert and Durand (1975), Fornell (1978), Cliff and Krus(1976), Perreault and Spiro (1978), and DeSarbo, et. Al (1982). In a more confirmatory sense, Bagozzi, Fornell, and Larcker (1981) and Wildt, Lambert, and Durand (1982) have shown how to subject canonical solutions (weights and loadings) to statistical tests (Fornell, 1985, p.15). Today, canonical correlation analysis can be used in marketing research widely for exploring different constructs such as consumer behaviors and marketing performance.

In this context, the purpose of this paper is highlight that in which extent canonical correlation has been applied in marketing research. For this reason, research papers published on leading marketing journals in last ten years were searched and the studies using canonical correlation in hypothesis testing were examined terms of usage aim and in which part of the marketing literature it has been used.

Finally, as an example of canonical correlation analysis in marketing area, methodology and findings of a study from Turkey was presented. Although studies show that brand personality has an effect on consumer behaviors and intentions in a

desired way, there is not so many studies exploring how it operates on different cultures and for different product categories. In this sense, this study explored how the brand personality construct (having five dimensions) operates on favorable behavioral intentions to the brand across symbolic and functional product categories in Turkey by means of canonical correlation analysis. Results of the study have shown that, although brand personality is an effective tool for favorable behavioral intentions to the brand, in terms of contribution to favorable behavioral intentions, the roles of brand personality dimensions can vary according to different product categories.

## 2. Canonical Correlation Analysis in Marketing Research

Canonical correlation is the appropriate technique for identifying relationships between two sets of variables (Sharma, 1996, p. 391). As Thompson stated “canonical correlation analysis can be as complex as reality in which most causes have multiple effects and most effects are multiply caused”(1984, p.9). Since it is particularly useful in situations in which multiple output measures such as satisfaction, purchase, or sales volume are available (Hair *et al.*, 1998, p. 442) it can be claimed that canonical correlation analysis is one of the most proper techniques for marketing research goals. Furthermore, canonical correlation is a flexible method doesn't requiring rigid restrictions on the types of the data which it operates (Hair *et al.*, 1998). However, although canonical analysis is the most general of the multivariate techniques in which many other procedures – multiple regression, discriminant function analysis, MANOVA – are special cases of it, paradoxically, it is also the least used of the techniques (Tabachnick and Fidell, 1996, p. 196).

Reid and Plank (2000) examined a total of 2194 articles in 28 leading marketing resources for the years 1978 through 1997 dealing with business marketing title and they have identified 10 studies using canonical correlation analysis.

Similarly, Hyman and Yang examined the content of five marketing serials (International Marketing Review, Journal of Euro-Marketing, Journal of Global Marketing, Journal of International Consumer Marketing and Journal of International Marketing) in terms of primary analysis techniques used and the findings have shown that, canonical correlation is one of the methods which are seldom appear in marketing serials (2001, p.701).

With a closer look, in order to see in which extent canonical correlation has been applied in marketing research, those journals having “marketing”, “product”, “brand”, “retailing” and “consumer” terms in their titles and indexed by Social Science Citation Index were searched. Because three of the journals in the result list don't concern with marketing mainly, they were removed from the frame list. However, four of the journals were not fully accessible by the researcher. Therefore, also they were removed from the list. As a result, totally sixteen journals were included in the study: European Journal of Marketing; Industrial Marketing Management; International Journal of Research in Marketing; International Marke-

ting Review; Journal of Business and Industrial Marketing; Journal of Business to Business Marketing; Journal of Interactive Marketing; Journal of International Marketing; Journal of Marketing; Journal of Marketing Research; Marketing Letters; Marketing Science; International Journal of Operations and Production Management; Journal of Retailing; Journal of Consumer Research; Journal of Consumer Affairs.

“Canonical correlation” term was searched in titles, keywords, abstracts and fulltexts of all studies published in these journals from 1997 to 2008 by electronic search engines of scientific databases and finally forty four studies have obtained. Then fulltexts of all studies were examined in order to see whether and in which extent canonical correlation analysis is used. Since there were a lot of studies including “canonical correlation” term in their fulltexts were used not canonical correlation but special cases of canonical correlation such as discriminant, manova or multidimensional analysis, most of the studies were removed. Also there were some studies including canonical correlation term in only their references sections, endnotes or in a similar way. So they were also removed from our frame.

There are just six studies using canonical correlation analysis in hypothesis testing for last ten years in mentioned journals. So, our findings are in consistent with Hyman and Yang (2001) and Reid and Plank (2000). After overview of the six studies, possible reasons of not using canonical correlation in marketing research were discussed below.

In order to test the effects of the leadership behaviors exhibited by the corporate buying center on the set of purchasing outcomes of cycle time, customer orientation, and relationship commitment of a multinational services organization, Hult et. al (1998) used canonical correlation analysis in their study named “The Effect of Global Leadership on Purchasing Process Outcomes”. From the results of the analysis, they suggest that the seven types of leadership behaviors explain a significant share of the variance in the three purchasing outcomes.

Hultink *et al.* (1998) investigated many of the complexities of new product launch strategies in their study: In Search of Generic Launch Strategies for New Products. They used canonical correlation analysis in order to determine whether the set of strategic launch decisions made to be associated with the set of tactical launch decisions made. Since their data were both nominal and ordinal, they used OVERALLS procedure of canonical correlaton. Empirically testing for hypothesized relationships among launch strategy decisions over 900 manufactured goods new product launches, they showed that over half the decisions in launch strategies are interdependent, that is, the decision made for one variable is associated with a decision choice made previously in the product development process.

In order to determine marketing orientation and its determinants, Avlonitis and Gounaris also used canonical correlation analysis in revealing whether the company’s (top management) attitude towards risk, as well as the degree of centralisa-

tion and formalisation that characterise its structural arrangements, determines the degree of Marketing Orientation and also whether and in which extent the importance assigned by the Top Management Team to different key factors of success determines the degree of Marketing Orientation (1999). According to their findings, marketing orientation is a result of company's both attitudes and behaviors.

