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The Scale of Effective Decision-Making in Sport (SEDMS): Validity and Reliability Study

Sporda Etkili Karar Verme Ölçeği (SEKVÖ): Geçerlik ve Güvenirlik Çalışması

Araştırma Makalesi / Research Article

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Bu araştırma, Mersin Üniversitesi Spor Bilimleri Etik kurulunun 26/12/2022 tarih ve 2022-063 sayılı kararı ile etik açıdan uygun bulunmuştur.

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Özet

Bu çalışmanın amacı, aktif spor yapmakta olan 18 yaş ve üstü lisanslı sporcuların karar vermede etkili olma seviyesini ölçen bir ölçme aracı geliştirmektir. Ölçeğin aday formunu oluşturma aşamalarında, sporculara kompozisyon yazdırma, ölçek literatür taraması, odak gruplarla görüşme "niteliksel adımlar" kapsamında gerçekleştirilirken, sayıltı analizleri ve geçerlik güvenirlik analizleri ise gerçekleştirilen "niceliksel adımlar" dır. Madde havuzunda oluşturulan 42 madde ile hazırlanan uzman görüş formu, Lawshe tekniğine göre değerlendirmeleri için uzmanlara sunulmuştur. Uzman dönütleri sonrası, 15 madde çıkartılmış ve 27 madde kalmıştır. Denemelik ölçek formu, 18 yaş ve üstü aktif lisanslı 806 sporcuya, çevrimiçi uygulanmıştır. Ardından niceliksel adımlar kapsamında Açımlayıcı Faktör Analizi'nin (AFA) temel sayıltıları sınanmış olup; AFA neticesinde 2 boyutlu toplam 15 maddeden oluşan yapı elde edilmiştir. SEKVÖ' nün psikolojik olarak yapı geçerliğini incelemek amacıyla; AFA sonrasında oluşan 15 maddelik nihai form ile yeniden veri toplama yoluna gidilerek, 493 aktif lisanslı sporcusundan yeni veriler elde edilmiş ve Doğrulayıcı Faktör Analizi (DFA) gerçekleştirilmiştir. DFA sonrası alt boyutlara ait standardize yük değerleri, değişkenlere ilişkin kestirilen hata varyansları, tüm maddelerin T değerleri ve model uyum iyiliği değerleri incelenmesi sonucunda ölçeğin 15 maddeden oluşan 2 faktörlü yapısının bir model olarak doğrulandığı saptanmıştır. Ayrıca DFA sonrasında ölçeğin yakınsak ve ıraksak geçerlikleri ile birleştirici güvenirlik değerleri incelendiğinde ölçütlere uygun değerlere sahip olduğu sonucuna ulaşılmıştır. Cronbach alfa iç tutarlık katsayısı; ''Dışsal Karar Verme'' alt boyutu için .87, ''İçsel Karar Verme'' alt boyutu için ise .85 olarak hesaplanmıştır. SEKVÖ' nün 18 yaş ve üstü sporcuların etkili karar verme seviyelerini ölçmede geçerli ve güvenilir bir ölçek olduğu sonucuna varılmıştır.

Anahtar Kelimeler: Spor, Güvenirlik, Geçerlik, İçsel karar verme, Dışsal karar verme

Abstract

The aim of this study is to develop a measurement tool that measures the level of influence in decision-making of licensed athletes aged 18 years and above who are active in sports. In the stages of creating the candidate form of the scale, writing essays by athletes, scale literature review, and interviews with focus groups were carried out within the scope of "qualitative steps", while hypothesis analyses and validity and reliability analyses were carried out within the scope of "quantitative steps". The expert opinion form prepared with 42 items in the item pool was presented to the experts for their evaluation according to the Lawshe technique. After the expert feedback, 15 items were removed, and 27 items remained. Trial scale form was administered online to 806 active licensed athletes aged 18 and over. Then, the basic assumptions of EFA were tested within the scope of quantitative steps; because of EFA, a 2-dimensional structure consisting of a total of 15 items was obtained. To examine the psychological construct validity of the SECVS, new data were obtained from 493 active licensed athletes by re-collecting data with the 15-item final form formed after EFA and CFA was performed. After CFA, the standardized loadings of the sub-dimensions, the estimated error variances of the variables, the T-values of all items and the goodness of fit values of the model were examined and it was determined that the 2-factor structure of the scale consisting of 15 items was confirmed as a model. In addition, when the convergent and divergent validity and convergent reliability values of the scale were examined after CFA, it was concluded that this scale had values in accordance with the criteria. Cronbach's alpha internal consistency coefficient was calculated as .87 for the ''External Decision Making'' sub-dimension and .85 for the ''Internal Decision Making'' sub-dimension. It was concluded that the SDEQ is a valid and reliable scale for measuring the decision-making effectiveness of athletes aged 18 and over.

Keywords: Sport, Reliability, Validity, Internal decision making, External decision making

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Introduction

Human beings always tend to make decisions as long as they live. It is thought that the basis of human behavior lies in the tendency to choose the most appropriate option among the alternatives. Therefore, in the decision-making stage, individuals prefer the optimal option(s) within the framework of the criterion that serves their purpose, considering the available options (Bayrak, 2015). In order to make the most appropriate choice, it is necessary to analyze the nature of decision and decision-making well. While decision means consciously choosing one out of the different possible options (Sánchez, Calvo, Buñuel & Godoy, 2009), decision-making is defined as the process of adequately reducing doubts and uncertainties between options (Tekin, Özmutlu & Erhan, 2009). In other words, Harris (1998) defined decision-making as not only defining alternatives concerning various events and developments but also as a process of choosing the most appropriate one together with goals, aspirations, lifestyle, and values in the selection of alternatives that are taken into consideration about various events and developments. Decision-making for actions in terms of physical education and sport can also affect the outcome of the action. In this sense, Çetin (2009) defines decision-making as ending the state of inaction and indecision in which the individual is in and transitioning this state to action and mobility. On the other hand, the learned and habitual reaction pattern that an individual exhibits when facing any decision-making situation is called a decision-making style (Scott & Bruce, 1995). It is thought that individuals make decisions according to their personal characteristics. This is because people's decision-making styles and the implementation of the decisions they make are the products of their characteristic features (Altay, 2011).

