

Brand Loyalty's Moderating Role Between Emotional Intelligence and Impulse Purchases: A Case Study in Turkey

Sibel Çimli¹ & Yakup Durmaz²

¹ Gaziantep Exporters Association, Gaziantep, Turkey

² Kilis 7 Aralık University, Faculty of Economics and Administrative Sciences, Department of Marketing, Kilis, Turkey

Correspondence: Yakup Durmaz, Kilis 7 Aralık University, Faculty of Economics and Administrative Sciences, Department of Marketing, Kilis, Turkey. <https://orcid.org/0000-0003-0332-4185>. E-mail: yakup.durmaz@kilis.edu.tr

Received: September 8, 2025; Accepted: September 24, 2025; Published: September 27, 2025

Abstract

This study aims to investigate the moderator role of brand loyalty in the relationship between emotional intelligence and impulse buying behavior. The sample of the study consists of consumers living in Turkey. Using the convenience sampling method, a survey was conducted with 956 people who shopped in the ready-to-wear department. Hypotheses were tested through SPSS and AMOS. The collected statistical data showed that there is a negative and significant relationship between emotional intelligence and impulse purchases, and that brand loyalty has a mediating role in this relationship. Although much research in the literature studies emotional intelligence and consumer behaviors in separate contexts, there is a limited number of studies that study them together. Thus, it is thought that this study will bring a new perspective to the literature.

Keywords: emotional intelligence, impulse purchasing behavior, brand loyalty

1. Introduction

The importance placed on consumer behavior is increasing in today's globalized marketing sector. This study aims to explore how brand loyalty moderates the relationship between emotional intelligence and impulse purchasing. It seeks to understand new strategic marketing approaches and develop tailored methods based on varying levels of emotional intelligence among consumers.

Traditionally, researchers assumed consumers made rational decisions. However, by the end of the 20th century, emphasis shifted toward emotions in the purchasing process (Bagozzi, 1999). This shift highlighted the role of emotions in consumer behavior, influencing marketing strategies and consumer satisfaction over time.

Emotions have become crucial in marketing, influencing both short-term and long-term consumer decisions. Establishing trust during the purchasing process relies significantly on brand familiarity. Brand loyalty plays a pivotal role here, influencing consumer decisions and marketing outcomes positively (MacDonald and Sharp, 2000; Hoyer and Brown, 1990).

Consumers often act emotionally and impulsively despite limited resources like time and money during the purchasing process. Unplanned purchases, driven by emotional impulses rather than cognitive evaluations, are common. This behavior, known as impulse buying, is driven by consumer needs and can occur unexpectedly during shopping (Huang, 2015; Jones et al., 2003).

Impulse buying provides a unique satisfaction not found in planned purchases, often influenced by store atmospheres and emotional triggers (Lee and Yi, 2008; Akram et al., 2016).

2. Literature Review and Hypotheses

2.1 Emotional Intelligence

The term "emotional intelligence" first gained attention in 1987 through Keith Beasley's article in British Mensa Magazine. Since then, it has been widely researched by scholars like Daniel Goleman, Salovey, and Mayer. The modern focus on emotional intelligence stems from its variability among individuals and its potential for improvement, making it relevant across various sectors.

Emotional intelligence plays a key role in understanding decision-making and problem-solving skills. By analyzing emotions, individuals can better categorize them, allowing for more effective thought processes. This connection between emotions and thinking helps explain how emotional intelligence influences impulse buying and brand loyalty, which can be harnessed to drive purchasing decisions in marketing.

To minimize emotional uncertainty in decision-making, understanding consumer values and decision strategies is crucial. For example, a study on the Croatian market found that emotional intelligence significantly affects purchasing behaviors (Kadic et al., 2016). Similarly, research by Kidwell et al. showed that employees with higher emotional intelligence better understand customer expectations and influence their decisions, highlighting its impact on market-oriented behaviors (Kidwell et al., 2011).

2.2 Brand Loyalty

Brand loyalty has attracted a lot of attention in the field of marketing, where consumer behavior is highly important. The issue of brand loyalty, which has become important for keeping customers in the field of marketing, has acquired a very important meaning for businesses (Kandampully et al., 2015). Because brand loyalty leads to re-purchase intentions (Dick and Basu, 1994), this situation is closely related to the business's profit (Bowen and Chen, 2001). Consumers decide whether to buy a product or not with their beliefs and likes (Bagozzi, 1978). For this reason, the beliefs and attitudes of customers about a brand determine their loyalty to that brand (Oliver, 1999; Back, 2003). Brand loyalty is defined as the decision of consumers to buy their preferred products by re-choosing them in their next purchase and their commitment to this preference (Silva and Gonçalves, 2016). The issue of how to ensure the loyalty of consumers to the same brand for a product and how to improve business performance has been an important topic that marketers are thinking about (Kumar Mishra et al., 2016). Because loyal customers are people who have the potential to exhibit re-purchasing behavior, companies will be able to gain a competitive advantage by making more profit against their competitors (Picón-Berjoyo et al., 2016). Such an important profit-making concept has made it mandatory for companies to develop strategies to retain their loyal customers (Chen, 2015). Loyal customers of brands that direct consumer behavior are also considered the most important building block in the consumer's relationship with the brand (Fullerton, 2009). Brand loyalty is defined as the willingness of customers to pay more for a brand and recommend that brand to others (Miller and Grazer, 2003). Companies that retain their customers provide a material advantage, thanks to brand loyalty by retaining their loyal customers instead of developing marketing strategies for new customers that will cost much more. It has become a generally accepted phenomenon of marketing that it costs less to retain existing customers than to find new ones. Similar studies revealed that the companies that develop their brand loyalty grow much faster. From the point of view of companies, these important advantages brought about by brand loyalty provide a sustainable competitive advantage in the field of marketing.

Khan (2022) explored the role of social media marketing activities (SMMA) in guiding brand experience, purchase intention, and attitude toward the brand. Khan & Fatma (2021) investigated online brand experience and authenticity in tourism destination literature. Khan et al (2020) examined the moderator role of customer experience by gender, loyalty card membership, age, and critical incident recovery in determining hotel brand loyalty.

2.3 Impulse Purchasing Behavior

Today, the term "consumption" meets not only the basic needs of individuals but also their emotional needs. Consumer preferences can be explained rationally in terms of the decision-making processes of consumers. This means that consumers decide by evaluating other alternatives. However, contrary to the rational behavior of consumers, in some cases, they can also exhibit a purchasing behavior without conducting any research on the product and without any reason behind buying the said product. This situation, which can be explained as an impulse purchase, was first claimed to be based on low prices (Kidwell et al., 2011); however, the studies later revealed that it is caused by the thoughts and emotions of customers (Hausman, 2000). As a result of impulse purchase behavior, rather than long-term emotions, short-term emotions are taken into consideration. Rook explained what pushes people towards impulse purchases. If impulse purchasing is a generally accepted behavior in society, then consumers can exhibit impulse purchasing behavior without thinking. However, if it is not an adaptable behavior in the ety, then the desire to impulse purchase decreases. In terms of impulse purchasing, the consumer can be said to be limited (Tek and Orel, 2006). Recently, scientists have pointed out that impulse purchasing depends on the instincts of consumers. In light of these studies, especially considering how much consumer behavior affects the purchasing decision process, it is evident how important and grand impulse purchasing is. For this reason, now the studies conducted in the field of marketing have focused specifically on issues such as how impulse purchase behavior is formed and what affects this behavior.