In Ferrand and Pages' case study (1999), in understanding about how image can create value for sports organisations, canonical correlation is applied to determine the effects of sponsor's image upon image of the event. By examining the strength and direction of the relationship, canonical correlation analysis provides researchers information about making predictive estimates of the suitability of a sponsorship "marriage" between a sporting organisation and a company. So, findings of this study can also assist in strategic decision makings for both groups: sport club and company.

Ellingera *et al* (2003). analyzed the informational and interactive content of the top 100 U.S. motor carrier firms' web sites to examine the relationship between firm size and Internet utilization. In this context, they used canonical correlation analysis to explore the overall effect of Internet utilization (operationalized by the motor carrier web site informational and interactive content composite variables) on financial performance. By testing multivariate significance of canonical correlation, which is significant at the  $p < .10$  level, researchers suggested that there may be quantifiable benefits from investing in the Internet for motor carrier firms.

Caruana and Ewing tested online retailer quality "eTail quality" scale of Wolfenbarger and Gilly (2006). In this context they tested both conceptual and psychometric validity of the scale across different product categories in three countries. Conceptual validity is tested by confirmatory factor analysis, while psychometric validity is tested by different analyses one of which is canonical correlation. As Caruana and Ewing stated, "To investigate nomological validity, the four dimensions of eTailQ were treated as a set of predictor variables and on the basis of existing literature, perceived value, overall satisfaction and loyalty were considered as criterion variables – enabling the data to be tested with canonical correlations"(2003, p.363). Using redundancy index, canonical weights, loadings and cross loadings they not only support a significant relationship between eTailQ dimensions and the constructs of perceived value, overall satisfaction and loyalty for all three product categories, but also show a relatively new form of using canonical correlation in marketing research.

As can be seen from these six studies canonical correlation analysis can be used in various areas of marketing theory such as marketing orientation, integrated marketing communication, brand management, consumer behavior. However, canonical correlation is not used widely in marketing research. In order to investigate this phenomenon, we should discuss the limitations of the method firstly.

When we look the main limitations of the technique we see that there is no any causal relationship in canonical correlation, but only a correlational technique (Aaker, et. al, 2007). Since today more advanced multivariate techniques based on causal relationships such as structural equation modelling are available, they might be preferred to use instead of canonical correlation. Also, the procedures that maximize the correlation do not necessarily maximize interpretation of the pairs of canonical variates in canonical correlation analysis, so solutions of canonical correlation are not easily interpretable. Furthermore, like in factor analysis, rotation of canonical variate to improve interpretability is not a common practice and not available in most computer programs in canonical correlation. Besides, since only orthogonal solution is normally available. Considering all of these factors together, it can be claimed that interpretation is difficult and there are indirect measures for interpreting canonical correlation analysis such as canonical loadings and cross loadings rather than precise statistics. Of course, this phenomenon may be an important reason to prefer more advanced multivariate techniques. Also, scale validity and reliability should be an important consideration in canonical correlation analysis because, changing variable in one set alters the composition of canonical variate in the other set significantly. So, researchers should be so careful and clear about the scales in this technique.

However, as Hair *et al* stated (1998, p. 455) “these limitations are not meant to discourage the use of canonical correlation. Rather, they are pointed out to enhance the effectiveness of canonical correlation as a research tool”. Researchers can overcome these limitations in different ways. For example, statistically significant dependent variates can be used in subsequent analysis such as multiple linear regression ( Hosie *e. al.*, 2006).

So, in the next section, as a detailed example of using canonical correlation analysis in marketing theory, empirical findings from Turkey were offered.

### **3. As an Example of Canonical Correlation Analysis in Marketing Area, Empirical Findings from Turkey**

#### **3.1. Brand Personality – Favourable Behavioural Intentions Relationship**

With the progress on information and transportation technologies, being different in terms of functionality is almost impossible for products in today’s competitive world. As a result of these environmental factors, some intangibles of brand such as brand equity and brand image have become one of the most important strategic tools for companies in getting competitive advantage. As the one of the brand intangibles, brand personality has drawn attention from both academicians and practitioners.

Brand personality which is defined formally “the set of human characteristics associated with a brand” by Jennifer Aaker (1997) has a strategic role in brand positioning and can be used for a main communication tool for the companies. Moreo-

ver, different researchers agree that, brand personality is a good tool for differentiating similar products in terms of functionality (Plummer, 1984/1985; Biel, 1993; Halliday, 1996; Kim *et al.*, 2001) and brand personality can create a base for consumers to express themselves (Malhotra, 1988; Belk, 1988; Aaker, D.A., 1996; Keller, 1998; Phau & Lau, 2001; Hellgeson & Supphellen, 2004).

Although the most of the brand personality researchers from both academic and private sector agree the idea that the brand personality can create some of the desired impact on consumers behavioral intentions (Sirgy, 1982; Plummer, 1984/1985; Malhotra, 1988; Biel, 1993; Aaker, J.L., 1997; Ferrandi, Fine-Falcy and Valette-Florence, 1999; Kim *et al.*, 2001; Phau and Lau, 2001; Magin *et al.* 2003; Suphellen and Gronhaug, 2003; Helgeson and Suphellen 2004; Azevedo ve Farhangmehr, 2005, Freling and Forbes, 2005) there is not enough findings about how the brand personality operates across different cultures and product categories. Recent findings have shown that, the working of the brand personality concept might be different across cultures and product categories (Ferrandi, Fine-Falcy and Valette-Florence, 1999; Aaker, J.L, Benet-Martinez and Garolera, 2001; Caprara *et al.*, 2001; Guliz, 2001; Koebel and Ladwein, 2001; Suphellen and Gronhaug, 2003; Yongjun and Tinkham, 2005).

### 3.2. Purpose of the Study

Therefore, the purpose of this study is to highlight several research proportions that will introduce brand personality as an evaluation indicator for developing behavioral intentions. In this sense, this study examines perceived brand personality dimensions and favorable behavioral intentions relationship across two different product categories.