Raehlin (1989) states that the theoretical views in the field of decision-making are determined by observing an individual's choices in some decision situations and obtaining information about the internal decision-making process through examining these choices (Alver, 2003). According to the behavioral approach explaining the decision-making process, decision-making requires a mental process (Kaya, 1996). According to Banks (1971), decision-making requires producing information, organizing the information produced, and then synthesizing this information, that is, verifying the result (Baysal, 2015). During decision-making, since the person is oriented towards the most appropriate option among the different alternatives, the fact that decisions are in the desired direction depends on the healthy functioning of cognitive processes (Eldeleklioğlu, 1999). Therefore, the process is as important as the whole picture formed as a result of decision-making.

Since human is not a creature that adapts to its environment with automatic and instinctive reactions, decision-making behaviors are dynamic and changeable depending on experiences (Kuzgun, 2009). For this reason, the fact that decision-making is not static imposes different decision-making responsibilities on the individual in different situations. Since decision-making tendency is formed as a result of cognitive and behavioral efforts (Deniz, 2004), it can change shape in line with needs and goals and can be directed towards the most appropriate one (Demir, Namlı, Hazar, Türkeli & Cicioğlu, 2018). Kuzgun (2009), who defines decision-making as the process of choosing the most appropriate one among the alternatives, pointed out that three conditions must exist for decision-making behavior to occur. The first of these is the existence of a strength that creates the need for decision-making and the feeling of strength by the individual, the second is the existence of at least two options to eliminate the strength, and the third is that the individual has the freedom to choose one of the options. In addition to these three items, it is believed that having a healthy psychological structure and the active functioning of the brain's decision-making regions play an important role in the decision-making process physically. The regions responsible for decision-making are expected to take an active role in the act of thinking.

Neuroscience research, which provides information about how our brain changes during thought processes, states that the human brain consists of seven regions: frontal lobe, temporal lobe, parietal lobe, occipital lobe, brain stem, limbic system, and neocortex. In their study, Rudorf and Hare (2004) found that the most active regions of the brain in the decision-making process are the dorsolateral and ventromedial prefrontal cortex regions and that these regions play an active role in the process by neuronal interaction while needing to make a decision. In addition, with brain imaging systems, it has been determined that these regions play an active role during activities such as short-term memory and decision-making behavior (Saraiva & Marshall, 2015). Considering the effect of exercise and sports on neurotransmitters, it is known that exercise increases central nervous system neurotransmitters such as neuradrenaline (NA), dopamine (DA), and serotonin (5-HT). When we look at the effect of neurotransmitters on decision-making, it is known that serotonin plays a mediating role in regulating the decision-making functions of the frontal cortex. There are studies in the literature showing that dopamine mediates the adaptation of behavior to new conditions in situations that require flexibility in the mesocorticolimbic system, again in connection with decision-making. It can be stated that due to the increase in these neurotransmitters, the cognitive control emerging as the brain's decision-making process and strategies becomes important in long-term activities (Martin, Meeusen, Thompson, Keegan & Rattray, 2018).As a result, it can be said that the increase in neurotransmitters, which play an active role in providing positive developments in the brain through exercise, improves the individual's abilities such as planning, reasoning, cognitive flexibility, and decision-

making. In this respect, it can be clearly stated that exercise and sports are very important for neurological health. Therefore, it is also possible to say that exercise and sports have a positive effect on decision-making.

It is believed that the integration of technology into sports today has accelerated the intercultural interaction of sports. It is observed that the increase in the importance of sports for countries is a result of this interaction and increases competition. Therefore, sportive activities that witness more competition may be instrumental in drawing attention to the importance of non-talent factors for success. In revealing sportive success, it is evident that physiological and technical tactical activities are not enough; mental and psychological factors also play a significant role (Turkay & Demir, 2021). In other words, in sporting environments where competition intensifies, countries consider the psychological and cognitive characteristics of athletes in addition to their abilities in order to be more successful in sportive activities. If pure talent and physical training were enough, we would observed that only the most talented athletes would be at the top of every competition rostrum and there would be no surprising results. However, the fact that highly talented athletes sometimes cannot reach the top suggest that talent is necessary but not sufficient on its own. Therefore, it can be stated that cognition and cognitive process are important in decision-making in sport. Rasmussen (1993), who studied decision-making in sport, expressed the cognitive decision-making process with three different types of behavior patterns. The first of these is skill-based decision-making, where the athletes make decisions based on their instincts without complete conscious control and execute actions because of a sudden decision (Vural, 2013). In the rule-based decision, which is the second type of decision-making behavior as expressed by Rasmussen, the criteria for the athlete's decision are the rules. In other words, the important thing in the decision is the perceived relationship between the task and the cue. While the behavior is automated in skill-based decision-making, the decision-making behavior is performed in a very meticulous manner in rule-based decision-making. Knowledge-based behaviors are more detailed and abstract, so evaluations need to be more understandable (Rasmussen, 1993).

There may be various dynamics affecting an individual's decision-making. While these dynamics are sometimes related to the internal mechanism of an individual, sometimes external factors can affect the decision process. Intrinsic decision-makers can be defined as individuals who consider their past experiences, think alternatively, and make make calm decisions among possible options. In addition, internal decision-makers are individuals who do not prefer to include external factors in the process. Internal decision-makers can think in detail and focus on the outcome (Johnson, 1978). On the other hand, extrinsic decision-makers can be expressed as individuals who may panic in situations such as intense pressure, sound, or light that may disturb the decision-making process, and the difficulty of the decision situation. In other words, external factors may have a negative impact on the process for this type of decision-makers. Extrinsic decision-makers often prefer to talk to avoid being affected by these pressurized and stressful environments and are generally negatively affected by external stimuli (Johnson, 1978).

Although there is no objective criterion for decision-making in sport, it can be said that there are some generally accepted characteristics. It would not be wrong to say that one of these characteristics is the naturalness of decision-making in sport. At the moment of competition, it is difficult for an athlete to precisely follow all the instructions given before the competition. This is because the number of preferences may vary when making decisions during the competition, the decision-maker may be in a conditional decision situation, and the decision could be based on their own initiatives. In this situation, which is expressed as the naturalness of decision-making, the athletes use their freedom (Johnson, 2006). Another point that can be expressed as the second characteristic feature of decision-making in sport is that decisions are based not only on the athlete making the decision but also on external factors. In other words, during the competition, the athletes may not be able to access the information they need to use from time to time and may have to make different types of decisions. In this situation, which is expressed as the dynamism of decision-making in sport, the athlete has to take responsibility for the decision (Johnson, 2006). The time pressure caused by this dynamism in decision-making in sport can be expressed as the third feature. Since the decisions are always made clearly in the competition, time pressure and clarity of behavior can be shown among the generally accepted characteristics of sportive actions.

