

Structural Equation Modeling of Risk-Taking Behaviors Based on Personality Dimensions and Risk Power

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Abstract

Aims: Risk-taking behaviors in industries can be one of the essential reasons for unsafe behavior and incident. The purpose of this study was to investigate the interactions between risk-taking behaviors and personality dimensions and develop a model with partial least squares structural equation modeling (PLS-SEM). **Methodology:** This cross-sectional analytical study was carried out on 96 participants in Hamadan in the west of Iran in 2016. Risk power and personality dimensions of individuals were evaluated using a questionnaire, and risk-taking behavior was also assessed using a balloon analog risk test. The data were modeled using PLS-SEM. **Results:** In females, the neuroticism dimension had a significant relationship with risk-taking behaviors ($P < 0.001$). Besides, in males, there was a significant relationship between risk-taking behaviors and extraversion ($P < 0.001$). Furthermore, people who were more inclined to social acceptance were more risk-averse and self-reported more risk-taking behaviors ($P < 0.05$). The results of this study showed that people with different personality dimensions have different risk-taking behaviors. **Conclusion:** Studying individuals and errors that may be committed, the system can be in a way that individuals' unsafe behaviors will reduce.

Keywords: Partial least squares structural equation modeling, personality, risk power, risk-taking behavior

INTRODUCTION

Human error has always been an essential factor in many accidents, and estimates have shown that >60% of accidents occur due to human error.^[1] Therefore, events can be significantly reduced by focusing on evaluating human behaviors.^[2] One of the dimensions of focusing on human behavior is the psychological approaches to behavior. Psychological approaches increase understanding of behavior and guide researchers to predict unsafe and risky behaviors.^[3] It is well accepted that occupational accidents are caused by individual workers' psychological and behavioral aspects.^[4] Among behavioral characteristics, impulsivity and risky behaviors, collectively referred to as risk-taking behaviors, include a

range of unrealized and enjoyable behaviors and are generally associated with high-risk levels.^[5] Risk-taking behavior is defined in a variety of ways, but the common theme of all these definitions is the balance of potential rewards and losses and the assessment of the relationship between short- and long-term outcomes.^[6] Risk-taking behavior is described as a voluntary activity, which results in damages in a variety of sectors, including financial, social, and individual ones.^[7] The three most important elements of risk-taking behavior are the assessment of the negative consequences of the behavior, rapid

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and unwanted response to stimuli before the full evaluation of the information, and disregard for the long-term consequences of the behavior.^[5] Risky behavior can have many dimensions such as an orientation toward the present, sensation seeking, reward dependence, impulsivity, diminished ability to delay gratification, risk-taking, boredom proneness, hedonism, poor planning, and novelty seeking.^[5]

Two important approaches to assessing risk-taking behaviors are cognitive and behavioral strategies.^[6] Cognitive strategies are more self-monitoring, using questionnaires, or interviewing. The behavioral procedure is performed using computerized or manual tests. In cognitive and self-monitoring approaches, many people do not have mature self-awareness of how they behave, and these methods generally measure risk aversion or records of past people's high-risk behaviors and do not allow individuals to be exposed in real and risky situations. Few studies have combined cognitive approaches with behavioral approaches, so combining behavioral and personality domains have the potential of generating rich information. Various studies have been done on risk-taking behaviors and their possible causes. Most of them have focused on one of the personality, cognitive or organizational dimensions, including cultural and social factors,^[8,9] anxiety and depression,^[10] interpersonal differences,^[6,11,12] sense of power,^[13,14] age,^[15,16] gender,^[17-20] and education level.^[21] In a 2020 study, LANDAY examined the relationship between the personality traits of truck drivers and traffic accidents. The results of the study showed that the relationship between age and personality dimension of neuroticism with the number of accidents was significantly negative. The results also showed that a tendency to anxiety, anger, and guilt might increase the incidence of accidents. They also found that there was no significant relationship between the number of accidents and the dimensions of extroversion and agreeableness. One of the interesting results of this study was that personality traits related to divergent thinking and creativity had a significant positive relationship with the number of accidents.^[22]

In the light of that individuals cannot be accurately categorized in a specific dimension, it is important to provide a study that simultaneously considers different aspects of personality dimensions along with individual characteristics. Given the aforementioned, and the fact that the personality dimensions, individual characteristics and risk power concerning risk-taking behaviors in Iranian society have not been studied, the present study aims to determine the data of individuals' personality dimensions and their risk power, using cognitive and behavioral approaches and develop a model with the partial least squares structural equation modeling (PLS-SEM) method.