Since further research is also needed to reveal how brand personality information is processed, finally, this study examines some of the key contributors that will lead to favorable behavioral intentions by means of brand personality. The key contributors are classified as self congruity, functional benefit cueing and relationship with a brand.

### 3.3. The Research Model

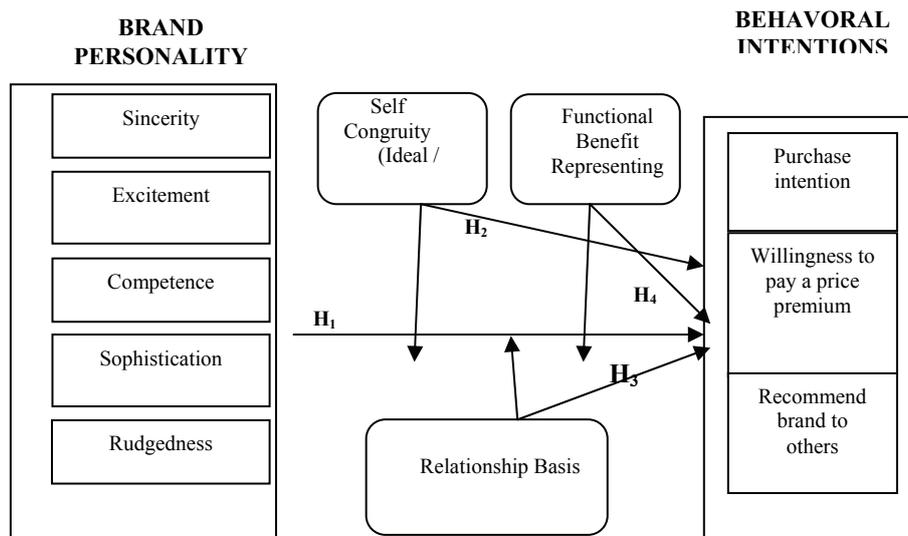
As can be seen below, research model refers a relationship between perceived brand personality and favorable behavioral intentions to the brand. Brand personality construct of Jennifer L. Aaker(1997) having five dimensions namely sincerity, excitement, competence, sophistication and ruggedness. Since, a simple variable does not seem to provide satisfactory answers to consumer behavior, favorable behavioral intentions have three dimensions: Recommending brand to others, willingness to pay a price premium and purchase intentions.

Also, there are moderating variables in the model. Moderating variables both intervene between the brand personality-favorable behavioural intentions relation-

ship and also contribute to final dependent variables. Since, this study focuses on using correlation analysis in marketing area; moderating variables' contributions to favourable behavioral intentions were tested, while their effects on the relationship between dependent and independent variables by manova were not tested.

Self congruity, relationship basis and functional benefit queing were chosen as moderator because Aaker suggested the brand personality can subsume an entire set of brand associations that in essence capture the value proposition driving the brand strategy and so contribute to brand equity (1996, p. 168). To this end, moderator variables of the research model were derived from David Aaker's model explaining how brand personality creates brand equity. As can be seen below, brand personality contributes brand equity with three different models: Self congruity, functional benefit queing and relationship basis.

**Figure 1: The Research Model**



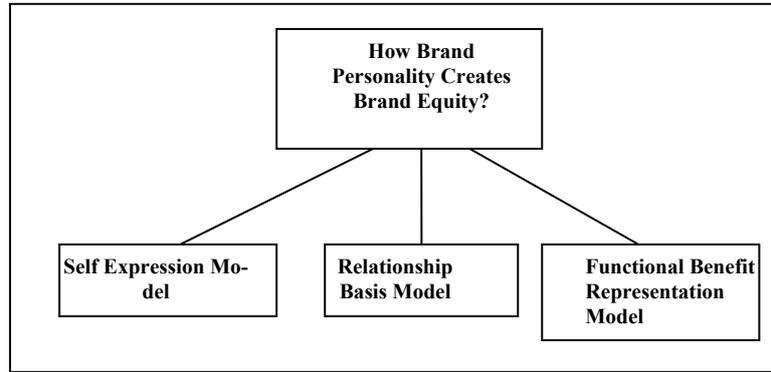
Self-congruity the term used for this study can be described as how much a consumer's perceptions about himself or herself match their perceptions about the personality of the brand. According to David Aaker, for some consumers, brand personality performs as an intermediary function in expressing themselves. Because of symbolic meanings they carry, the brands are used as a tool of communication (1996). As a result of this phenomenon, the concept has been used to explain and

predict brand attitude, product use and ownership, store loyalty, purchase intention, and so forth (Sirgy et. al, 1997; Helgeson et. al, 2004).

Functional benefit representation model explains, in which extent functional benefits of the brand are associated with the brand personality. Since brand personality can be a vehicle for representing and cueing functional benefits and brands attributes in memory (Aaker, D.A., 1996, p. 168), it encourages active processing of brand related information -including functional benefits-, resulting in interpretations that have greater meaning for the consumer (Biel, 1993, p: RC-9).

Relationship basis model explains in which extent brand personality provides a basis for a relationship between the customer and the brand. Recent studies have shown that as one step further of expressing themselves, consumers can have a relationship with the brand – which can be developed in the same way of other social relationship constructs. Moreover, the results of these studies have indicated that consumers can be differentiated in terms of not only perceiving the brands but also developing relationships with the brands (Blackston, 1993; Fournier, 1998; Muniz Jr. and O’Guinn, 2001). For example, Fournier claims that brand relationships involves a wide spectrum ranging from best friend to flirt and even if hatred.

**Figure 2: How Brand Personality Creates Brand Equity?**



Aaker, D. A, 1996, p. 153.

### 3.4. Research Hypotheses

1.H<sub>1</sub>: There is a statistically significant and positive relationship between dimensions of perceived brand personality and favourable behavioral intentions to the brand.