Sudden changes in the flow of sportive games may occur, requiring dynamic decisions to be taken continuously (Kelecek, Altıntaş & Ascı, 2013). Especially in sports where environmental conditions are unpredictable and require open skill during action (Çimen, 2022) such as football, basketball, volleyball, and handball that played using a ball, or sports that demand instant reactions to the opponent’s student movements like karate, judo, taekwondo, aikido, or racket-based games like table tennis, court tennis, paddle tennis, making dynamic decisions and their instant implementation are of great importance. Therefore, how athletes and coaches think and what they take into consideration when making decisions is extremely important. Since changing conditions in sport can affect the outcome, the need for dynamic decision-making mechanisms is increasing day by day. However, in sports such as golf and sailing, which do not have time pressure and time limitations, instant decision-making is less important for success (Seiler, 1997). The time pressure involved in sportive success and the need to choose the most appropriate choice among the alternatives in a short time reveal the importance

of decision-making in sport. Another point that indicates the importance of decision-making in sport is the possibility that the decisions taken before the competition may change due to the change of conditions during the competition. During the competition, the athletes are expected to make the right decision and put it into practice quickly to be considered successful. In the competition, the opponent(s) may exhibit some misdirection tactics during the decision-making process. At this point, the athlete who makes a decision is expected to quickly consider all possible alternatives and make a judgment. Because the judgment of deceptive information and correct information is an important criterion for success (Uzunoğlu, 2008).

Effective decision-making, which is one of the cognitive processes and can be expressed as one of the non-ability factors, is important for sportive success. Although there are decision-making studies in the literature, the lack of a decision-making scale developed solely for athletes constitutes the motivation of the current study. For this reason, it was aimed to develop an effective decision-making scale in sports to fill the gap in the field.

Method

Type of Research

This research study aims to develop a scale to determine the extent to which athletes aged 18 and above who are actively engaged in licensed sports in different branches can make effective decisions about the competition environment or their opponents within the framework of the dynamic structure in sports. The present study, which utilized the scaling approach through ranked sums, one of the approaches based on subject responses, was conducted as basic research.

Study Group

This study, which attempts to measure the level of effective decision-making in athletes, consists of two different study groups. For the exploratory factor analysis (EFA) conducted to explore and determine the measurement model, the study group consists of a total of 806 volunteer participants aged 18 and over who are actively engaged in licensed sports. The data were collected between January and February 2023 from the athletes who voluntarily participated in the study. The participants consisted of 429 female (53.2%) and 377 male (46.8%) individuals, with an average age of $\bar{X}$ =22.05, *SD* = 6.07. In addition, 390 of the participants were individual athletes (48.4%), 416 were team athletes (51.6%); 345 of the athletes (42.8%) were athletes for 1-3 years, 174 (21.6%) for 4-6 years, 118 (14.6%) for 7-9 years, and 169 (21%) for 10 years or more.

Confirmatory factor analysis (CFA) was applied to provide additional evidence regarding the construct validity, convergent validity, divergent validity, and to test the psychometric properties of the final form formed EFA. For the CFA, the data were collected again in March 2023 from 493 athletes aged 18 years and over who were actively engaged in licensed sports. The data were collected online based on a voluntary participation.

Developing the Scale and Creating the Trial Scale Form

Stage 1 (Focus Group Interview): In order to create an item pool, focus group interviews were conducted with 12 national athletes who represented the national team in their branches and four expert academicians. Convenient sampling method, one of the qualitative research sampling methods, was used for the study group planned to form the individuals who would participate in the focus group interview.

Stage 2 (Printing Composition to the Target Audience): In order to collect data, a total of 226 athletes over the age of 18, who were doing sports in various sports clubs and athletes who were actively participated in licensed sports besides study at Hatay Mustafa Kemal University School of Physical Education and Sports, Osmaniye Korkut Ata University School of Physical Education and Sports, and Mersin University Faculty of Sports Sciences, were asked to write essays concerning their views and experiences related to decision-making by responding to the given open-ended questions.

Stage 3 (Literature Review): The scales related to decision-making in the literature were examined. The Melbourne Decision-Making Scale developed by Mann, Radford, Burnett, Ford, Bond, Nakamura, Vaughan & Yang (1998) and adapted to Turkish culture by Deniz (2005) was examined, which contributed to the item pool. In qualitative steps of the scale development phase, the target group was asked to write essays, focus group interviews were conducted, and a literature review was performed on the subject. As a result of these qualitative steps, the item pool created was evaluated by the target group and researchers and was turned into sentences to determine effective decision-making in sports. These sentences were further refined in terms of language and expression.

Stage 4 (Examining Content Validity): Within the scope of the scale development stages, the trial scale form processing steps were carried out. Within the scope of expert evaluation, a total of 27 experts, including 12 national athletes, 3 academicians who specialized in decision-making in sport in their academic studies, and 12 academicians who were experts in scale development and had scale development studies, were identified, and the form prepared to obtain their opinions was sent to these experts via e-mail to evaluate it electronically. In the evaluation form, the experts were asked to evaluate the items separately by marking them as 3: Good - 2: Should be improved, and 1: Poor, for the criteria of "Representativeness", which emphasizes the strength of the relationship with the theoretical structure, and "Comprehensibility", which emphasizes its comprehensibility by the target audience, and provide their suggestions and corrections, if any.

As a result of the expert feedback, the Lawshe technique was employed to calculate the content validity. In the Lawshe technique, which is an item statistic based on content validity regarding the presence or absence of an item in the scale, a value between -1 absolute rejection and +1 absolute acceptance is obtained.

$$\text{CVR} = \frac{Nu}{\text{N}/2}\ 1\text{(Equation 1)}$$

In Equation 1, which shows the calculation of the content validity rate according to the value obtained, Nu indicates the number of experts who rated the item as good, and N indicates the total number of experts who provided their opinions on the item. If all experts say the item is good, the CVR = 1, if half of the experts say the item is good, the CVR = 0. If all experts say the item is bad, the CVR = -1. As a result of the calculation, if the CVR=0 or a negative value, the relevant item does not satisfy the CVR criteria and should be removed from the scale (Ayre & Scally 2014; Lawshe, 1975; Wilson, Wilson, Pan & Schumsky, 2012). In the current study, the critical value of CVR=CVR for 27 experts at α=0.05 level of significance was 0.407 (Lawshe, 1975), therefore 12 items did not meet the content validity criterion and 3 items were removed from the trial form upon the experts' recommendation. As a result, after the expert evaluation and content validity study, 15 items were removed from the 42-item initial form, and the final version of the 27-item trial form was obtained.