Hypotheses

This study will examine the relationships between emotional intelligence, brand loyalty, and impulse purchasing, and the possible effect of brand loyalty on the relationship between emotional intelligence and impulse purchasing. The first hypothesis is as follows:

H_{1a}: People's evaluation of their emotions positively and significantly affects brand loyalty.

H_{1b}: Evaluating the emotions of others positively and significantly affects brand loyalty

H_{1c}: The extent to which a person benefits from emotions positively and significantly affects brand loyalty

H_{1d}: Being able to adjust one's emotions positively and significantly affects brand loyalty

Today, the concept of emotional intelligence, understanding consumers, being able to identify their perceptions of different brands, and then correlating these perceptions with the dimensions of emotional intelligence has become an important topic for theories of procurement. A study by Irissapane and Shankardevi investigated the effect of consumers' emotional intelligence on the level of adoption of Samsung-branded devices. They found that the dimensions of emotional intelligence have a significant and positive effect on attraction toward the related brand (Irissapane and Shankardevi, 2015).

Ahn et al. found that frustration and conflict cause consumers with a low level of emotional intelligence to take a destructive approach to the consumer-brand relationship, while consumers with high emotional intelligence are more constructive (Ahn et al., 2015).

H_{2a}: Evaluating one's feelings negatively and significantly affects impulse buying behavior

H_{2b}: Evaluating the feelings of others negatively and significantly affects impulse buying behavior.

H_{2c}: Benefiting from feelings negatively and significantly affects impulse buying behavior.

H_{2d}: Being able to adjust feelings negatively and significantly affects impulse buying behavior.

The level of emotional intelligence shapes the way people perceive and transform their behavior into action. Individuals who develop emotional intelligence have more control in making decisions, which strengthens their self-control (Pop et al., 2013). While strengthening self-control makes the decisions taken more accurate. In terms of consumer behavior, this is manifested in the willingness to make impulse buys. Momentary or impulse buying behavior is unplanned (Baumeister, 2002). Self-control is wanting to behave in a way that is most beneficial to oneself (Tamir et al., 2015). Self-control is a sub-component of emotional intelligence and is expected to reflect the decision-making process in consumers. Thus, impulse buying in individuals with low self-control has been associated with behaviors that will not be accepted in the long term (Brici et al., 2013). Individuals with high emotional intelligence have a low probability of making an impulse purchase (Nair and Das, 2015; Peter and Krishnakumar, 2010). In other words, impulse buying behavior decreases as the level of emotional intelligence increases. Additionally, people with high emotional intelligence can better control their impulse-buying behavior because they have higher self-control. Thanks to self-control, they can cope with the temporary dissatisfaction that is caused by not having bought the product. Thus, people with high self-control have high emotional intelligence, and they are not controlled by their emotions. Individuals with high emotional intelligence who are aware of their feelings can establish a strong balance between these emotions when making decisions, so they do not regret their decisions (Nair and Das, 2015).

H₃: Brand loyalty positively and significantly affects impulse buying behavior.

To become a strong brand, it should aim to establish brand loyalty by establishing impulse buying behavior in consumers in the long term. In this sense, consumers identify the brand with the motive of belonging in a social sense or situations that create a surplus value for themselves. It has been revealed that this effect, which is influenced by consumer behavior, value-adding, and socially accepted situations, is also influenced by concepts such as impulse buying and brand loyalty (Zampetakis, 2014). In one study, perceived quality and brand equity were examined as components of brand loyalty. It was found that perceived quality and brand equity significantly and positively affect impulse buying behavior (Wasaya et al., 2016). Another study also found that brand loyalty has a significant and positive effect on impulse buying behavior (Malik, 2013). In a study examining the effects of happiness and brand loyalty on impulse buying behavior, it was found that brand loyalty has a significant and positive relationship with the emotional aspect of impulse buying behavior. While brand loyalty increases impulse buying behavior (Šeinauskienė et al., 2015).

H₄: Brand loyalty has a moderating role between emotional intelligence and impulse buying behavior.

The level of emotional intelligence shapes the way people perceive and transform their behavior into action. Individuals who develop emotional intelligence have more control in making decisions, which strengthens their self-control (Pop et al., 2013). While strengthening self-control makes the decisions taken more accurate. In terms of consumer behavior, this is manifested in the willingness to make impulse buys. Previous studies showed that the determinants of brand loyalty highly affect impulse buying behavior (Shukla, 2010).

3. Methodology

3.1 Study Model and Purpose

The proposed model predicts the moderating role of brand loyalty in the relationship between emotional intelligence and impulse buying behavior. It is expected that the relationship of emotional intelligence with impulse buying has a significant and negative correlation. It is believed that brand loyalty will have a moderating effect on this relationship. The model is shown in Figure 1.

The research on consumers was conducted based on the model. Validity and reliability analysis will be performed on the research model. After these analyses, exploratory factor analysis will be performed to determine the factor structures. After that, a confirmatory factor analysis will be conducted in which the suitability of the scale with the original factor structure is tested. A structural equation model is going to be used in this study, as the relationships between the variables will be analyzed.

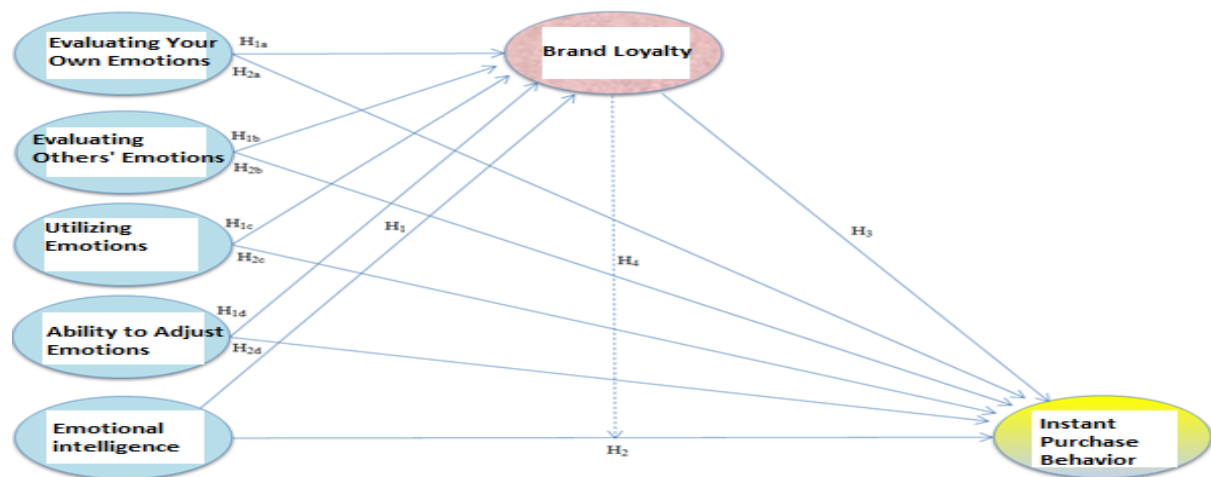


Figure 1. Research model

This study aims to express the existence of a moderating effect of brand loyalty in the relationship between emotional intelligence and impulse buying behavior. Although there are many studies conducted on emotional intelligence and consumer behavior in different contexts, not a lot of studies have analyzed them together. Thus, it is thought that this study will bring a new perspective to the literature. In addition to the main purpose of the study, it also aims to give more insights to the researchers in the field and company owners by analyzing the collected data, and it aims to research the different factors that affect decision-making processes from a different point of view. Therefore, it is thought that the research will contribute to the literature in terms of how, when, and to what extent integrated marketing activities are effective and in terms of developing different marketing tactics for different consumer groups.

