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DEVELOPMENT OF ARTIFICIAL INTELLIGENCE AND ROBOT TECHNOLOGY PERCEPTION SCALE[1]

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ABSTRACT

The Artificial Intelligence and Robot Technology Perception Scale is a measurement tool developed to assess people's perception of risk and functionality related to the said technology. 47-item draft form was applied to a total of 460 volunteer participants. Statistical analysis of the data was performed using IBM SPSS Statistics v26.0 and Lisrel 8.80 programs. According to the EFA result, the developed scale consisted of a 4-factor structure and 26 items, and as a result of Principal Component Analysis scale explained 61.10% of the total variance. The fit indices of the scale were examined with CFA and it was determined that the fit indices of 26 items and the 4-factor structure were at a sufficient level. Within the scope of reliability analysis, Cronbach Alpha internal consistency coefficients were calculated and found to be .89 for general function perception and .93 for general risk perception, and the reliability level of the scale was found to be high. In the analysis of the scale's items, it was determined that the items were highly predictive and discriminative.
Upon thorough examination of all statistical data, it has been established that the developed scale is valid and reliable.

Anahtar Kelimeler: Risk Perception, Function Perception, Artificial Intelligence, Robot.

YAPAY ZEKA VE ROBOT TEKNOLOJİSİ ALGI ÖLÇEĞİNİN GELİŞTİRİLMESİ

ÖZET

Yapay Zeka ve Robot Teknolojisi Algı Ölçeği, kişilerin söz konusu teknolojiye ilişkin risk ve işlevsellik algısını değerlendirmek amacıyla geliştirilmiş bir ölçüm aracıdır. 47 madde içeren taslak form, toplamda 460 gönüllü katılımcıya uygulanmıştır. IBM SPSS Statistics v26.0 ve Lisrel 8.80 programları kullanılarak verilerin istatistiksel analizi yapılmıştır. AFA sonucuna göre, geliştirilen ölçeğin 4 faktör yapı ve 26 madde içerdiği belirlenmiş ve Temel Bileşenler Analizi sonucunda ölçeğin toplam varyansın %61.10'unu açıkladığı görülmüştür. Ölçeğin uyum indeksleri DFA ile incelenmiş ve 26 madde ve 4 faktör yapısının uyum indekslerinin yeterli düzeyde olduğu belirlenmiştir. Güvenilirlik analizi kapsamında, Cronbach Alfa iç tutarlılık katsayıları hesaplanmış ve genel işlev algısı için .89, genel risk algısı için ise .93 olduğu ve ölçeğin güvenilirlik düzeyinin yüksek olduğu belirlenmiştir. Geliştirilen ölçeğin madde analizi yapıldığında, maddelerin öngörü gücünün ve ayırt edici düzeylerinin yüksek olduğu belirlenmiştir. Tüm istatistiksel veriler incelendiğinde, geliştirilen ölçeğin hem geçerli hem de güvenilir olduğu tespit edilmiştir.

Keywords: Risk Algısı, İşlev Algısı, Yapay Zeka, Robot.

[1] This article is based on a part of the PhD thesis entitled “A Sociological Study on the Perception of Artificial Intelligence and Robotic Technology” preparing by Meltem Toksoy Çağal, at Bolu Abant İzzet Baysal University, Department of Sociology, Bolu, Turkey,

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INTRODUCTION

Artificial intelligence (AI) refers to computer systems capable of perceiving, reasoning, and occasionally acquiring knowledge to act in alignment with their observations or objectives (PricewaterhouseCoopers [PWC], 2018). Nowadays, AI has applications such as digital assistants, facial recognition, language processing, and these applications are distributed in areas such as transportation and logistics, financial, security, law, as well as health, education and other public and personal services (PWC, 2018). AI, which has proven prosperous in numerous tasks traditionally performed by humans. AI finds application across various domains such as disease diagnosis, translation services, and customer support, with its adoption steadily rising daily (Wilson & Daugherty, 2018). The robots (Özfirat, 2009, p.413) which are part of the AI system in terms of artificial neural networks, expert systems, problem solving, and genetic algorithms are differ from artificial intelligence applications that they have bodies (Say, 2020, p.120). Just as computers have become widespread, robots have moved beyond the industrial sector and begun to proliferate in daily life (Harris, 2002). Moreover, it is becoming cheaper and more accessible daily (Cincioğlu, Şişman & Yaman, 2015, p.43). Robots appear to be integrating into the everyday lives of people through tasks such as constructing machines, celaning (Hockstein, Gourin, Faust & Terris, 2007, p.113).