Stage 5 (Application of the Trial Form of Scale to Athletes): As a result of the expert feedback, 27 items were tested for content validity and a trial form was created in the form of a 5-point Likert type scale (5: Strongly Agree, 4: Agree, 3: Neutral, 2: Disagree, 1: Strongly Disagree). The trial form was applied to 806 active licensed athletes aged 18-47.

Stage 6 (Factor Analyses; EFA, CFA): Before performing EFA, the data were transformed into the desired form for factor analysis in terms of the number of participants and testing the missing data, outliers, multicollinearity, linearity, normality, and the factorability of scale. The criteria for factor analysis were tested separately for EFA and CFA.

Data Analysis Techniques

EFA and CFA were conducted quantitatively for validity, while for reliability, Cronbach's alpha was employed for internal consistency, along with composite reliability based on the CFA findings. Hypothetical analyses were performed before conducting EFA in the study, conducted to test the effective decision-making of licensed athletes aged 18 years and above who are active in sports, to determine the number of items and the dimensionality of scale, and if applicable, the relationship between the factors in the study. Then, the explained variances and factor loadings of the items were calculated. After the rotation process, the calculated loadings were recalculated. Cronbanch's Alpha reliability coefficients were also determined after EFA.

The data were analyzed in terms of missing values and sample size. According to Guilford (1954), the sample size should be at least 200 in order to perform factor analysis, while Child (2006) emphasized that the number of items should be determinative, and the data collected should be at least 5 times the number of items. On the other hand, Comrey and Lee (1992) emphasized that 100 is a poor sample size, 300 is a good sample size, 500 is a very good sample size and 1000 is an excellent sample size. Tabachnick and Fidell (2015) also stated that the minimum number should be 300. Considering that the number of data collected for this study was 806, it can be stated that it is close to perfect and very good. Since the research data were collected online via the online Google form, there was no missing data.

The item distributions were normal since the possible measures of central tendency (i.e., mode, median, and arithmetic mean values) were close to each other. When Mahalanobis distances and Z values were examined to find the outliers of the study, all Z values were in the range of 4.69 to -3.32, and when Tabachnick's criteria were taken into account, two observations were not included in the analysis because they were univariate outliers. Mertler and Vannatta (2005) state that in studies with more than 100 samples, the Z score range can be expanded to values between -4 and +4. As a result of the analysis conducted to determine whether there were multivariate outliers using Mahalanobis distances and taking the Chi-square distribution a criterion (χ2 27 ;0.001 = 55.47),55 observations not meeting the Mahalanobis values were excluded from the analysis. Thus, the analysis continued with the data from the remaining 749 observations.

Since it is very difficult to capture the relationship between two variables, the analyses were continued with the assumption that the relationships between the items were linear. Within the framework of normality assumptions, each item was examined one by one, and the data had a univariate normality distribution since the measures of central tendency and kurtosis-skewness were generally close (Can, 2018). When the skewness and kurtosis values of the 27 items were analyzed separately, it was found that the skewness values were between .687 and -1.355, and the kurtosis values were between 3.326 and -.949. As a result of the analysis, it was concluded that the skewness coefficient between -3.3 and +3.3 and the kurtosis coefficient between -7 and +7 were sufficient to meet the normality conditions (Bernstein, 2000). Considering these values, it is possible to say that the distribution is normal.

Tolerance and VIF values were analyzed to check the multicollinearity problem. Tolerance values between the items were between .423 and .870. VIF values were between 2.362 and 1.149. When the items were analyzed, there was no multicollinearity problem since the Tolerance values were > 0.20 and VIF values were < 5. In addition, since the Durbin-Watson value provided for all items within the scope of autocorrela-

tion of errors is DW = 2.087, the errors were independent of each other (Kalaycı, 2005). When the data set was analyzed in terms of "Measurement of Sampling Adequacy Test" and Bartlett's Test of Sphericity" for the factorability of scale, which is another assumption, it was concluded that the data set was factorable since the Kaiser-Meyer-Olkin (KMO) value was KMO = .897 and the relationships between the items were significant and different from 0. Hutcheson and Sofroniou (1999) state that the KMO values are normal when they range between 0.5 and 0.7, good when between 0.7 and 0.8, very good when between 0.8 and 0.9, and excellent when 0.9 and above is (Dağlı, 2015). Within the framework of this information, it can be said that the values obtained are very good. The fact that the results obtained are significant ($p< 0.05$) reveals that the matrix created for the variables is meaningful and can be used for factor analysis (Gürbüz & Şahin, 2016). Since the KMO statistic reached to question the factorability of the current study group was .897, a good factorability of the correlation matrix was reached. In addition, as indicated in Table 2, according to the results of Bartlett's Test of Sphericity, the null hypothesis was rejected ($\chi 2 = 6767.351$, $p< 0.05$) and the relevant analysis was carried out.

Tablo 1. Data on age, gender, sport category, and years of experience of active licensed athletes.

		N	%	$\bar{X}$	SD
Age				22.05	6.07
Gender	Female	429	53.2		
	Male	377	46.8		
Sports Category	Individual	390	48.4		
	Team	416	51.6		
Sports Experience Year	1-3 Years	345	42.8		
	4-6 Years	174	21.6		
	7-9 Years	118	14.6		
	10 and more	169	21.0		
Total			100.0		

The descriptive statistics of 806 active licensed athletes aged 18 and over who participated in the study are shown in Table 1. According to the data obtained, the average age of the participants was $\bar{X}$ = 22.05 (*SD* = 6.07). Moreover, 53.2% of the participants were female, 46.8% were male; 48.4% were interested in individual sports while 51.6% were involved in team sports. It was revealed that 42.8% of the athletes had 1-3 years of sports experience, 21.6% had 4-6 years of sports experience, 14.6% had 7-9 years of sports experience, and 21% had over 10 years of sports experience.

Table 2. KMO and Bartlett's Test

KMO and Bartlett's Test		
KMO Measurement of Sampling Adequacy		.897
Bartlett's Test of Sphericity	Approximate Chi-Square	6767.917
	df	351
	Sig.	.000

To determine the construct validity of the scale in psychological terms, CFA was conducted with data collected again from 493 participants. With CFA, standardized loading values, estimated error variances, and goodness of fit values of the factors of the scale were calculated. After CFA, Cronbanch's Alpha reliability coefficients revealing the internal consistency of the scale were calculated.