SEM is a multivariate statistical analysis method and a combination of factor analysis, path analysis, and regression.^[23] This approach is a comprehensive statistical approach for identifying latent variables associated with an index.^[24-26] There are two main methods for estimating structural equations: One is based on the covariance (CB-SEM), and the other is a PLS method. Structural

equations with partial least squares (PLS-SEM) are not sensitive to the data normality or sample size.^[24]

METHODOLOGY

Ethical approval was obtained from the Ethics Committee of Hamadan University of Medical Sciences before the commencement of the study (code: IR.UMSHA.REC.1397.455). Participants were recruited by the incidental sampling of individuals encountered in a variety of communications in IRAN. Only those aged >18 and have basic literacy skills were included in the study. Finally, 48 women and 48 men, 96 total, participated in this study. Before the study, individuals were given a satisfaction form. For each participant, about 10 min, before the test, the stages of implementation, how to complete the questionnaires, how to do BARTS' test, and the way the participants could opt-out at every step of the trial, were explained. Data were collected based on two cognitive and behavioral approaches. In the cognitive approach, the goals were to determine the personality dimensions of individuals and their risk power. Furthermore, in the behavioral approach, the goal was to assess the level of risk-taking behavior of individuals in a real-life simulation. First, participants were asked to complete the Eysenck questionnaire.

The Eysenck questionnaire was created in 1963 to measure some aspects of personality such as extraversion, neuroticism, psychoticism, and agreeability. The questionnaire consists of 90 questions.^[26] Validity and reliability of this questionnaire were studied for the Iranian community in 2005, and the results indicated a very high and acceptable validity of this questionnaire.^[27]

Then, the participants were asked to complete the Power Risk Questionnaire. The questionnaire has 29 items and determines the risk-taking capacity of individuals.^[28] Completion of the questionnaires took about 30 min.

In the next stage, the behavioral approaches were started. For this, Balloon analog risk task (BART), a prevalent laboratory task for testing risk-taking behavior, was used to evaluate behavioral approaches. The BART task consists of different balloons that have to be pumped up by individuals. Individuals earn something by each pump, but after every pump, the balloon may explode, which means that the individuals lose all the points they have earned. Here, the person with each pump risks his points. This makes it possible to assess risky decisions or decisions in uncertainty. The average pumping frequency of balloons that have not been exploded is a subject of risk assessment. In this study, the average pumping frequency of balloons that have not been exploded is considered to be the basis for risk-taking behavior.^[29]

Risk-taking behavior was defined as an indicator variable. The latent variables included extraversion, psychoticism, neuroticism, lie, and risk power. Each of them is described in Table 1 and following:

Neuroticism

Neuroticism is defined as the desire to experience negative emotions and psychological distress. Neuroticism reflects low-stress tolerance. People with high neuroticism scores are more likely to be depressed, anxious, and insecure. Neuroticism has some components, including anxiety, angry hostility, depression, self-consciousness, impulsivity, and vulnerability.^[30]

Extraversion

Extraverts are social people and they like excitement and movement. Extraversion scales that including attractiveness, gregariousness, assertiveness, activity, excitement seeking, and positive emotions are showing people's interest in developing their industry and work.^[31]

Psychoticism

Flexible people are curious both in the outside world and in their inner world and their lives are rich experience. They want to accept new ideas. The components of this dimension include fantasy, esthetics, feeling, actions, and ideas.^[32]

Lie

An agreeableness person, who tends to have high social acceptance. The components of this dimension include trust, straightforwardness, altruism, compliance, modesty, and tough-mindedness.^[32]

Risk power

The risk power shows the level of risk and willingness to risk in individuals.^[33]

SEM modeling is based on the hypotheses that are to be investigated. Modeling in this study was performed based on the hypotheses in Table 2. The proposed model is based on the effect of personality characteristics on risk-taking behavior. Given the fact that modeling of these parameters has not been done so far, based on the relationship between personality parameters and risk power that has been studied in various studies,^[6,10-17,20,21,27,34] a conceptual model was presented. The validity of the model has been investigated, and its fit results are presented in the results section. Given the fact that women and men are different in terms of impulsivity and risk aversion.^[21] The impact of personality dimensions and the power of risk on high-risk behavior was made by gender. The collected data was first fed into SPSS 20 (IBM Corp., Armonk, NY, USA), and then modeling with PLS (<https://www.smartpls.com/smartpls2>) was done. Based on the hypotheses and available information, the model in Figure 1 was drawn.