3.2 The Population and the Sample

The population of the research is made up of consumers living in Turkey. Because of time and accessibility limitations, the study was conducted on a sample that could represent the population. A sample size of 384 people represents a population between 100.000 and 100 million people and within a 95% reliability interval. Convenience sampling was used as a non-probability sampling method, and a questionnaire was conducted with 956 people. Because of the pandemic and social distancing rules, the questionnaire was carried out online.

3.3 Data Collection Tools

The data was collected through a questionnaire from the participants using the convenience sampling method. The questionnaire form consists of questions regarding emotional intelligence, brand loyalty, impulse buying, and demographics.

3.4 The Scales

The questions of the scales will be asked in a 5-point Likert-type scale (Strongly Disagree=1, Strongly Agree=5). The first section consists of questions related to the demographics of the participants. The final section has 25 questions that cover emotional intelligence, brand loyalty, and impulse buying behavior.

Table 1. The scales

Scale	Source	Item Number
Emotional Intelligence	Wong and Law (2002)	16
Brand Loyalty	Ozdemir and Koçak (2012)	4
Impulse Buying Behavior.	Weun et al. (1997)	5

4. Findings

Firstly, the variables were defined by looking at the structural validity of the scales using exploratory factor analysis. Then, the confirmatory factor analysis was performed to determine the suitability of the responses with the scale tools. To determine the consistency of the measurement tool, a validity analysis was conducted. The statistical data of the research includes the average for quantitative variables (X), standard deviation (SD), frequency for minimum and maximum quantitative variables (n), and percentages (%). Exploratory factor analysis was used to test the reliability of the scales, and confirmatory factor analysis was used to test the reliability and validity of the scales.

Pearson correlation analysis was performed to determine the direct relations and the strength between independent variables. To determine whether there is a significant relationship between the variables, the t-test was performed. A t-test performed using the technique of examining more than two groups, independent of each other in terms of another quantitative variable, allows for determining how a quantitative variable affects independent groups. One-way ANOVA (variance analysis) test was used to determine the difference between the averages of the sample groups with no relationship between them. The Structural Equation Model was used for the analysis of the predicted model for the research. (Ozdamar, 2004). Additionally, for the multiple comparisons, Tamhane (if the group variances are not homogeneous) and Tukey (if the group variances are homogeneous) were used according to the results of the homogeneity tests.

4.1 Descriptive Findings

69.1% (n=661) of the participants were female and 30.9% (n=295) were male. 0,4% (N:4) of the participants were under the age of 18, 25,0% (N = 239) in the age range of 18-24 to 46.7% (n = 446) were between 25-34, 19.9% (N = 190) were between 35-44, 5,6% (n = 54) between 45-54, 2,0% (n:19) between 55-64% and 0,4% (N = 4) were over 65. It was found that 59.6% of the respondents (n: 570) were single, and 40.4% (n:386) were married. 60,3% (n=576) of the participants had a bachelor's degree, 23,6% (n=226) had either a master's degree or a PhD, 7,7% (n=74) had an associate degree, 6,6% (n=63) were in high school, and 1,8% (n=17) were in primary school. 74% of the participants had a medium level of income (n:707).

4.2 Exploratory Factor Analysis

To determine both the factor loadings and the structural validity of the research scales and to understand which of these factors are grouped, exploratory factor analysis was performed. To determine whether the scales were suitable for factor analysis, the KMO and Bartlett tests were performed. KMO is calculated to test the size of the sample, while the normal distribution is analyzed through the Bartlett test. KMO test result has to be .50 or higher, and the Bartlett test result has to be statistically significant ($p < 0,001$) (Jeong, 2004). In the process of factor analysis, factor loadings were used in the process of assigning scale items to factors or removing them from the scale.

4.3 Exploratory Factor Analysis Results of the Emotional Intelligence Scale

According to the results of factor analysis for the emotional intelligence scale, the KMO value was calculated as 0.852. This result shows that the sample size is suitable for factor analysis ($KMO > 0.500$). In the Bartlett test, the X^2 value was calculated as 6778.791, which is statistically significant ($p < 0.05$). The data of the study are normally distributed. Thus, the results of the KMO and Bartlett tests obtained from the research data confirmed the conclusion that it is suitable for factor analysis.

Table 2. Results of the Analysis of the Scale Factors

	Factor 1 DD	Factor 2 KDD	Factor 3 DK	Factor 4 BDD	Cronbach's Alpha
I am someone who can motivate himself/herself	0.813				
I always encourage myself to do my best	0.808				
I always tell myself I'm a talented person	0.781				0.825
I always set goals for myself, and then try to do my best to achieve them	0.702				
I understand my feelings well		0.818			
I always understand how I feel		0.815			
I often understand why I feel certain emotions		0.780			0.788
I always know if I'm happy or not		0.683			
I can control my anger and handle difficulties in a logical way			0.795		
I calm down quickly when I'm very angry			0.788		0.830
I can control my own emotions well			0.783		
I am quite capable of controlling my own emotions			0.760		
I have a good understanding of the feelings of people around me				0.859	
I observe the feelings of others well				0.851	0.835
I always understand the feelings of my friends from their behavior				0.746	
I am sensitive to the feelings and emotions of others				0.601	

The scale has a 4-factor structure. The table presents the division of the questions and the factor loadings. As a result of the analysis, no items were removed from the scale. The percentage of the total variance explained is 66,322% and the Cronbach's Alpha coefficient is 0,864.

The first factor of the scale, the emotional evaluation dimension, consists of 4 questions with factor loadings ranging from 0,702 to 0,813. The Cronbach's Alpha coefficient of the factor is 0,825. The second factor, evaluating one's own emotions, has 4 questions with factor loadings ranging from *,683 to 0,818. The Cronbach's Alpha coefficient of the factor is 0,825. The third factor, being able to use emotions, also has 4 questions with factor loadings ranging from 0,760 to 0,795. The Cronbach's Alpha coefficient of the factor is 0.830. The fourth factor of the scale, evaluating others' emotions, consists of 4 questions whose factor loadings range from 0,601 to 0,859. The Cronbach's Alpha coefficient of the factor is 0,835.

4.4 The Results of Exploratory Factor Analysis of Brand Loyalty Scale

The KMO value of the scale was calculated as 0,272. This shows that the sample size is suitable for factor analysis. The X^2 value was 1733,303, therefore it is statistically significant ($p < 0,05$). Thus, the normal distribution is achieved. KMO and Bartlett test results show that the data are suitable for factor analysis.

Table 3. Results of the Analysis of the Scale Factors

	Factor Loading	Cronbach's Alpha
I prefer the same brand I used before when I have to buy a product again	0.837	
I will keep buying from this brand	0.827	
I am addicted to this brand	0.826	0.834
I can pay more for the products of this brand	0.801	

The scale is a 1-factor scale. As a result of the analysis, no items were removed from the scale. The percentage of total variance explained by the scale was found to be 69,201% and the Cronbach's Alpha coefficient was found to be 0,834.. The variance explained ratio of the first and only factor of the scale is 67.666%. The scale consists of 4 questions whose factor loads range from 0.801 to 0.837. Cronbach's Alpha coefficient of the scale is 0.834.