CFA was conducted to test the psychological construct validity of the SEDMS. Prior to the analysis, the SEDMS, which was reduced to 15 items, was again administered face-to-face and online to the target population of active licensed athletes aged 18 and older. Firstly, assumption analyses were performed with 493 observations. In this context, sample size, missing values, linearity analysis, normality assumption, multicollinearity, and sample size adequacy tests were conducted.

Tabachnick and Fidell (2015) state that a sample size above 300 is sufficient. As a result of the sample size and missing data analysis, one observation containing missing data was excluded from the analysis, and it was deemed appropriate to continue the analysis with the normality assumption of the remaining 492 observations. The 15 items in the final application form were analyzed separately, and it was determined that the data showed univariate normal distribution characteristics since the mode, median, and mean values were generally close to each other or equal (Can, 2018). On the other hand, when the skewness values were analyzed, it was found that these values were generally close to negatively skewed values but took values between -1.467 and 0.254. Considering Bernstein (2000) that the skewness coefficient taking values between -3.3 and +3.3 meets the normality assumption, the results obtained met the assumptions. In order to detect outliers, Z values and Mahalanobis distances were analyzed. Mertler and Vannatta (2005) stated that Z score values can be in the range of +4 to -4 when the population reached is more than 100. Since the extreme Z values of the sample reached for CFA were between 5.53 and -2.31, two observations exceeding the range of -4 and +4 were excluded from the analysis as they were univariate outliers. In subsequent analysis, there were no univariate outliers and the analysis continued with 490 observations. In the analysis based on the Mahalanobis values of the items and chi-squares, multivariate outliers of .001 and smaller were examined ($\chi 215; 0.001 = 37.70$). As a result, 26 observations were excluded from the analysis and

the analysis continued with the remaining 464 observations. VIF statistics and Tolerance values were analyzed to determine the multicollinearity problem. Inter-item VIF values were between 1.273 and 2.248, while Tolerance values were between 0.445 and 0.785. Since the Tolerance values were > 0.20 and VIF values were < 5, there was no multicollinearity problem. As a result of these hypothesis analyses, 464 observations were obtained, and considering Tabachnick's criteria, it was decided that the observation set obtained was large enough for CFA applications (Tabachnick & Fidell, 2015). After the completion of the hypothesis analyses, CFA was applied with the remaining 464 observations and 15 items.

When the data collected from 464 participants for CFA were analyzed, the mean age of the participants was $\bar{X}$ = 21.58, *SD* = 5.32, where 220 were female (47.4%), 244 were male (52.6%). Moreover, 255 were individual athletes (55%) and 209 (45%) were team athletes. In addition, 161 (34.7%) of the participants had 1-3 years of experience, 116 (25%) had 4-6 years of experience, 86 (18.5%) had 7-9 years of experience, and 101 (21.8%) had more than 10 years of experience.

Ethics Statement

Ethical permission of this research was approved by Mersin University Sports Sciences Ethics Committee on the date and number of 26/12/2022-063.

Findings

Study Group Validity Findings

Stag EFA Finding

As a result of the analyses, all the assumptions of the EFA were met and the factor analysis continued with 27 items and 749 observations. It was concluded that the explained variance ratio, which expresses the extent to which the sub-dimensions represent the variables in the data set, took values between .399 and .634 in the SEDMS. It can be stated that if the common variance explained by the factors of the items is less than .10, the possibility of encountering a problem is high. Considering the values obtained, no item was removed. It is also stated that making a decision only by looking at the table of values is wrong and therefore more information should be obtained about whether the items work or not (Çokluk, Şekercioğlu & Büyüköztürk, 2018). On the other hand, it is also possible to interpret these values as coefficient of determination. For determining the number of factors, the "Scree Plot", "Percentage of Total Variance Method", "Kaiser Method", and "Explained Variance Criterion" methods were applied.

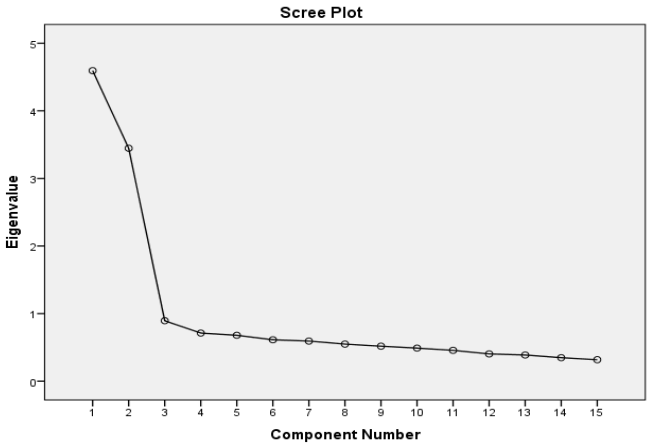

Figure 1. *Scree plot*

The distance between two points is accepted as a factor in Scree plots, which is one of the methods used to determine the factor(s). In determining the factor, the plateau formation of the criterion, that is, the transition from vertical to horizontal position, is taken into consideration. In the Scree plot shown in Figure 1, it was determined that a plateauing was observed starting from the 3rd point. Accordingly, the presence of a two-factor structure stands out. According to the Kaiser Method, which is another criterion, an eigenvalue value greater than 1 indicates a factor structure. In this direction, when Figure 1 is analyzed, two values with eigenvalues above 1 are observed. Therefore, the existence of a two-factor structure is clear. In Figure 1, the eigenvalues gradually decrease from the beginning, but the acceptance of a 2- or 3-factor structure is prone to personal interpretation. For this reason, the total explained variance table should be analyzed in order to determine the main breaking points more objectively and to determine the appropriate number of factors.