RESULTS

A total of 96 participants were evaluated. Forty-eight were male, and forty-eight were female. Participants with missing data were excluded from the study. To analyze the data, SEM was used. As shown in Table 3, the study on the goodness of fit indicators showed that the model is well suited to the data. Furthermore, according to Standardized Root Mean square

Residual (SRMR), Chi-square and Normed Fit Index (NFI), model fit for men were better than that of women. The definition of SRMR is the difference between the observed correlation, and the model implied correlation matrix. A value of less than 0.08 is considered a good fit.^[26] The SRMR in the present study was 0.022 for males and 0.035 for females, as these values are less than 0.08, indicating the fitness of the model. The NFI is defined as one minus the Chi-square value of the proposed model divided by the Chi-square values of the null model. Consequently, the NFI results in values between 0 and 1. The closer to 1, the better the fitness of the model.^[27] In the present study, as shown in Table 3, the value for males is 0.945 and for females is 0.842. Chi-square for males was 21.795, while it was 40.316 in females.

As Figure 2 and Table 4 shows, neuroticism index, which represents the exciting and unstable persons, had a significant

Table 1: Definition of index and latent variables

Safety variable	Latent variables	Code	Question?
Risk-taking behavior	Extraversion	EXT	Does extraversion increase risk-taking behavior?
	Neuroticism	NEU	Does neuroticism increase risk-taking behavior?
	Psychoticism	PSY	Does psychoticism increase risk-taking behavior?
	Lie	LIE	Does lie increase risk-taking behavior?
	Risk power	RT	Does risk power increase risk-taking behavior?

Table 2: Definition of hypotheses

Code	Hypothesis
H1	Extraversion people have higher risk power and more risky behavior
H2	People who tend to social acceptability have higher risk power and more risky behavior
H3	Psychoticism people have higher risk power and more risky behavior
H4	Neuroticism people have higher risk power and more risky behavior
H5	People who have a higher risk of power have more risky behavior

Table 3: Goodness of fit indices of the risk-taking behavior model

Indices	Values	
	Male	Female
χ^2	21.795	40.316
SRMR	0.022	0.035
NFI	0.945	0.842

SRMR: Standardized root mean square residual, NFI: Normed Fit Index

Table 4: Indices of structural equation modeling for relationship between variables

Varibales	Path coefficient		P		t	
	Female	Male	Female	Male	Female	Male
EXT-risk power	NM	0.971	0.868	<0.001	0.166	85.632
LIE-risk power	NM	NM	<0.05	<0.001	2.436	3.634
NEU-risk power	0.962	NM	<0.001	0.966	17.403	0.043
PSY-risk power	NM	NM	0.121	0.969	1.555	0.038
RTB-risk power	0.915	0.950	<0.001	<0.001	19.161	96.079
Indirect effect of NEU-RTB	0.88	NM	NM	NM	NM	NM
Indirect effect of EXT-RTB	NM	0.923	NM	NM	NM	NM

NM: Not measured, EXT: Extraversion, NEU: Neuroticism, PSY: Psychoticism, RTB: Risk taking behavior

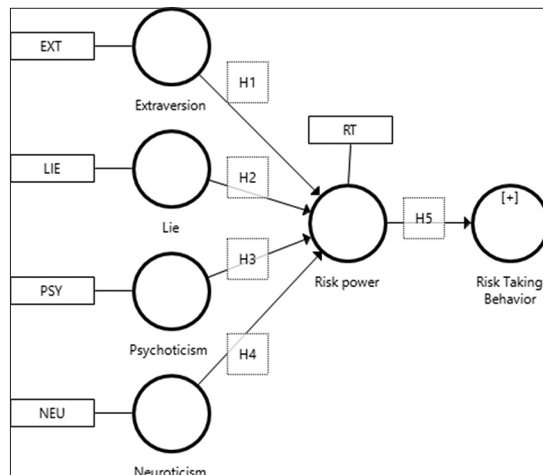


Figure 1: The hypothesis model for describing the influence of personality dimensions and risk power on risk-taking behavior. EXT: Extraversion, LIE: Lie, PSY: Psychoticism, NEU: Neuroticism, RT: Risk power

relationship with the risk power ($P < 0.001$) and according to Hypothesis 4, which states that neuroticism is related to the power of risk, this hypothesis is proven in females, and it shows that the more neuroticism females are individuals with more risk power. As Figure 3 illustrates, the assessment of personality dimensions with men's risk power shows that in males, the risk power has a significant relationship with extraversion ($P < 0.001$), which is, according to hypothesis 1, the more men are extraversion, the higher their risk power. In females, there is no significant relationship between extraversion and the risk power ($P > 0.05$), which suggests that extraversion in females does not have a meaningful relationship with their risk-taking power. Concerning hypothesis 2, in male and female participants, the higher the desire for social acceptance, the more risk power the participants possess. The desire for social acceptance, which is evaluated by LIE in the questionnaire, has a significant relationship with the risk of individuals in both groups ($P < 0.05$).