4.5 KFA Results of the Impulse Buying Behavior Scale

The KMO value of the scale was calculated as 0,272. This shows that the sample size is suitable for factor analysis. The X^2 value was found to be 2080,775; therefore, it is statistically significant ($p < 0,05$). Thus, the normal distribution is achieved. KMO and Bartlett test results show that the data are suitable for factor analysis.

Table 4. Results of the Analysis of the Scale Factors

	Factor Loading	Cronbach's Alpha
I make impulse buying decisions	0.869	0.849
When I go shopping, I buy things that I had no intention of buying	0.833	
When I see something really interesting, I buy it without thinking about the consequences	0.832	
It's fun to buy things for no reason	0.781	
I avoid buying things that are not on my shopping list	-0,623*	

*Reverse-coded question

The scale is a 1-factor scale. As a result of the analysis, no items were removed from the scale. The percentage of the total variance explained is 62,810% and the Cronbach's Alpha coefficient is 0,849. The variance explained ratio of the first and only factor of the scale is 62,810%. The scale consists of 5 questions with factor loadings ranging from 0.623 to 0.869. Cronbach's Alpha coefficient of the scale was calculated as 0.849.

4.6 Reliability Analysis

Cronbach's alpha coefficient represents the reliability level of the scale. The coefficient ranges from 0 to 1. Depending on the alpha (α) coefficient, the reliability of the scale is interpreted as follows (Nunnally, 1967).

- $.00 \leq \alpha < .40$, the scale is not reliable,
- $.40 \leq \alpha < .60$, the reliability of the scale is low,
- $.60 \leq \alpha < .80$, the scale is quite reliable,
- $.80 \leq \alpha < 1.00$, the scale is highly reliable.

Another opinion regarding the reliability of a scale is that the level should be .70 or higher for it to be called "good" (Hair et al., 2006). Thus, the reliability of the scales of this study is on a "good" level.

Table 5. Reliability analysis

Variables	Cronbach's Alpha Coefficient	Item Number
Evaluating Your Own Emotions	0.788	4
Evaluating the Emotions of Others	0.835	4
The Use of Emotions	0.830	4
Emotional Management	0.825	4
Brand Loyalty	0.834	4
Impulse Buying	0.849	5

As can be seen in the table above, since the Cronbach Alpha Coefficient is 0.788 and above, it can be said that it is a "highly reliable scale".

4.7 Model Test Results

To test the research model, the structural equation model was analyzed. Structural equation modeling (SEM) is obtained from a combination of multivariate statistics. Regression analysis and factor analysis are combined for the structural equation model analysis. In this way, it is possible to analyze multivariate (dependent and independent) relationships (Özdamar, 2016). Thus, to analyze relationships between variables used in the study and to detect the relationship effect between the dependent and independent variables, analyses regarding the structural equation modelling were conducted. With the structural equation model, the accuracy of the relationships established in the data of the research can be analyzed. In this way, the structural equation model finds the best model that fits. The accuracy of the relationships between variables and the structural equation model is determined through the goodness of fit values (Gürbüz and Şahin, 2016). The moderating effect is used to detect the

relationship between the dependent and independent variables. Thanks to the moderating effect, it will be possible to understand the direction, strength, and effect of the relationship between two variables (Baron and Kenny, 1986). The effect of the moderating variable can be in an increasing or decreasing direction between the independent and dependent variables. The effect of the moderating variable can increase while the independent variable can decrease or increase the dependent variable. In other words, the moderating variable determines the relationship between the independent and dependent variables.

Figure 2 presents the structural equation model.

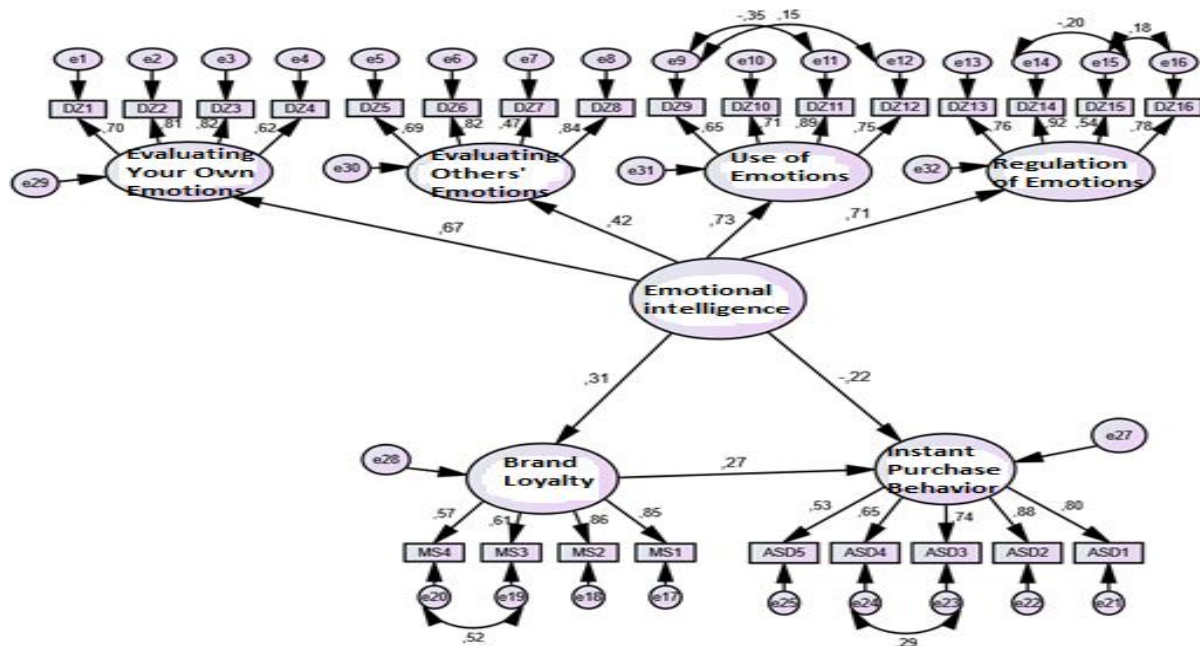


Figure 2. Structural equation model

Table 6. Goodness of Fit Value of the Structural Equation Model

Index	Good Fit	Acceptable Fit	SEM
χ^2	x	x	816.680
sd	x	x	262
χ^2/sd	≤ 3	≤ 5	3.117
RMR	$\leq 0,05$	$\leq 0,08$	0.070
GFI	$\geq 0,95$	$\geq 0,90$	0.935
AGFI	$\geq 0,90$	$\geq 0,85$	0.919
NFI	$\geq 0,95$	$\geq 0,90$	0.927
TLI	$\geq 0,95$	$\geq 0,90$	0.942
CFI	$\geq 0,97$	$\geq 0,90$	0.949
RMSEA	$\leq 0,05$	$\leq 0,08$	0.047

The goodness of fit values show that the model has a good fit ($\chi^2/\text{df}=3,117$; $\text{RMSEA}=0.047$; $\text{CFI}=0.949$; $\text{NFI}=0.927$; $\text{GFI}=0.935$). The structural equation model has shown that the goodness of fit values ensure the validity of the model.