Table 3. Table of total variance

Component	Initial Eigenvalues			Total Extraction of squared loads		
	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %
1	4.594	30.626	30.626	4.594	30.626	30.626
2	3.446	22.973	53.599	3.446	22.973	53.599
3	.894	5.963	59.562			
15	.318	2.118	100.000			

Another method used to determine the factors is the "Percentage of Total Variance" method. According to this method, the maximum number of factors can be reached when the contribution of each additional factor to the explanation of the total variance falls below 5% (Kalaycı, 2005). When Table 3 is analyzed in the light of this information, the result indicates a two-factor structure. Within the framework of the Explained Variance Criterion, Adams states that a value

between 40% and 60% of the variance explained in social sciences is sufficient (as cited in Tavşancıl, 2005). As a result, the criteria were examined separately, and the presence of a two-factor structure was clearly revealed. Horn's (1965) parallel analysis within the framework of principal component analysis compares eigenvalues with randomly distributed empirical data. When the table of the total variance explained is examined, a two-factor structure with eigenvalues greater than 1 explaining 54% of the total structure was obtained. While deciding on the number of factors, Horn's parallel analysis, which is based on the Kaiser method and is a more objective indicator at this stage, was also applied and consistent results were obtained. As a result, Factor 1 explained 30.62% of the variance, while Factor 2 explained 22.97% of the variance.

When considering the number of factors reached and clarified as 2, it is possible to summarize the EFA performed, and the items excluded from the analysis with the parameters specified in the method section and their reasons as follows.

Tablo 4. Items excluded as result of EFA

Communalities <0.30 (Items)	Items with Factor Loadings Below 0.45	Overlapping Values with at Least 0.10 Difference	Items not forming sub-dimensions alone
10, 16, 18, 27	22	12, 24, 25, 26	13, 15, 23

As seen in Table 4, 4 items with communalities less than 0.30 (10, 16, 18, 27), one item with a factor loading less than 0.45 (22), and 4 items with overlapping values (12, 24, 25, 26) were identified. In addition, 3 items (13, 15, 23), which were deemed insufficient to form a sub-dimension when left alone, were removed from the analysis. It was concluded that the final structure reached was a two-factor structure. As a result of the analysis, it was determined that the total variance explained was 54% in the two factors. After removing the mentioned items, the common variance table for the items decided upon for the final structure were presented in Table 5.

Tablo 5. Common variances of the items, factor loadings, and the factors

No	Item	F1	F2	Common factor variance (h2)
m21	Making a decision in a time-limited situation makes me panic.	.796		.634
m19	I feel pressure when making decisions in competition.	.752		.567
m20	The possibility of failure while making decisions makes me panic.	.748		.559
m9	I find it difficult to make decisions when the opponent is under intense pressure.	.736		.551
m14	I have negative thoughts when I have serious decisions to make in the competition.	.734		.547
m17	The intense crowd pressure affects my decisions in a match.	.725		.526
m11	I cannot make a quick decision in a difficult position.	.667		.467
m8	I am influenced by external factors (e.g., noise, music) when making decisions in competition.	.632		.399
m3	When making decisions before the competition, I can take into account the possible positions of the opponent.		.791	.630
m2	I can consider different alternatives when making an immediate decision in a position in the competition.		.785	.619
m4	When making a decision, I consider whether I have other options.		.773	.598
m5	I am selective when making decisions in competition.		.727	.533
m1	I make decisions based on my sportive experience in competitions.		.716	.513
m7	I do not make a decision in a competition without considering all alternatives.		.657	.436
m6	I act calmly when making a decision in a position.		.643	.460

Extracted Variance: 30.626 22.973, Cronbach Alpha Values: 1st Sub dimension: 0.87 2nd Sub dimension: 0.85

In Table 5, the total variance explained was found to be 54%. Since all the items had high factor loadings, this structure was named as "Effective Decision-Making Scale in Sport (EDSS)". The Cronbach's Alpha internal consistency reliability coefficients calculated for the factors were .87 and .85. Factor names and reliability coefficients are summarized in Table 6.

Table 6. Factor names and reliability coefficients.

Number of Factors	Factor Names	Number of Items	Cronbach Alpha
1st Factor	Extrinsic Decision Making	8	.87
2nd Factor	Intrinsic Decision-Making	7	.85

When Table 6 is examined, it is seen that Factor 1 is named "External Decision-Making" and Factor 2 is named "Internal Decision-Making". Since the reliability coefficient were above the accepted critical point (>0.70) for both factors, it can be said that the measurement tool produces reliable measurements.

CFA Findings

According to the results of the CFA conducted after EFA, the standardized factor loadings of the ''Internal Decision-Making'' sub-dimension range between .44 and .80, and item 3 stands out as the item that best explains sub-dimension 2. The standardized factor loadings of the ''External Decision-Making'' sub-dimension varied between .56 and .76, and it was observed that item 20 was the reference item of this sub-dimension. The t-values obtained for the discriminative validity of the items should be between -1.96 and +1.96 for all items in the variable, i.e. the t-values to reveal the difference between those who responded most positively to an item and those who responded most negatively. T-values, which are an additional proof of validity, fulfill this requirement in all values of the present study. For this reason, it was concluded that all 15 items in the final form had discriminant validity. In addition, the error variances of the sub-dimensions varied between .35 and .72 for the first sub-dimension and between .42 and .60 for the second sub-dimension.