2.H<sub>1</sub>: There is a statistically significant and positive relationship between self congruity, functional benefit representing and relationship basis potential of brand personality and the dimensions of favourable behavioral intentions to the brand.

### 3.5. Design

Since, some researchers claim that brand personality offers symbolic benefits to customers rather than functional ones (Keller, 1993; 1998), two different product categories which can be characterized with symbolic and functional features were chosen in order to test whether perceived brand personality has an impact on favorable behavioral intentions for both symbolic and functional product categories.

Some criteria were taken into consideration in the selection of product categories. In the widely recognized product categories, socially visible products which have a high level of involvement and a lot of competitive brands were chosen. In order to minimize the difficulties of data gathering, also the product categories which are used by the most of the people were tried to chosen. Considering these limitations, Ratchford's (1987) product category classification scheme was used and as a result, blue jean and mobile phone products were selected for namely symbolic and functional product categories. In this study, a blue jean and a mobile phone brand which are widely global and highly recognized were tested.

Since there are both financial and technical difficulties in reaching to population of country, the research area was limited to Istanbul city. Sample was calculated as 500 people. So, there were 250 people in the sample for both of the product categories. In order to test understandability of the question form and also approximate time of data gathering, a pre questionnaire was tested on 20 people. After the revisions made, researcher gathered the data as face to face using a question form. The research was conducted on five hundred respondents at two different shopping centers which are visited by various city residents in terms of socio demographic characteristics.

In this study, in order to investigate the scale validity for brand personality and its impact for developing favorable behavioral intentions, two different product categories – symbolic (blue jean) and functional (mobil phone) is tested. Since brand personality contributes brand equity with three different models: Self congruity, functional benefit queing and relationship basis, their effects on favorable behavioral intentions are also tested.

### 3.6. Analysis

Brand personality's impact on developing favorable behavioral intentions can vary among different product categories. However, this difference can also be stem from different samples in terms of demographic and socio economic characteristics. In order to minimize such a risk and reveal in which extent the role of brand personality and other moderating variables on favorable behavioral intentions to the brand can vary among different product categories, similarity of samples' demographic and socio economic characteristics was tested by using a Kolmogorov Simirnov test. Test results have shown that, samples are similar.

For validity of the scales, factor analysis was used. Factor loadings expressing correlation coefficients between variables and the factor they possess and total explained variance for every factor were taken into account and minimum level of factor loading was accepted as 70%.

For scale reliability, Cronbach's Alpha was used. 70 percent was accepted as the minimum level of reliability.

After testing similarity of the samples and validity and reliability of scales, then research hypotheses were tested by SPSS 13 Statistical Package Software.

### 3.7. Test of Hypotheses

#### 3.7.1. Test of Hypotheses 1

*1.H1: There is a statistically significant and positive relationship between dimensions of perceived brand personality and favourable behavioral intentions to the brand.*

As can be seen above, in the first research hypothesis, it is tried to determine magnitude of the relationships that may exist between perceived brand personality and favourable behavioral intentions to the brand. In order to develop our understanding about whether perceived brand personality has an impact on favorable behavioral intentions for both symbolic and functional product categories, same hypothesis was tested on two different product categories.

In situations with multiple dependent and independent variables, such as in our hypothesis, canonical correlation is the most appropriate and powerful multivariate technique with its flexible nature having fewest restrictions on the types of data on which it operates. Although the issues of the impact of sample size and the necessity for a sufficient number of observations per variable are frequently encountered with, it can accommodate any metric variable (Hair *et al.*, 1998). Also, mainly necessitating the assumption of linearity, it has a strong method in terms of possible deflections on other assumptions such as normality or homoscedasticity (Tabachnick and Fidel, 1996, p. 198).

In order to investigate linearity of data for both of the product categories, statistical significance of correlation coefficients between predictor and criterion data set were explored. Correlation matrix showed that all of the correlation coefficients between dependent and independent variables are significant at 0,01 level. So, the assumption of linearity is satisfied.

The first step of canonical correlation analysis is to derive one or more canonical functions. As is known, canonical functions can be described as relationship between dependent and independent variates representing the weighted sum of data sets both dependent and independent (Hair *et al.*, 1998, p. 443). Since, there are three dependent variables in our model, three canonical functions were derived. The

statistical significance of each canonical function was examined separately in order to determine the exact number of relations between the two sets of variables (Levine, 1977). And test results has shown that (See Table 1), for both of the product categories, there is only one canonical function which is statistically significant at 1% level. So, first canonical functions were interpreted while, other two canonical functions were not interpreted because of the relationships among the variables deemed insignificant.

**Table 1: Measures of Overall Model Fit for Canonical Correlation Analysis**

<b>X Brand Mobile Phone</b>					
<b>Canonical Function</b>	<b>Can. Cor. Coefficient (Rc)</b>	<b>Canonical (Rc<sup>2</sup>)</b>	<b>Chi Square</b>	<b>DF</b>	<b>Sig.</b>
1	0,529	0,280	93,01	15,00	<b>0,000</b>
2	0,196	0,038	12,73	8,00	0,121
3	0,113	0,013	3,145	3,00	0,370
<b>Y Brand Blue Jean</b>					
<b>Canonical Function</b>	<b>Can. Cor. Coefficient (Rc)</b>	<b>Canonical (Rc<sup>2</sup>)</b>	<b>Chi Square</b>	<b>DF</b>	<b>Sig.</b>
1	0,572	0,327	108,93	15,00	<b>0,000</b>
2	0,186	0,035	12,07	8,00	0,148
3	0,118	0,014	3,46	3,00	0,327

In order to evaluate the significance of canonical roots, a multivariate test of all canonical roots should be used in addition to separate tests of each canonical function, (Hair et. al, 1998). A collective examination of Rc<sup>2</sup> allows us to determine if the Rc<sup>2</sup> values differ statistically from the zero. In this sense, statistical significance of discriminant functions was also provided. In assessing the significance of discriminant functions, Wilks' lambda, Hotelling's trace, Pillai's trace tests were used. Since Roy's Greatest Root is preferred for a few reseachers because of explaining only first dimension of function (Tabachnick and Fidell, 1996, p. 401) it was not used in this study.