Table 7. Structural Equation Model Regression Weights

Dependent	Independent	β	t	p
Brand Loyalty	Emotional Intelligence	0.310	6.895	0,000*
Impulse Buying Behavior	Emotional Intelligence	-0.224	-4.948	0,000*
Impulse Buying Behavior	Brand Loyalty	0.267	6.606	0,000*

Emotional intelligence has a statistically significant positive effect on brand loyalty ($\beta=0,310$) and a negative effect on impulse buying behavior ($\beta=-0,224$) ($p<0,05$). Brand loyalty has a positive and statistically significant effect ($\beta=0,267$) on impulse buying behavior ($p<0,05$). The data regarding the structural equation model shows that the model is valid, and the analysis results are consistent with the data of the model

The conducted analysis shows that,

H_1 : Emotional intelligence positively and significantly affects brand loyalty

H_2 : Emotional intelligence negatively and significantly affects instant buying behavior

H_3 : Brand loyalty positively and significantly affects impulse buying behavior.

Figure 3 presents the structural equation model.

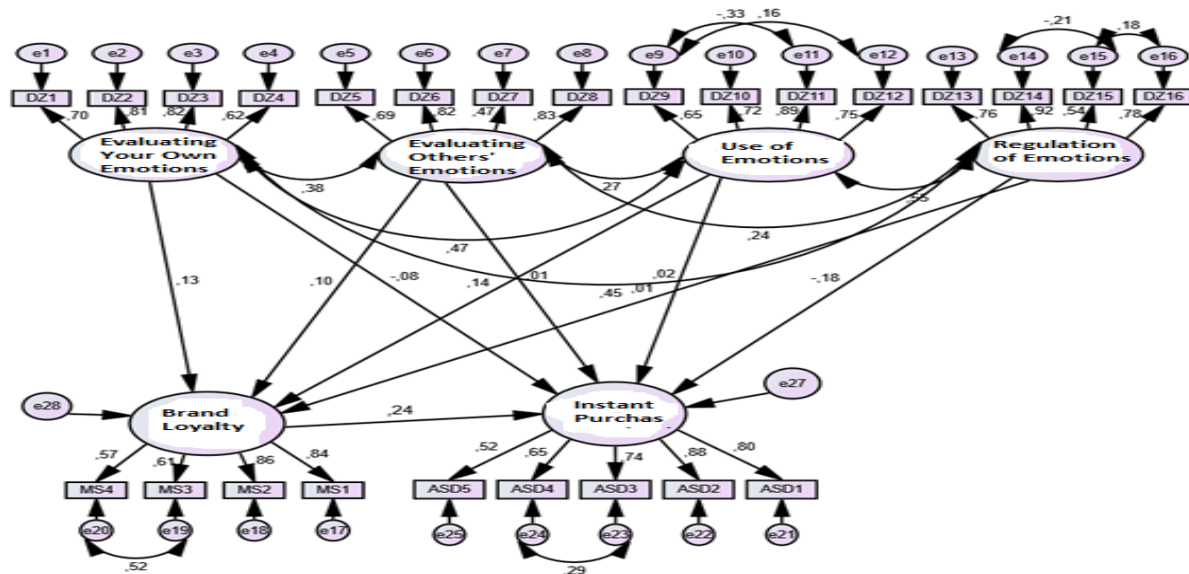


Figure 3. Structural Equation Model

Table 8. Goodness of Fit Value of the Structural Equation Model

Index	Good Fit	Acceptable Fit	SEM
χ^2	x	x	778.700
sd	x	x	254
χ^2/sd	≤ 3	≤ 5	3.066
RMR	$\leq 0,05$	$\leq 0,08$	0.067
GFI	$\geq 0,95$	$\geq 0,90$	0.938
AGFI	$\geq 0,90$	$\geq 0,85$	0.921
NFI	$\geq 0,95$	$\geq 0,90$	0.931
TLI	$\geq 0,95$	$\geq 0,90$	0.943
CFI	$\geq 0,97$	$\geq 0,90$	0.952
RMSEA	$\leq 0,05$	$\leq 0,08$	0.047

The goodness of fit values ($\chi^2/\text{sd}=3,066$; $\text{RMSEA}=0.047$; $\text{CFI}=0.952$; $\text{NFI}=0.931$; $\text{GFI}=0.938$) show that the model has a good fit. The structural equation model has shown that the goodness of fit values ensure the validity of the model.

Table 9. Structural Equation Model Regression Weights

Dependent	Independent	β	t	p
Brand Loyalty	Evaluating Your Own Emotions	0.125	2.637	0,008*
	Evaluating the Emotions of Others	0.097	2.356	0,018*

	The Use of Emotions	0.140	2.904	0,004*
	Emotional Management	0.015	0.312	0.755
Impulse Buying Behavior.	Evaluating Your Own Emotions	-0.083	-1.756	0.079
	Evaluating the Emotions of Others	0.034	0.265	0.791
	The Use of Emotions	0.022	0.463	0.644
	Emotional Management	-0.182	-3.903	0,000*
Impulse Buying Behavior.	Brand Loyalty	0.241	6.175	0,000*

* $p < 0.05$ there is a significant effect, $p > 0.05$ there is no significant effect;

The following dimensions, Evaluating One's Own Emotions ($\beta=0,125$), Evaluating the Emotions of Others ($\beta=0,097$), and The Use of Emotions ($\beta=0,140$) affect Brand Loyalty positively and significantly ($p < 0,05$). The effect of emotional management is not significant ($p > 0,05$). The emotional management ($\beta=-0,182$) dimensions negatively and significantly affect Impulse Buying ($p < 0,05$). The dimensions, Evaluation One's Own Emotions, Evaluating the Emotions of Others, The Use of Emotions ($p > 0,05$). Brand Loyalty ($\beta=0,241$), positively and significantly affects Impulse Buying Behavior ($p < 0,05$).

The following hypotheses were accepted: H_{1a} : Evaluating one's own emotions has a positive and significant effect on brand loyalty.

H_{1b} : Evaluating the emotions of others positively and significantly affects brand loyalty

H_{1c} : The extent to which a person uses emotions positively and significantly affects brand loyalty

The following hypotheses were not accepted: H_{1d} : Being able to adjust one's emotions positively and significantly affects brand loyalty

H_{2a} : Evaluating one's own emotions negatively and significantly affects impulse buying behavior

H_{2b} : Evaluating the emotions of others negatively and significantly affects impulse buying behavior.

H_{2c} : Using emotions negatively and significantly affects impulse buying behavior.

H_{2d} : Being able to organize emotions negatively and significantly affects impulse buying behavior.

The moderating effect is used to detect the relationship between the dependent and independent variables. Thanks to the moderating effect, it will be possible to understand the direction, strength, and effect of the relationship between two variables (Baron and Kenny, 1986). The effect of the moderating variable can be in an increasing or decreasing direction between the independent and dependent variables. The effect of the moderating variable can increase while the independent variable can decrease or increase the dependent variable. In other words, the moderating variable determines the relationship between the independent and dependent variables (Gürbüz ve Şahin, 2016).