In both gender groups, the results showed that the psychoticism dimension is not significant with risk, and hypothesis 3 is rejected ($P > 0.05$). The relationship between risky decision making and unsafe behaviors, which is measured using BART software, has a significant relationship with risk power for both

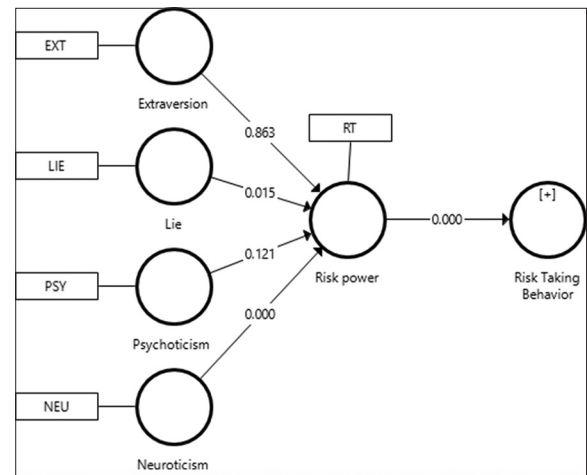


Figure 2: The structural equation model for describing the influence of personality dimensions and risk power on risk-taking behavior in females. EXT: Extraversion, LIE: Lie, PSY: Psychoticism, NEU: Neuroticism, RT: Risk power

males and females ($P < 0.001$). That is, higher the people score in the BART, their risk power will also be high.

Furthermore, in Table 4, it is observed that the indirect effect of neuroticism on risk-taking behaviors in females with a path coefficient of 0.88 and the indirect impact of extraversion on risk-taking behaviors had a path coefficient of 0.923. The higher the women score in neuroticism, the higher their risk-taking behavior and the more men get higher scores on extraversion, the higher their risk-taking behavior.

DISCUSSION

Risk-taking behaviors in industries can be one of the most important reasons for incidents.^[28] In the analysis of risk-taking behaviors and unsafe behaviors, all system interactions must be considered, and various studies have shown that incidents should be investigated and analyzed using systematic methods to detect defects in all components of the system including human.^[29,35] The aim of this study was to investigate the capacity of personality dimensions in explaining risk power and risk-taking behaviors, and examine their interactions using PLS-SEM. In the present study, modeling was done using 5 hypotheses.

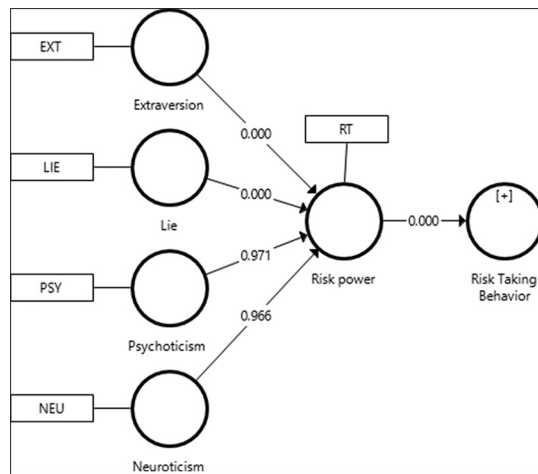


Figure 3: The structural equation model for describing the influence of personality dimensions and risk power on risk-taking behavior in males. EXT: Extraversion, LIE: Lie, PSY: Psychoticism, NEU: Neuroticism, RT: Risk power

Hypothesis 1 which states extraverted people have higher risk power and more risky behavior was confirmed in men. Various studies have shown that risk-taking behaviors are a conscious sensation seeking, and those who are highly exposed to extraversion are consciously jeopardizing their emotional sense.^[21] Waldeck's study showed that men need a higher level of arousal, which is the reason for their greater sense of emotion and the appearance of impulsive behavior by them.^[36] In general, research on extraversion and risk-taking behaviors can be divided into three categories: Positive relationship, negative relationship, and meaningless relationship. A study of Lajunen in 2001 showed that people who score high on extraversion seek to attract attention and compete with others, leading to unsafe behaviors.^[31] Results of a study by Morgan in 2007 showed that extraverts experience more insecure situations due to risky and careless behaviors, but introverts have more intrinsic control and are expected to be more vigilant in their tasks.^[32] In a study of factory managers, Thomas found that extraverted managers had more communication skills with their employees, which reduced job losses.^[37] Some studies^[38,39] found no coherent patterns of associations between extraversion facets and risk-taking tendencies. Nonetheless, in line with our research, some researches suggest that extraversion is associated with risk-taking^[40-43] which confirms our hypothesis. The results showed that people who have higher levels of extraversion often risk a new, unreliable situation, to increase their perspective and vision of the world, such as those that conflict with the norms of the society.^[44]