**Table 2: Multivariate Tests of Significance**

Statistics	X Brand Mobile Phone			Y Brand Blue Jean		
	Value	F	Conf.	Value	F	Conf.
Pillai's Trace	0,33112	6,05447	0,000	0,37576	6,98752	0,000
Hotelling- Lawley Trace	0,44160	7,08520	0,000	0,53622	8,60329	0,000
Wilk's Lamda	0,68358	6,58435	0,000	0,64048	7,80158	0,000

As can be seen at Table 2, cumulative statistics of  $R_c^2$  differ from the zero statistically. After testing statistical significance of canonical correlation ( $R_c$ ) and squared canonical correlation ( $R_c^2$ ) values, then practical significance of them were examined. The practical significance of the canonical functions is represented by the size of the canonical correlation coefficient and explains the magnitude of the canonical correlation. Hair *et al*, stated that there are not any generally accepted guidelines have been established regarding suitable sizes for canonical correlations.”(1998, p.451). However, it can be said that, the higher levels of canonical correlation coefficient implies stronger relation between predictor and criterion variables. In this context, when we look at the Table 1, we can see that canonical correlation coefficient for X Brand Mobile phone ise 52,9% while it is 57,2% for Y Brand blue jean. These rates satisfy the expectations of research model. So, the magnitude of relationship shows that there is a not only statistically but also practically significant relationship between perceived brand personality and favorable behavioral intentions to the brand.

Canonical correlation coefficient of functional product (X Brand Mobile Phone 52,9%) is lower than symbolic one(Y Brand Blue Jean 57,2%). Somebody can interpret this result as an evidence of Keller's claim that that brand personality offers symbolic benefits to customers rather than functional ones(Keller, 1993; 1998). However, this situation does not eliminate the current relationship between proposed variables. Furthermore, relatively low levels of relationship can be a result of some strategical and tactical mistakes of X Mobile Phone Company. Since the test of the research model is depend on only one brand instead of several brands in same product, making generalizations about product categories may not be completely explanatory from this model. At that point, suggesting similar studies including functional and symbolic product groups as future research is proper rather than making generalizations.

After examining the magnitude of the relationship, the latter criterion measures the redundancy of the common variance. Hair *et al* stated that “Although squared canonical correlations provide an estimate of the shared variance between the canonical variates, it may lead to some misinterpretation because the squared canonical correlations represent the variance shared by the linear composites of the sets of dependent and independent variables, and not the variance extracted from the sets of variables. Thus, a relatively strong canonical correlation may be obtained be-

tween two linear composites (canonical variates), even though these linear composites may not extract significant portions of variance from their respective sets of variables” (1998, p.451). So, in order to overcome possible risks of canonical roots, the Stewart-Love redundancy index was used in the study as an indicator of shared variance. Presenting the amount of variance in one set of variables that can be explained by the variance in the other set, it is perfectly analogous to multiple regressions’ R<sup>2</sup> statistic, and its value as an index is similar (Hair *et al*, 1998, p.451). Dependent variate’s Stewart Love redundancy coefficient for functional product category was calculated as 17,9%, while it was 19,7% for symbolic product category. When we look at the independent variate’s redundancy index, we see 8% and 9,3% namely, which are relatively low. However, as Hair *et al* States, in most instances the researcher is concerned only with the variance extracted from the dependent variable set, which provides a much more realistic measure of the predictive ability of canonical relationships(1998, p. 452).Just as with canonical correlations, no generally accepted guidelines have been established about the minimum acceptable redundancy index needed to justify the interpretation of canonical functions (Hair *et al*, 1998, p 452). To this end, in our study exploring perceived brand personality’s impact on favorable behavioral intentions, 17,9% and 19,7% can be evaluated as worth to study for future researchs.

Since practical significancy of the first canonical functions were provided by canonical correlations and redundancy index, then interpretation of the results are required. In the interpretation process which reveals the contribution of each original variable to canonical relationship, canonical loadings and canonical cross loadings were used. Since canonical weight is open to criticism on interpretation of beta weights (Hair *et al*, 1998, p. 453), it was not used.

From the test results, we see that, contributions of each dimension of perceived brand personality to independent canonical variate are different. For X Brand Mobile Phone, canonical loadings of independent variables, in other words, contributions of each brand personality dimension to the brand personality canonical variate are “Competence”(90%), “Sincerity”(73,7%), “Rudgedness”( 72,5%), “Excitement”(60,6%) and “Sophistication”(57,7%). When we look at cross loadings, we see that contributions of independent variables to dependent canonical variate follow same order in terms of amount of contributions namely: “Competence”(47,6%), “Sincerity”( 39%), “Rudgedness”( 38,3%), “Excitement”( 32,1%) and “Sophistication”( 30,5%).

**Table 3 : Hypothesis 1- Canonical Loadings , Canonical Cross Loadings for Dependent and Independent Variables and Redundancy Indexes**

	<b>X Brand Mobile Phone</b>		<b>Y Brand Blue Jean</b>	
	For the First Canonical Function Which Is Statistically Significant : (Rc=0,529, p=0,00)		For the First Canonical Function Which Is Statistically Significant: (Rc=0,572, p=0,00)	
<b>Independent Canonical Variate</b>	<b>Canonical Loadings</b>	<b>Can. Cross Loadings</b>	<b>Canonical Loadings</b>	<b>Can. Cross Loadings</b>
Sincerity	0,737	0,390	0,585	0,335
Excitement	0,606	0,321	0,910	0,520
Competence	0,900	0,476	0,763	0,437
Sophistication	0,577	0,305	0,737	0,422
Ruggedness	0,725	0,383	0,464	0,302
<b>Dependent Canonical Variate</b>	<b>Canonical Loadings</b>		<b>Canonical Loadings</b>	
Recommend Brand to Others	0,858		0,834	
Willingness to Pay a Price Premium for the Brands	0,710		0,616	
Purchase Intention to the Brand	0,824		0,856	
<b>Redundancy Index for Independent Canonical Variate</b>		0,08		0,093
<b>Redundancy Index for Dependent Canonical Variate</b>		0,179		0,197