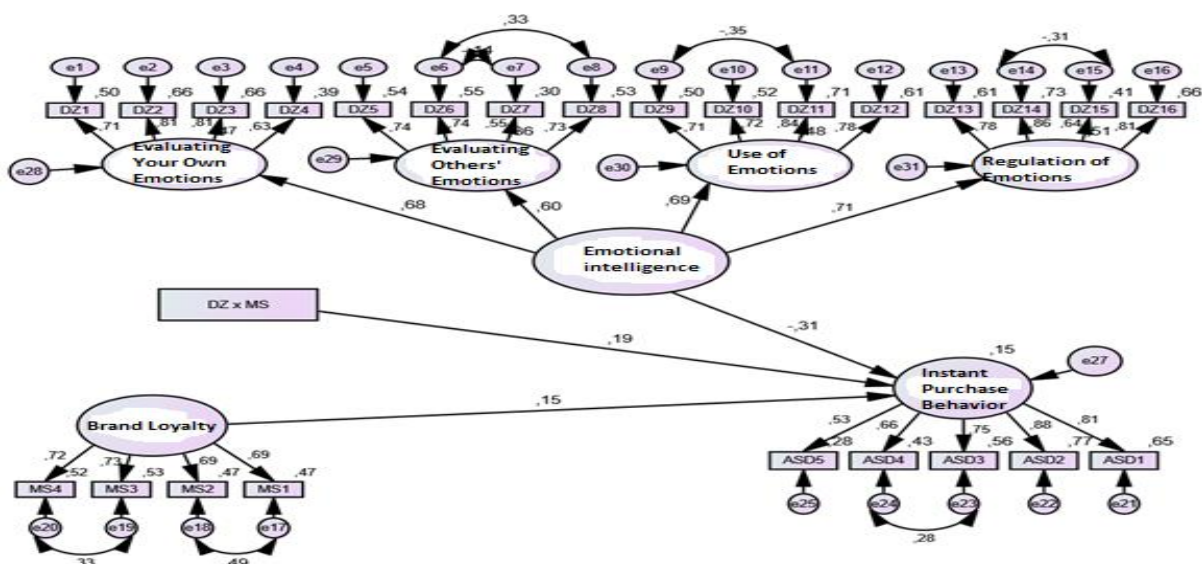


Figure 4. Moderating Effect Structural Equation Model

If the independent variable significantly affects the dependent variable during the moderating effect analysis, then it means that the hypotheses regarding the moderating effect are supported. H₄ hypothesis is on the moderating effect of brand loyalty between emotional intelligence and impulse buying behavior.

Table 10 shows the goodness-of-fit values of the structural equation model

Table 10. Moderating Effect SEM Goodness of Fit Indices

Index	Good Fit	Acceptable Fit	SEM
X ²			991.736
sd			282
X ² /sd	≤ 3	≤ 5	3.517
RMR	≤ 0,05	≤ 0,08	0.079
GFI	≥ 0,95	≥ 0,90	0.926
AGFI	≥ 0,90	≥ 0,85	0.953
NFI	≥ 0,95	≥ 0,90	0.935
TLI	≥ 0,95	≥ 0,90	0.946
CFI	≥ 0,97	≥ 0,90	0.953
RMSEA	≤ 0,05	≤ 0,08	0.051

A BootLLCI (low and high) reliability analysis will be performed on the moderating effect. The important thing in this analysis is that the reliability interval is not 0 (zero) (Hayes, 2017).

Table 11. Moderating effect SEM results

Hypotheses	Stages	β	sh	t	p	R ²	LLCI	ULCI
H ₄ DZ _{MC} " ASD	IE» IBB	-0.310	0.041	-8.271	0,000*		-0.380	-0.244
	BL» IBB	0.151	0.027	6.261	0,000*	0.153	0.105	0.197
	EI * BL	0.194	0.040	4.947	0,000*		0.135	0.267

*p<0.05, there is a significant effect; p>0.05, there is no significant effect; SEM (BL: Brand Loyalty, EI: Emotional Intelligence, IBB: Impulse Buying Behavior)

As a result of the testing of the H₄ hypothesis, the effect of the interaction term (EI x BL) was found to be statistically significant and positive (β=0,194; LLC=0.135; ULCI=0.267). Emotional Intelligence (β=-0,310, LLC=-0.380, ULCI=-0.244) negatively and significantly affects Impulse Buying Behavior (p<0,05). Thus, the moderating effect of Brand Loyalty in the relationship between Emotional Intelligence and Impulse Buying Behavior is statistically significant. Therefore, H₄ is accepted.

5. Discussion

Globalization has increased the importance of the marketing sector and consumer behavior. Therefore, brand loyalty and impulse-buying behavior have become topics of interest among researchers. The previous studies show how important marketing strategies are for purchasing decisions. The studies conducted on consumer behaviors have revealed that everything related to humans affects the purchasing decision process.

To determine which integrated marketing activities are effective and to develop different methods for different consumer groups, this study analyzes the moderating role of brand loyalty between emotional intelligence and impulse purchases. Thus, this study analyzed the effect of emotional intelligence on impulse buying behavior and the role of brand loyalty in this relationship. The study was conducted on consumers in Turkey, and it has 4 main hypotheses on the moderating of brand loyalty between emotional intelligence and impulse buying behavior. A pilot analysis was first conducted on a small sample group using the previously used scales to see whether they fit the sample or not. The reliability and validity of the scale were analyzed through the pilot analysis. For the collection of data, a convenience sampling method was used. The questionnaire form includes questions regarding the demographics of the participants, emotional intelligence, brand loyalty, and impulse buying behavior.

The findings of the study show that as the level of emotional intelligence increases, impulse buying behavior decreases. These findings are in line with the findings of the previous studies in the literature (Peter and Krishnakumar, 2010; Nair and Das, 2015). Consumers who have high levels of emotional intelligence were seen

to be aware of their emotions (Vohs and Faber, 2007). In the emotional analysis of the consumers, it was found that in the face of the driving force of impulse buying behavior, consumer rethink their decisions and then make a purchase. Consumers with high emotional intelligence will act, knowing the possible consequences of impulse buying when they are faced with impulse-buying stimuli. As consumers with high emotional intelligence are aware of the impulse buying stimulus, they can change their emotional reaction into indifference and therefore can suppress their impulse buying motives (Bell, 2011). In conclusion, the studies in the literature support the findings of this study.

5.1 Conclusion and Recommendations

The obtained statistical data support the opinion that brand loyalty positively affects impulse buying behavior. Additionally, the previous studies show that the determinants of brand loyalty highly affect impulse buying behavior (Shukla, 2010). The findings from the study showed that consumers with higher levels of emotional intelligence are more loyal consumers. According to the literature, the purchasing decision processes of consumers with a high level of emotional intelligence are not much affected by impulses (Ahn et al., 2016; Aziziha et al., 2014; Tsai et al., 2015), rather by the research findings; it was seen that they made impulse purchases with the impetus to purchase brands that they knew and trusted.

It was found that consumers respond positively to brands they are loyal to. However, when consumers act based on their emotional intelligence, impulse buying decreases. The cognitive and emotional readiness of consumers significantly influences their purchasing decisions, with high emotional intelligence reducing impulse buying. Brand loyalty moderates this relationship, strengthening the negative connection between emotional intelligence and impulse buying. When brand loyalty is low, this negative relationship weakens, whereas high brand loyalty strengthens it due to increased stimuli. In summary, brand loyalty plays a moderating role in the negative relationship between emotional intelligence and impulse buying, allowing emotional intelligence to control impulse purchases triggered by external factors.

The study showed that brand loyalty moderates the relationship between emotional intelligence and impulse buying. In consumers with high brand loyalty and emotional intelligence, the strength of the negative relationship between emotional intelligence and impulse buying increases. Conversely, in those with low brand loyalty, the relationship weakens. Therefore, companies should invest in building brand loyalty to encourage more purchases and gain a competitive advantage. A stronger commitment to the brand can lead to more impulse buying. Understanding consumer loyalty is crucial for meeting their needs and boosting impulse purchases, which can give companies an edge in the market.