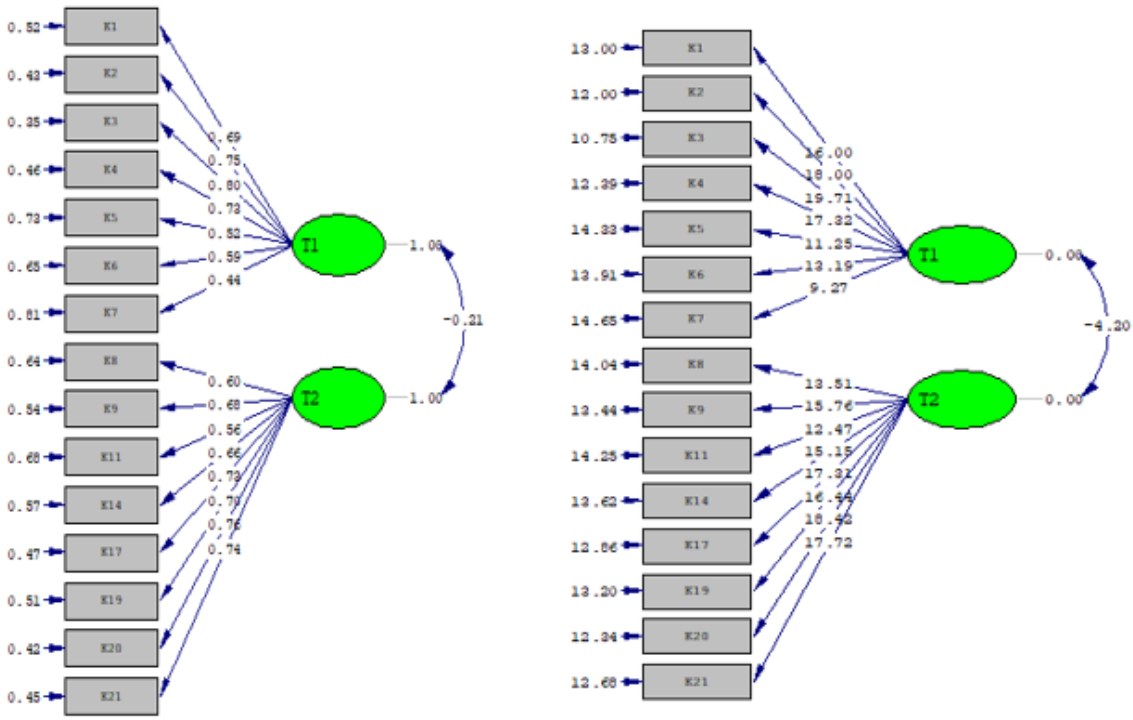

Figure 7. Standardized values of the tested model and significance levels of t-values (p<=.05)

It is shown in Figure 7 that all the standardized correlation coefficients belonging to the model are highly significant, and all t-values obtained for the items in the scale are significant. In addition, when the model goodness of fit criteria is taken into consideration, it is clear that the model fit of the study group is achieved (Çokluk, Şekercioğlu & Büyüköztürk, 2012).

When the findings of the model fit of the SEDMS are examined, the χ2/df indicator (χ2:250.97 and df: 89) is 2.8. Considering that a low value in the model indicates model fit, a value below 3 is an indicator of perfect fit (Kline, 2014; Sumer, 2000). Therefore, considering the ratio of 2.98, it is possible to say that the research is in perfect fit. Other indicators obtained for model fit were CFI = .96 and NNFI = .96. Considering that CFI > .95 and NNFI > .95 critical values indicate perfect fit, it can be concluded that that the research has achieved a perfect fit. RMSEA =. 068 and SRMR = .060, which are indicators that the values obtained in terms of model badness, are desired to be low. Considering that RMSEA<.08 and SRMR<.08, it has been revealed that the values obtained represent a good fit (Gürbüz & Şahin, 2016; Jöreskog & Sor-bom, 1993; Meydan & Şeşen, 2015). At this point, it is clear that the two-factor 15-item structure of the Effective Decision-Making Scale in Sport was confirmed within the framework of the model fit without the need for modification. Following the validated psychological construct validity of the Effective Decision-Making in Sport Scale, which is planned to be a valid and reliable measurement tool, the maximum shared variance squared (MSV), average variance explained (AVE), average of maximum shared variance squared (ASV), and composite reliability values (CR) of the factors are given in Table 9. It is desired that the two dimensions in the Effective Decision-Making in Sport Scale converge closely and explain at least half of the relevant factor. In this context, considering the evidence for convergent validity, the AVE values in both sub-dimensions were greater than 0.5 (AVE>0.5) and all CR values were greater than the AVE values, (Yaşlıoğlu, 2017). Therefore, the desired criteria were generally achieved. In this context, the condition that the CR values, considered the basic criterion for convergent validity, were

greater than the AVE values, the average of the explained variance, has been met (CR>AVE). On the other hand, the AVE values were less than 0.50 but at an acceptable level (Hatcher, 1994). In addition, both CR values were greater than 0.70.

In multifactorial constructs, evidence for divergent validity can be expressed as the absence of high relationships between factors and that the relationships between constructs are not greater than the forms they serve. In other words, aim is to obtain relatively independent factors and the factors should diverge from each other. In this context, the square of the maximum shared variance, MSV, reveals the square of the relationship between the two sub-dimensions and the average of the square of the maximum shared variance, ASV, reveals the average of this square. To be able to talk about divergent validity, the conditions of ASV<MSV, MSV<AVE, and also the square root value of AVE should be greater than the correlation between factors (Yaşlıoğlu, 2017). At this point, it was revealed that the criteria for divergent validity were met in the current study.

When the composite reliability values (CR), which are accepted as another criterion, are analyzed, it is seen that the requirement of .70 is fulfilled. The criteria and values of compliance with the criteria are given in Table 7 below.

Table 7. Convergent and divergent validity of the scale and composite reliability values

Factors	AVE	MSV	ASV	CR
Extrinsic Decision-Making	0.44	0.44	0.44	0.84
Intrinsic Decision-Making	0.47	0.46	0.44	0.87
Criteria	AVE>.50 CR>AVE	MSV<AVE	ASV<MSV	CR>.70

The Cronbach's alpha reliability coefficients obtained for the final 15-item scale form applied to 464 observations and the target group included in the analysis within the scope of SEDMS were calculated as .83 for the first factor "External Decision-Making" and .87 for the second factor "Internal Decision-Making". According to the data obtained, it can be considered as a highly reliable measurement tool.

Conclusion and Recommendations

In this study, a measurement tool was developed to determine the effective decision-making in athletes. As a result of the analyses, the scale was named as ''Scale of Effective Decision-Making in Sport (SEDMS)''. The second sub-dimension, which consists of eight items and is called ''Internal Decision-Making's, refers to alternative thinking and not being affected by dynamics while making decisions. However, the first sub-dimension, which consists of seven items and is called ''External Decision-Making'', refers to the external factors that athletes have difficulty in making decisions. The scores obtained in terms of sub-dimensions revealed that the SEDMS is a measurement tool that can measure the extent to which athletes are effective in decision-making. It can be used in sports sciences for all athletes aged 18 years and above.

During the development of the scale, focus group interviews, item writing by athletes for the question pool, examination of content validity according to the Lawshe technique, application of the trial form, and factor analysis were carried out. In order to ensure the scientific steps in the research, in addition to the hypothesis analyses, EFA and CFA analyses, convergent and divergent validity, and composite reliability analyses were performed. After conducting the EFA, the significance of Barlett's test of sphericity and the KMO value of .89 indicated the presence of a correlation matrix. Since the correlation values between the factors were uncorrelated, Varimax technique was preferred among the orthogonal rotation methods (Saraçlı, 2011). In order to be objective in selecting the factor structure, Horn's parallel analysis and Scree plot were utilized. Cronbach's alpha values were calculated as 0.87 for the Internal Decision-Making sub-dimension and 0.85 for the External Decision-Making sub-dimension in the structure consisting of 15 items and two sub-dimensions obtained through EFA. After the EFA, data were collected again, and hypothesis analyses were performed prior to CFA. The data were analyzed by controlling for univariate and multivariate outliers. In addition, multicollinearity was examined with tolerance and VIF values and autocorrelation of errors was examined with Durbin-Watson value. As a result, since the data obtained were suitable for CFA, the analyses were carried out. After CFA, internal consistency values were examined again, and Cronbach's alpha values were calculated as 0.83 for the Internal Decision-Making sub-dimension and 0.87 for the External Decision-Making sub-dimension.