For Y Brand Blue Jean, canonical loadings of brand personality variables to brand personality variate are: “Excitement” (91%), “Competence” (76,3%), “Sophistication” (73,7%), “Sincerity” (58,5%) and “Ruggedness”( 46,4%). Canonical cross loadings of brand personality variables to favourable behavioural intentions are also similar in the amount of contributions: “Excitement” (52%), “Competence” (43,7%), “Sophistication” (42,2%), “Sincerity” (33,5%) and “Ruggedness”( 30,2%).

Since the research model is concerned predictive ability of independent variables set, canonical loadings and cross loadings of dependent variables were not interpreted here. The only thing we should mention here is that canonical cross loadings of dependent canonical variables are so lower than canonical cross loadings of independent canonical variables.

As Lambert and Durand stated that “in making subset interpretations based on loadings, the point above which loading values are considered to be nontrivial

however, in n past studies, it has tended to range from .28 to .45 with 30 being used most often” (1975, p. 472). In this context, it is possible to claim that all variables of our model are meaningful in terms of contributions to canonical variates they made.

The final issue of interpretation is examining the signs of the cross-loadings(Hair *et al*, 1998, p. 460). As can be seen from Table 3, all independent variables have positive correlations with dependent canonical variate. So, we can say that, the sign of the relationship is positive as in our hypothesis.

Since test results shows that every dimension of perceived brand personality has a positive and meaningful contribution to favorable behavioral intentions for both of the product categories,  $H_1$  is accepted for both X Brand Mobile Phone and Y Brand Blue Jean.

### 3.8. Test of Hypotesis 2

2.  $H_1$ : *There is a statistically significant and positive relationship between self congruity, functional benefit representing and relationship basis potential of brand personality and the dimensions of favourable behavioral intentions to the brand.*

In the second hypothesis, predictive abilities of moderator variables on favourable behavioural intentions to the brand were explored.

In the literature, there are four main types of self congruity: Actual self congruity (the current self-concept perceptions about us), the ideal self congruity (the ideal self-concept perceptions about us), social self congruity (the self-concept as perceived by significant others) and ideal social self congruity (the self-concept as ideally perceived by significant others). As Sirgy(1982) stated “whereas all four variants have been shown to affect brand attitudes or choice, actual self congruity and ideal self congruity have received the strongest empirical support”(Helgeson and Supphellen, 2004, p. 209). So, only ideal and actual self congruity dimensions were measured seperately in this study while other dimensions were excluded. In this context, there will be two sub hypotheses:

2.1. $H_1$ : *There is a statistically significant and positive relationship between actual self congruity, functional benefit representing and relationship basis potential of brand personality and the dimensions of favourable behavioral intentions to the brand.*

2.2.  $H_1$ : *There is a statistically significant and positive relationship between ideal self congruity, functional benefit representing and relationship basis potential of brand personality and the dimensions of favourable behavioral intentions to the brand.*

Testing two dimensions of self congruity for both mobile phone and blue jean may develop our understanding about whether test results differ in terms of different

dimensions of self congruity in the same product category, and also which dimension of self congruity is more meaningful among different product categories.

Since there are three independent variables (moderator variables of the research model) and dependent variable has also three sub dimensions, canonical correlation analysis was used. Both sub hypotheses were tested for namely X Brand Mobile Phone and Y Brand Blue Jean.

### 3.8.1. Test of Hypotesis 2 for X Brand Mobile Phone

First of all, statistical significance of correlation coefficients between dependent and independent variables were explored in order to see whether the assumption of linearity is satisfied or not. Results have shown that all of the correlations between dependent and independent variables are statistically significant at 0,01 level except one correlation between ideal self congruity and willingness to pay a price premium for the brand. However, since it is also significant at 0,05 level, so the assumption of linearity is satisfied.

Then practical significance of canonical functions were tested both separately and collectively. As can be seen from Table 4, there is only one statistically significant canonical function at 1% level for both of the models.

**Table 4: Measures of Overall Model Fit for Canonical Correlation Analysis**

<b>X Brand Mobile Phone(Actual Self Congruity)</b>					
<b>Canonical Function</b>	Can. Cor. Coefficient (Rc)	Canonical (Rc <sup>2</sup> )	Chi Square	DF	Sig.
1	0,719	0,517	183,638	9,000	<b>0,000</b>
2	0,132	0,017	4,885	4,000	0,299
3	0,049	0,002	0,591	1,000	0,442
<b>X Brand Mobile Phone (Ideal Self Congruity)</b>					
<b>Canonical Function</b>	Can. Cor. Coefficient (Rc)	Canonical (Rc <sup>2</sup> )	Chi Square	DF	Sig.
1	0,715	0,512	183,745	9,000	<b>0,000</b>
2	0,144	0,021	7,818	4,000	0,098
3	0,105	0,011	2,706	1,000	0,100

When we test significance of canonical functions collectively, we see that  $R_c^2$  differs from the zero statistically.