The study also found a positive relationship between impulse buying and brand loyalty. Repeat purchases are driven by loyalty, and as consumers with high emotional intelligence tend to be loyal, fostering brand loyalty can benefit a company's profits. Analyzing consumers' decision-making processes is key for marketers. A deep understanding of the emotional and cognitive factors influencing purchases can reveal when and why consumers buy. Insights into how emotional intelligence affects impulse buying will help marketers identify target markets and craft strategies.

This study focused on Turkey's garment sector but can be replicated across other groups and regions. Conducted online due to the pandemic, future studies could use different methods and compare results. Additionally, researchers could explore how emotional intelligence affects other aspects of branding.

Consumers purchase products and services based on their desires. In recent years, consumption has shifted from being seen as a rational process for fulfilling physiological needs to one driven by psychological satisfaction, social adaptation, and communication. This shift has led companies to focus on better understanding consumers, as today's shoppers are driven by emotions rather than logic. Emotional intelligence, now a key concept in marketing, significantly impacts impulse buying, with high emotional intelligence reducing such behavior. Thus, businesses must manage loyal consumers' decision-making processes in ways that encourage brand-specific purchases. Understanding emotional and cognitive influences on purchasing decisions is essential for crafting targeted marketing strategies and gaining valuable insights.

Funding: No funding details were reported by the author(s)

Data availability: No datasets were generated or analysed during the current study.

Declarations

Conflict of interest. The authors have no conflict of interest to declare relevant to this article's content.

References

- Ahn, H., Sung, Y., & Drumwright, M. E. (2016). Consumer emotional intelligence and its effects on responses to transgressions. *Marketing Letters*, 27, 223–233. <https://doi.org/10.1007/s11002-014-9342-x>
- Akram, U., Hui, P., Khan, M. K., Hashim, M., & Rasheed, S. (2016). Impact of store atmosphere on impulse buying behaviour: Moderating effect of demographic variables. *International Journal Of U- And E-Service, Science And Technology*, 9(7), 43–60. <http://dx.doi.org/10.14257/ijunesst.2016.9.7.05>
- Aziziha, H., Faraji, A., Khodsetan, A., Mousavi, S., & Alikhani, E. (2014). An investigation on the effects of emotional intelligence on development of brand equity. *Management Science Letters*, 4(2), 311–314.
- Back, K.-J., & Parks, S. C. (2003). A brand loyalty model involving cognitive, affective, and conative brand loyalty and customer satisfaction. *Journal of Hospitality & Tourism Research*, 27(4), 419–435. <https://doi.org/10.1177/10963480030274003>
- Bagozzi, R. P. (1978). The construct validity of the affective, behavioral, and cognitive components of attitude by analysis of covariance structures. *Multivariate Behavioral Research*, 13(1), 9–31. https://doi.org/10.1207/s15327906mbr1301_2
- Bagozzi, R. P., Gopinath, M., & Nyer, P. U. (1999). The role of emotions in marketing. *Journal of the Academy of Marketing Science*, 27(2), 184–206. <https://doi.org/10.1177/0092070399272005>
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173–1182. <https://doi.org/10.1037/0022-3514.51.6.1173>
- Baumeister, R. F. (2002). Yielding to temptation: Self-control failure, impulsive purchasing, and consumer behavior. *Journal of Consumer Research*, 28(4), 670–676. <https://doi.org/10.1086/338209>
- Bell, H. (2011). A contemporary framework for emotions in consumer decision making: Moving beyond traditional models. *International Journal of Business and Social Science*, 2(17), 12–16.
- Bowen, J. T., & Chen, S. (2001). The relationship between customer loyalty and customer satisfaction. *International Journal of Contemporary Hospitality Management*, 13(5), 213–217. <https://doi.org/10.1108/09596110110395893>
- Büyüköztürk, Y. (2002). Faktör Analizi: Temel Kavramlar ve Ölçek Geliştirmede Kullanımı (Factor analysis: Basic concepts and using to development scale). *Kuram ve Uygulamada Eğitim Yönetimi*, 32, 470–483.
- Chen, S.-C. (2015). Customer value and customer loyalty: Is competition a missing link? *Journal of Retailing and Consumer Services*, 22, 107–116. <https://doi.org/10.1016/j.jretconser.2014.10.007>
- Dick, A. S., & Basu, K. (1994). Customer loyalty: Toward an integrated conceptual framework. *Journal of the Academy of Marketing Science*, 22(2), 99–113. <https://doi.org/10.1177/0092070394222001>
- Fullerton, G. (2003). When does commitment lead to loyalty? *Journal of Service Research*, 5(4), 333–344. <https://doi.org/10.1177/1094670503005004005>
- Gifford, R., & Newmeyer, C. E. (2017). Brand leadership: Behaviors that drive brand and consumer engagement—An abstract. In M. Stieler (Ed.), *Creating marketing magic and innovative future marketing trends: Proceedings of the 2016 Academy of Marketing Science (AMS) annual conference* (pp. 627–628). Springer International Publishing. <https://doi.org/10.1007/978-3-319-45596-9>
- Gilbride, T. J., Inman, J. J., & Stilley, K. M. (2015). The role of within-trip dynamics in unplanned versus planned purchase behavior. *Journal of Marketing*, 79(3), 57–73. <https://doi.org/10.1509/jm.13.0286>
- Gürbüz, S., & Şahin, F. (2016). *Sosyal bilimlerde araştırma yöntemleri (Research methods in social sciences)* (3rd ed.). Seçkin Yayıncılık.
- Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis*. Pearson Prentice Hall.
- Hausman, A. (2000). A multi-method investigation of consumer motivations in impulse buying behavior. *Journal of Consumer Marketing*, 17(5), 403–426. <https://doi.org/10.1108/07363760010341045>
- Hayes, A. F. (2017). Partial, conditional, and moderated mediation: Quantification, inference, and interpretation. *Communication Monographs*, 85(1), 4–40. <https://doi.org/10.1080/03637751.2017.1352100>
- Hopkins, K. D., & Weeks, D. L. (1990). Tests for normality and measures of skewness and kurtosis: Their place