Hypothesis 2 is confirmed. This hypothesis states that people who tend to social acceptability have higher risk power and more risky behavior. The results of this study showed that in both women and men, the higher the tendency to social acceptability, and the importance of other people's theories about themselves, the higher their behavioral risk. In a study, by Morgan results stated that incompatible people, known

as social misfits, often show negative and hostile emotions in the workplace.^[32] Furthermore, the results of Shokrkon's study showed that since the feature of agreeableness is a mixture of respect, democracy, and nonprofit, this feature has a positive effect on safety performance.^[45] High scores in the dimension of agreeableness are associated with a dependent personality disorder, and these people are less likely to engage in risk-taking behaviors, and low scores in this dimension are associated with narcissistic and antisocial personality traits that are more likely to engage in high-risk behaviors. Most of the studies in the field of relationship between agreement and risk-taking behavior were in line with the present study. The results of Henning's study showed that consistent and agreeableness people in the organization have a greater sense of responsibility, which leads to a positive attitude towards safety and avoidance of risk-taking behavior.^[30]

In hypothesis 3, the relationship between personality's psychological dimension with risk power and risk-taking behaviors was investigated. This hypothesis was rejected. One of the most important features of Psychoticism is conscientiousness. Conscientious people follow the rules and are aware of the expected behaviors in a particular situation. These people believe in better performance, have a high level of motivation and behave safely in the workplace.^[46] Morgan's study found that conscientious objectors followed the rules and were less likely to be involved in accidents and injuries.^[32] The results of the mentioned studies were in line with the results of the present study.

Hypothesis 4, which states neurotic people have higher risk power and more risky behavior, was approved in females. Impulsivity is an unconscious risk that is related to the neuroticism dimension; that is, those who achieve a high degree of neuroticism readiness are unknowingly vulnerable to risk-taking behavior.^[34] Persons with higher levels of neuroticism tend to experience more intense negative emotions, concern, experiencing sadness, and responding more hardly to stressors.^[29] But then, anger irritability and immoderation-impulsivity are also often considered facets of neuroticism, and these might promote risk-taking through behavioral disinhibition or lower behavioral control under negative emotional situations.^[35,36,38] People with neuroticism are more likely to become anxious or angry about their job needs. As a result, their attention span decreases, and they become more prone to unsafe behaviors.^[47] In a study, Geller stated that there is no significant relationship between neuroticism and increasing risk-taking behaviors.^[48] Beecher found that drivers with high levels of anger exhibited more risky behaviors while driving and had higher crash rates.^[49] People with high scores on neuroticism show irrational beliefs, less power to control impulses, and a poorer degree of adaptation. People with low scores have stable emotions. They are usually calm and comfortable and are able to cope with stressful situations without confusion or noise. Some studies have shown that the neuroticism dimension increases risk-taking

behavior,^[39-44,50] and some studies have also rejected this hypothesis.^[51,52] In general, the evidence for the association of neuroticism with low-risk behaviors is less clear, and the findings are somewhat contradictory. Morgan, for example, believes that while increasing anxiety can lead to distractions, in reality, this increase in anxiety may lead to fewer accidents, as these people may be more focused due to their high anxiety.^[32]

CONCLUSION

These findings suggest that individuals with different emotions transmit different types of information, and this can create different attitudes. That's why we get different results in various studies of personality and risk-taking. Gender, nationality, age, education, economic well-being, health status, and many other personal factors can affect one's emotions. We cannot change people's feelings or expel them from their work, requiring people to change their feelings is like asking them to shorten or raise their height. Hence recognizing individuals, their characteristics, and their personality dimensions should be accomplished to adapt the system. The methods of profit and loss in sensation seeking and extraversion people are entirely meaningless because they decide at the moment and do not think about the result. Therefore, to prevent unsafe behavior and to prevent the occurrence of accidents, we must seek to secure the system following human beings. In addition to personality dimensions, many factors can contribute to risk-taking behaviors that are partly studied in the present study. Therefore, it is recommended that the factors involved in risk-taking behaviors and their relation to unsafe behavior and ways of adapting the system to these behaviors in different industries are studied.

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Conflicts of interest

There are no conflicts of interest.

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