**Table 5: Multivariate Tests of Significance**

Statistics	X Brand Mobile Phone (Actual Self Congruity)			X Brand Mobile Phone (Ideal Self Congruity)		
	Value	F	Conf.	Value	F	Conf.
Pillai's Trace	0,53693	17,875	<b>0,00</b>	0,54316	18,129	<b>0,000</b>
Hotelling Lawley T	1,09124	29,4228	<b>0,00</b>	1,07960	29,109	<b>0,000</b>
Wilk's Lamda	0,47330	23,748	<b>0,00</b>	0,5545	18,094	<b>0,000</b>

Since, significance of the canonical functions are also represented by the size of the canonical correlations(Hair et. al, 1998 ), canonical correlation coefficients were also considered. As can be seen from the Table 4, for X Brand Mobile Phone, canonical correlation between moderator variables and dependent variables is 71, 9% for Hypothesis 2.1 while it is 71,5% for Hypothesis 2.2. Although the sizes of the coefficients are so similar, coefficient of the model including ideal self congruity dimension is relatively low. This situation may be associated with Keller's claims that self congruity works better on symbolic products because it represent a base for ideal self (1993, 1998). Although canonical correlations coefficients were highly satisfied our expectations for this model, further research is required for generalizations.

As the last measurement about practical significancy of canonical function, dependent variates' Stewart Love redundancy indexes were calculated as 32,5% for Actual Self Congruity and 32,2% for Ideal Self Congruity. As variances extracted from the dependent variable, size of indexes satisfy expectations of the research model.

From the test results, we see that, the highest contribution of moderator variables to independent canonical variate is relationship basis with 61,7% for both of the hypotesis. Functional benefit representing follows it with 60,1% for actual self congruity and 60% for ideal self congruity. Self congruity is the last moderator variable in terms of the size of the contribution which is 41,3 for actual dimension and 30% for ideal dimension. As stated before, 30% is the most often used level in defining meaningful variables of the model in terms of contributions to canonical variates they made. In this context, since all independent variables contribute to independent variate meaningfully and also all independent variables have positive correlations with dependent canonical variate (See Table 6), 2.H<sub>1</sub> and 2.H<sub>2</sub> are accepted for X Brand Mobile Phone.

**Table 6 : Hypothesis 2 for X Brand Mobile Phone- Canonical Loadings , Canonical Cross Loadings for Dependent and Independent Variables and Redundancy Indexes**

	X Brand Mobile Phone (Actual Self Congruity)		X Brand Mobile Phone (Ideal Self Congruity)	
	For the First Canonical Function Which Is Statistically Significant : (Rc=0,719, p=0,000)		For the First Canonical Function Which Is Statistically Significant : (Rc=0,715, p=0,00)	
<b>Dependent Canonical Variate</b>	<b>Canonical Loadings</b>	<b>Canonical Cross Loadings</b>	<b>Canonical Loadings</b>	<b>Canonical Cross Loadings</b>
Self Congruity	0,575	0,413	0,419	0,300
Functional Benefit Representing	0,835	0,601	0,839	0,600
Relationship Basis	0,858	0,617	0,862	0,617
<b>Dependent Canonical Variate</b>	<b>Canonical Loadings</b>		<b>Canonical Loadings</b>	
Recommend Brand to Others	0,916		0,916	
Willingness to Pay a Price Premium for the Brands	0,716		0,707	
Purchase Intention to the Brand	0,731		0,740	
<b>Redundancy Index for Dependent Canonical Variate</b>		<b>0,325</b>		<b>0,322</b>

### 3.8.2. Test of Hypotesis 2 for Y Brand Blue Jean

The same procedure was followed for Y Brand Blue Jean. In order to see whether the assumption of linearity is satisfied, the correlations between dependent and independent variables were tested in terms of statistical significance. Since all of the correlations are statistically significant – at 0,01 level except one correlation which is between actual self congruity and purchase intentions to the brand significant at 0,05 level –, practical significance of canonical functions were examined.

In both models, there is only one canonical function statistically significant at 1% level. Also multivariate tests of significance shows that canonical functions are also significant when tested cumulatively.

**Table 7: Measures of Overall Model Fit for Canonical Correlation Analysis**

<b>Y Brand Blue Jean (Actual Self Congruity)</b>					
<b>Canonical Function</b>	<b>Can. Cor. Coefficient (Rc)</b>	<b>Canonical (Rc<sup>2</sup>)</b>	<b>Chi Square</b>	<b>DF</b>	<b>Sig.</b>
1	0,636	0,405	135,944	9,000	<b>0,000</b>
2	0,170	0,029	8,490	4,000	0,075
3	0,073	0,005	1,325	1,000	0,250
<b>Y Brand Blue Jean (Ideal Self Congruity)</b>					
<b>Canonical Function</b>	<b>Can. Cor. Coefficient (Rc)</b>	<b>Canonical (Rc<sup>2</sup>)</b>	<b>Chi Square</b>	<b>DF</b>	<b>Sig.</b>
1	0,654	0,427	144,760	9,000	<b>0,000</b>
2	0,158	0,025	7,979	4,000	0,092
3	0,084	0,007	1,742	1,000	0,187

When we look the size of canonical correlations we see that Rc is 63,6% for 2H1 and 63,4% for 2H2 which can be evaluated as satisfying. Interestingly, this time canonical correlation coefficient for ideal self congruity is relatively higher than actual self congruity on the contrary of functional product category. This situation may verify that, in symbolic products, ideal self congruity is more effective than actual on developing favorable behavioral intentions to the brand. Also, redundancy indexes of dependent variates' are also in expected levels which are 25,1% and 28,6% for namely actual and ideal self congruity(See Table 9).

**Table 8: Multivariate Tests of Significance**

Statistics	<b>X Brand Mobile Phone (Actual Self Congruity)</b>			<b>X Brand Mobile Phone (Ideal Self Congruity)</b>		
	Value	F	Conf.	Value	F	Conf.
Pillai's Trace	0,43913	14,06101	<b>0,000</b>	0,45932	14,82436	<b>0,000</b>
Hotelling Lawley T	0,71565	19,29599	<b>0,000</b>	0,77855	20,99191	<b>0,000</b>
Wilk's Lamda	0,57479	16,86208	<b>0,000</b>	0,55452	18,09367	<b>0,000</b>

From the test results, we see that, the highest contribution of moderator variables to independent canonical variate is relationship basis with 61,7% for both of the hypothesis. Functional benefit representing follows it with 60,1% for actual self

congruity and 60% for ideal self congruity. Self congruity is the last moderator variable in terms of the size of the contribution which is 41,3% for actual dimension and 30% for ideal dimension. As stated before, 30% is the most often used level in defining meaningful variables of the model in terms of contributions to canonical variates they made. In this context, since all independent variables contribute to independent variate meaningfully and also all independent variables have positive correlations with dependent canonical variate (See Table 6), 2.H<sub>1</sub> and 2.H<sub>2</sub> are accepted for X Brand Mobile Phone.