- in research reporting. *Educational and Psychological Measurement*, 50(4), 717–729. <https://doi.org/10.1177/0013164490504001>
- Hoyer, W. D., & Brown, S. P. (1990). Effects of brand awareness on choice for a common, repeat-purchase product. *Journal of Consumer Research*, 17(2), 141. <https://doi.org/10.1086/208544>
- Huang, L.-T. (2015). Exploring utilitarian and hedonic antecedents for adopting information from a recommendation agent and unplanned purchase behaviour. *New Review of Hypermedia and Multimedia*, 22(1-2), 139–165. <https://doi.org/10.1080/13614568.2015.1052098>
- Irissappane, D. A., & Shankardevi, B. (2015). Influence of consumers' emotional characteristics on brand love. *Pacific Business Review International*, 7(11), 76–80.
- Jones, M. A., Reynolds, K. E., Weun, S., & Beatty, S. E. (2003). The product-specific nature of impulse buying tendency. *Journal of Business Research*, 56(7), 505–511. [https://doi.org/10.1016/s0148-2963\(01\)00250-8](https://doi.org/10.1016/s0148-2963(01)00250-8)
- Kadic-Magljalic, S., Vida, I., Obadia, C., & Plank, R. (2016). Clarifying the influence of emotional intelligence on salesperson performance. *Journal of Business & Industrial Marketing*, 31(7), 877–888. <https://doi.org/10.1108/jbim-09-2015-0168>
- Kandampully, J., Zhang, T. (Christina), & Bilgihan, A. (2015). Customer loyalty: A review and future directions with a special focus on the hospitality industry. *International Journal of Contemporary Hospitality Management*, 27(3), 379–414. <https://doi.org/10.1108/ijchm-03-2014-0151>
- Kemp, E., & Kopp, S. W. (2011). Emotion regulation consumption: When feeling better is the aim. *Journal of Consumer Behaviour*, 10(1), 1–7. <https://doi.org/10.1002/cb.341>
- Khan, I. (2022). Do brands' social media marketing activities matter? A moderation analysis. *Journal of Retailing and Consumer Services*, 64, 102794. <https://doi.org/10.1016/j.jretconser.2021.102794>
- Khan, I., & Fatma, M. (2021). Online destination brand experience and authenticity: Does individualism-collectivism orientation matter? *Journal of Destination Marketing & Management*, 20, 100597. <https://doi.org/10.1016/j.jdmm.2021.100597>
- Khan, I., Fatma, M., Shamim, A., Joshi, Y., & Rahman, Z. (2020). Gender, loyalty card membership, age, and critical incident recovery: Do they moderate experience-loyalty relationship? *International Journal of Hospitality Management*, 89, 102408. <https://doi.org/10.1016/j.ijhm.2019.102408>
- Kidwell, B., Hardesty, D. M., Murtha, B. R., & Sheng, S. (2011). Emotional intelligence in marketing exchanges. *Journal of Marketing*, 75(1), 78–95. <https://doi.org/10.1509/jmkg.75.1.78>
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607–610. <https://doi.org/10.1177/001316447003000308>
- Kumar Mishra, M., Kesharwani, A., & Das, D. (2016). The relationship between risk aversion, brand trust, brand effect, and loyalty. *Journal of Indian Business Research*, 8(2), 78–97. <https://doi.org/10.1108/jibr-04-2015-0045>
- Lee, G. Y., & Yi, Y. (2008). The effect of shopping emotions and perceived risk on impulsive buying: The moderating role of buying impulsiveness trait. *Journal of Business Research*, 14(2). <https://doi.org/10.35152/snusjb.2008.14.2.004>
- Macdonald, E. K., & Sharp, B. M. (2000). Brand awareness effects on consumer decision making for a common, repeat purchase product. *Journal of Business Research*, 48(1), 5–15. [https://doi.org/10.1016/s0148-2963\(98\)00070-8](https://doi.org/10.1016/s0148-2963(98)00070-8)
- Mathai, S. T., & Haridas, R. (2014). Personality-its impact on impulse buying behaviour among the retail customers in Kochi City. *IOSR Journal of Business and Management*, 16(4), 48–55. <https://doi.org/10.9790/487X-16444855>
- Mayer, J. D., & Salovey, P. (1997). What is emotional intelligence? *Emotional Development and Emotional Intelligence*. <http://doi.org/10.1177/1066480710387486>
- Miller, A. R., & Grazer, W. F. (2003). Complaint behavior as a factor in cruise line losses. *Journal of Travel & Tourism Marketing*, 15(1), 77–91. https://doi.org/10.1300/j073v15n01_05
- Nair, D., & Das, S. (2015). Impact of emotional intelligence on impulse buying and product value proposition. *European Journal of Business and Management*, 7(1), 165–172. <https://core.ac.uk/download/pdf/234626175.pdf>

- Nunnally, J. C. (1967). *Psychometric theory*. McGraw-Hill. <https://doi.org/10.3102/00028312005003431>
- Oliver, R. L. (1999). Whence consumer loyalty? *Journal of Marketing*, 63(4), 33–44. <https://doi.org/10.1177/00222429990634s105>
- Peter, P., & Krishnakumar, S. (2010). Emotional intelligence, impulse buying, and self-esteem: The predictive validity of two ability measures of emotional intelligence. *Advances in Consumer Research*, 37, 877–878.
- Picón-Berjoyo, A., Ruiz-Moreno, C., & Castro, I. (2016). A mediating and multigroup analysis of customer loyalty. *European Management Journal*, 34(6), 701–713. <https://doi.org/10.1016/j.emj.2016.07.006>
- Pop, N. A., Iorga, A., & Pelau, C. (2013). Process, using neuromarketing studies to explore emotional intelligence as a key to the buying decision. *European Conference on Knowledge Management*, 1-8.
- Pradipto, Y. D., Winata, C., Murti, K., & Azizah, A. (2016). Think again before you buy: The relationship between self-regulation and impulsive buying behaviors among Jakarta young adults. *Procedia - Social and Behavioral Sciences*, 222, 177–185. <https://doi.org/10.1016/j.sbspro.2016.05.209>
- Rook, D. W., & Fisher, R. J. (1995). Normative influences on impulsive buying behavior. *Journal of Consumer Research*, 22(3), 305. <https://doi.org/10.1086/209452>
- Šeinauskienė, B., Maščinskienė, J., & Jucaitytė, I. (2015). The relationship of happiness, impulse buying, and brand loyalty. *Procedia - Social and Behavioral Sciences*, 213, 687–693. <https://doi.org/10.1016/j.sbspro.2015.11.487>
- Shukla, P. (2011). Impact of interpersonal influences, brand origin, and brand image on luxury purchase intentions: Measuring interfunctional interactions and a cross-national comparison. *Journal of World Business*, 46(2), 242–252. <https://doi.org/10.1016/j.jwb.2010.11.002>
- Silva, G. M., & Gonçalves, H. M. (2016). Causal recipes for customer loyalty to travel agencies: Differences between online and offline customers. *Journal of Business Research*, 69(11), 5512–5518. <https://doi.org/10.1016/j.jbusres.2016.04.163>
- Tek, Ö. B., & Orel, F. D. (2006). *Perakende Pazarlama Yönetimi (Retail Marketing Management)*. Birleşik Matbaacılık.
- Toufaily, E., Ricard, L., & Perrien, J. (2013). Customer loyalty to a commercial website: Descriptive meta-analysis of the empirical literature and proposal of an integrative model. *Journal of Business Research*, 66(9), 1436–1447. <https://doi.org/10.1016/j.jbusres.2012.05.011>
- Tsai, Y.-C., Chang, H.-C., & Ho, K.-C. (2015). A study of the relationship among brand experiences, self-concept congruence, customer satisfaction, and brand preference. *Contemporary Management Research*, 11(2), 97–116. <https://doi.org/10.7903/cmr.12970>
- Verplanken, B., & Sato, A. (2011). The psychology of impulse buying: An integrative self-regulation approach. *Journal of Consumer Policy*, 34(2), 197–210. <https://doi.org/10.1007/s10603-011-9158-5>
- Vohs, K. D., & Faber, R. J. (2007). Spent resources: Self-regulatory resource availability affects impulse buying. *Journal of Consumer Research*, 33(4), 537–547. <https://doi.org/10.1086/510228>
- Zampetakis, L. A. (2014). The emotional dimension of the consumption of luxury counterfeit goods: an empirical taxonomy. *Marketing Intelligence & Planning*, 32(1), 21–40. <https://doi.org/10.1108/mip-10-2012-0102>

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).