In the light of the information from the literature, it was determined that there were many measurement tools measuring decision-making, but there was no measurement tool measuring decision-making in sports, and the measurement tools used in the field were adaptation studies to Turkish culture. Therefore, SEDMS is important because it is the first measurement tool developed directly in Turkish culture and the study group comprise only athletes. When the related literature is examined, frequently used decision-making measurement tools stand out. The short form of the "Emotional and Personality Related Career Decision-Making Difficulties" scale for high school students adapted to Turkish Culture by Öztemel (2014), the "Decision-Making Styles Scale" created by Taşdelen (2002) with a study group of university students studying in different faculties and adapted to Turkish Culture,

''Career Decision-Making Competence Scale'' developed by Ulaş and Yıldırım (2016) for university students, ''School Administrators' Decision-Making Effectiveness Scale'' developed by Özmen and Yörük (2005) for school administrators, and ''Melbourne Decision-Making Scale'' adapted to Turkish culture by Deniz (2005) contributed to the current study as frequently used studies in terms of decision-making studies. However, since there was no study that directly measured the decision-making levels of athletes in Turkish culture, a valid and reliable measurement tool was developed. The current study is different due to both the study group and its development in Turkish Culture.

When all the results are taken into consideration, it is thought that SEDMS is a valid and reliable measurement tool in sport sciences. It can be used for all branches, and therefore it can fill the gap in the field. In the future, another sports decision-making scale can be developed specifically for primary and secondary levels of education (under the age of 18) to contribute to the field. In addition, separate scales for team and individual sports can be developed and their similarities or differences can be revealed, and the results can be compared with this study.

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Conflict of Interest

There is no conflict of interest between the authors regarding the publication of this study.

Author Contributions

Research Idea: MÇÇ; Research Design: MÇÇ; Analysis of Data: MK; Article Writing: MK; Critical Review: MÇÇ

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Appendix

Effective Decision-Making Scale in Sport (EDMSS)

Athletes may exhibit different behavioral patterns in the decision-making process. These decisions are an indicator of the decision-making level of athletes. The following scale questions, which aim to measure this level, are not right or wrong. They are appropriate for you. In the table below, there are items that express the behaviors that can be possessed in the decision-making process in sports. Please mark the most appropriate option for you. Thank you for your contribution.		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	I make decisions based on my sportive experience in competitions.	5	4	3	2	1
2.	I can consider different alternatives when making an immediate decision in a position in a competition.	5	4	3	2	1
3.	When making a decision before the competition, I can take into account the possible positions of the opponent.	5	4	3	2	1
4.	When making a decision, I consider whether I have other options.	5	4	3	2	1
5.	I am selective when making a decision in a competition.	5	4	3	2	1
6.	I act calmly when making a decision in a position.	5	4	3	2	1
7.	I do not make a decision in a competition without considering all alternatives.	5	4	3	2	1
8.	I am influenced by external factors (e.g., noise, music) when making decisions in competition.	5	4	3	2	1
9.	I find it difficult to make a decision when the opponent is under intense pressure.	5	4	3	2	1
10.	I cannot make a quick decision in a difficult position.	5	4	3	2	1
11.	I have negative thoughts when I have to make serious decisions in the competition.	5	4	3	2	1
12.	Intense spectator pressure affects my decisions in the competition.	5	4	3	2	1
13.	I feel pressure when making decisions in the competition.	5	4	3	2	1
14.	The possibility of failure makes me anxious when making decisions.	5	4	3	2	1
15.	Making a decision in a time-limited situation makes me panic.	5	4	3	2	1

Sporda Etkili Karar Verme Ölçeği (SEKVÖ)

Sporcular karar verme sürecinde farklı şekilde davranış kalıpları sergileyebilirler. Verilen bu kararlar, sporcuların karar verme düzeyinin bir göstergesidir. Bu düzeyi ölçmeyi amaçlayan aşağıdaki ölçek sorularının, doğruluğu ya da yanlışlığı yoktur, size uygunluğu vardır. Aşağıdaki tabloda sporda karar verme sürecinde sahip olunabilecek davranışları ifade eden maddeler yer almaktadır. Lütfen size en uygun olan seçeneği işaretleyiniz. Katkılarınız için teşekkür ederiz.		Kesinlikle Katılıyorum	Katılıyorum	Nötrüm	Katılmıyorum	Kesinlikle Katılmıyorum
1.	Müsabakada, sportif tecrübelerimden faydalanarak karar veririm.	5	4	3	2	1
2.	Müsabakada bir pozisyonda anlık karar alırken farklı alternatifleri düşünebilirim.	5	4	3	2	1
3.	Müsabaka öncesi karar alırken, rakibin olası pozisyonlarını hesaba katabilirim.	5	4	3	2	1
4.	Karar alırken, başka seçeneğim olup olmadığını düşünürüm.	5	4	3	2	1
5.	Müsabakada karar alırken seçici davranırım.	5	4	3	2	1
6.	Bir pozisyonda karar alırken soğukkanlı davranırım.	5	4	3	2	1
7.	Müsabakada tüm alternatifleri göz önüne almadan karar vermem.	5	4	3	2	1
8.	Müsabakada karar verirken, dış etkenlerden (örn: gürültü, müzik) etkilenirim.	5	4	3	2	1
9.	Rakip yoğun baskı yaptığı anda karar vermekte zorlanırım.	5	4	3	2	1
10.	Zor bir pozisyonda hızlı karar veremem.	5	4	3	2	1
11.	Müsabakada almam gereken ciddi kararlarda olumsuz düşüncelere kapılırım.	5	4	3	2	1
12.	Yoğun seyirci baskısı, müsabakadaki kararlarımı etkiler.	5	4	3	2	1
13.	Müsabakada karar verirken üstümde baskı hissederim.	5	4	3	2	1
14.	Karar verirken başarısız olma ihtimali beni telaşlandırır.	5	4	3	2	1
15.	Zamanın kısıtlı olduğu bir durumda karar almak bende panik yaratır.	5	4	3	2	1