When we look correlations of each moderator variable with dependent canonical variate, we see that, relationship basis has the highest correlation with 59,9% for the model including actual self congruity and 59,6% for the model including ideal self congruity. Functional benefit representing follows it with 48,2% for actual self congruity and 48,5% for ideal self congruity. Although canonical cross loading of ideal self congruity is above 30% with 46,9%, actual self congruity's cross loading is 23,1% . Since, canonical cross loading of actual self congruity does not have any meaningful contribution to the favorable behavioral intentions, findings of B Brand Blue Jean satisfies the expectations of research model only for ideal self congruity. In summary, 2.H<sub>2</sub> is rejected for Y Brand Blue Jean, while 2.H<sub>1</sub> is accepted.

In an overall evaluation of Hypothesis 2, it is interesting that for a functional product category, both ideal and actual self congruity have meaningful contributions to the favorable behavioral intentions to the brand, while for a symbolic product category, only ideal self congruity has a meaningful contribution. However, in terms of the size of the meaningful contributions, actual self congruity is more important at functional product category. These results may imply that actual self is relatively important for functional product categories. Similarly, for symbolic product categories, brand strategist should focus on ideal self rather than actual one. Findings support the current literatur in this context. However, testing the same model in different products and brands chosen from different product categories in Turkey will increase the validity and reliability of these findings.

**Table 9: Hypothesis 2 for Y Brand Blue Jean - Canonical Loadings , Canonical Cross Loadings for Dependent and Independent Variables and Redundancy Indexes**

	X Brand Mobile Phone (Actual Self Congruity)		X Brand Mobile Phone (Ideal Self Congruity)	
	For the First Canonical Function Which Is Statistically Significant : (Rc=0,719, p=0,000)		For the First Canonical Function Which Is Statistically Significant : (Rc=0,715, p=0,00)	
Dependent Canonical Variate	Canonical Loadings	Canonical Cross Loadings	Canonical Loadings	Canonical Cross Loadings
Self Congruity	0,363	<b>0,231</b>	0,717	0,469
Functional Benefit Representing	0,757	0,482	0,741	0,485
Relationship Basis	0,941	0,599	0,912	0,596
Dependent Canonical Variate	Canonical Loadings		Canonical Loadings	
Recommend Brand to Others	0,871		0,846	
Willingness to Pay a Price Premium for the Brands	0,764		0,792	
Purchase Intention to the Brand	0,717		0,727	
<b>Redundancy Index for Dependent Canonical Variate</b>		<b>0,251</b>		<b>0,286</b>

#### 4. Discussion

As can be seen from brand personality – favorable intentions to the brand relationship, canonical correlation analysis can be used effectively in marketing literature. As Hair *et al.* stated, canonical correlation analysis is particularly useful in situations in which multiple output measures such as satisfaction, purchase, or sales volume are available (1998, p. 442 ). However, as is known, it is not used widely in marketing literature. This situation can be explained with three main reasons.

First of all, limitations of the analysis can be mentioned as an important factor such as being not easily interpretable and offering not a causal but correlational relationship. Because of these limitations, Tabachnick and Fidell concluded that (1996:196) “in its present stage of development canonical correlation is best considered as a descriptive technique or a screening procedure rather than a hypothesis testing procedure”.

Secondly, today another dramatic change has occurred and a new generation of multivariate methods is now available to marketing research. Covariance structure analysis or with a wellknown name structural equation modeling is the most widely used representative of those new generations method. As providing precise

statistics for interpretation and also ability of exploring causal relationships, this new generation of multivariate model are not only powerful than all earlier multivariate techniques, they also bring new perspective on overall research methodology (Fornell, 1985, p. 1). However, these new methods may not substitute of canonical analysis always. So, as Fornell stated, “canonical correlation occupies an intermediate position between the first and the second generation of methods” (1985, p. 15). Most of these techniques necessitate metric data and many assumptions while canonical correlation has no any restriction about the data and also the assumptions on data is minimal.

Finally, Hair *et al.* explained this situation from a different perspective: “Because the other techniques impose more rigid restrictions, it is generally believed that the information obtained from them is of higher quality and may be presented in a more interpretable manner. For this reason, many researchers view canonical correlation as a last-ditch effort, to be used when all other higher-level techniques have been exhausted. (1998, p.444). This may be also another reason of using canonical correlation in marketing seldom.

Although availability of new powerful methods may be preferred to canonical correlation, it is still possible to say that, with its flexible nature, canonical correlation analysis can serve a broader area than these new methods. For example, Hultink *et al* (1998) investigated many of the complexities of new product launch strategies using nominal and ordinal data within a special case of canonical correlation: Overals. Within the marketing research perspective, Horvath *et al* suggested using canonical correlation analysis as a complementary technique. In their study, in order to test the existence of structural relationships between consumer response and marketing instruments they used canonical correlation and its associated Wiener-Granger causality testing based on the canonical coefficients (2002, p.53). Similarly, Caruana and Ewing (2006) used canonical correlation to investigate nomological validity of online retailer quality-eTailQ- scale. Naik *et al* (2000) used multi dimensional analysis as a special case of canonical correlation analysis in their new dimension reduction approach for data rich marketing environments : Sliced Inverse Regression. All of these studies and more of them can be used as evidence to prove that some of the research questions can be addressed effectively by using canonical analysis in marketing. Although it is not widely used, it has gained acceptance in marketing literature and in many situations canonical correlation represents an appropriate and effective tool for multivariate analysis in addressing some of the reseach questions.

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