Witnessing the swift advancement of artificial intelligence and robot technology, today's societies (Unesco & Comest, 2019, p.3) will face great problems both on the basis of individuals and on the basis of the state or institutions if they cannot keep up with this rapid change (Öztemel, 2020, p.77). It is observed that this technological progress will yield both favorable and unfavorable impacts on the social framework (Anderson, Rainie, & Luchsinger, 2018; Frank et al., 2019). It is mentioned that the social impacts of the technology in question, which have become a part of the social structure due to their widespread use, will increasingly persist in the coming years. Considering this situation and the emergence of questions about the social issues caused by this technology, its development has now entered the research domain of sociology (Mlynar, Alavi, Verma & Cantoni, 2018). It is noted that artificial intelligence and robots are currently undertaking a wide array of tasks, encompassing roles traditionally held by soldiers, journalists, drivers, physicians, bankers, nurses, and even attorneys (Oberson, 2017, p. 247). This situation brings about various discussions, with positive expectations on one hand and deep concerns on the other (Graetz & Michaels, 2018, p.753). In this context, research has been intensified on the risks of AI and robot technology as well as its functions which is the opposite thesis.

The definition of risk cannot be made clearly (Williams & Narendran, 1999) because the value judgments of societies are different, and the content of risk is constantly diversifying and changing (Furedi, 2001). However, it is generally known that losses and the uncertainties of these losses are included in the structure of risk (Williams & Narendran, 1999). Ulrich Beck (1992). The risk phenomenon has been theorized under the title "Risk Society" (Boudia & Jas, 2007, s.317). Beck stated that risks are associated with the rise of industrial society. Additionally, Beck emphasized that risks arise from conscious decisions made by individuals or societies (Jarvis, 2007). Beck pointed out that while technology can have positive effects on human welfare, it also brings risks (Jarvis, 2007). He defined the late modern period as the world risk society (Beck, 1999a). Beck has stated that societies have always faced risks. The risks in the early periods were external risks such as earthquakes, storms, and droughts (Giddens, 2012). It has been emphasized that the risks in the later periods were not coming from outside but were manufactured by humans (Burgess, Wardman, & Mythen, 2018). The risks that people take with their own decisions are personal risks. Risks that threaten all humanity are global risks. Global risks are not limited to a single geography and reach everywhere (Beck, 2019, s. 357). Humanity is currently faced with a range of global risks created by scientific and technological activities (Boudia & Jas, 2007). Risk is generally the realization or probability of negative consequences, and the way in which the risk is defined differs according to personal, social or cultural characteristics (Pligt, 1998, p.1). For instance, Beck considers Genetically Modified Organisms (GMOs) developed with technology a risk for some people, while for others, the person who brings up GMO-containing food is perceived as the risk (Beck, 1999b, s.38-40). Advancements in artificial intelligence and robotics bring along undesirable social impacts. It causes societies and individuals to confront new risks (Hagerty & Rubinov, 2019). The changes brought about by artificial intelligence and robotics technologies raise risks such as prejudice, discrimination, increased surveillance, loss of privacy, data ownership, equality, alienation, deskilling, job loss, security, social disconnection, and environmental destruction Unesco & Comest, 2019; Brussevich 2018; Broadbent, 2017).

Function or functionality is the set of activities necessary to meet the needs of the system or systems (Rocher, 1975, p.40). It is the state of meeting the needs of individuals and societies of parts or elements in the society (Gönç- Şavran, 2011, p.6). In functionalism, the significance of the components within the system is determined by the functions they fulfill for the system (Swingewood, 1998).

From the functionalist perspective, every aspect of society, including its norms, values, and institutions, contributes to the overall functioning and well-being of the social system. The parts are functional as long as they meet the needs and ensure continuity (Gönç-Şavran, 2011). R. Merton expressed criticism towards the assumptions of functional unity, indispensability and functional universality (Chaudhry & Venugopal, 2004, p. 57). Functional unity posits that standardized communal and cultural beliefs or applications serve a functional aim for all members of society. Functional unity, as a sociological concept, indeed posits that standardized social and cultural beliefs or practices serve a functional purpose for all members of society. This perspective is rooted in functionalism, a theoretical framework in sociology that views society as a complex system whose parts work together to promote stability and cohesion. However, Merton argues that this is not feasible in modern societies and may only hold true for primitive societies (Ritzer, 2011). Merton highlighted that modern societies comprise groups with diverse structures, and what benefits one group may be detrimental to another (Chaudhry & Venugopal, 2004, s.57). Merton pointed out that there is no positive function for every structure or belief (Ritzer, 2011, p.252). In other words, some may be dysfunctional and some other may be nonfunctional as stated by Merton (Merton, 1968). Additionally, Merton distinguished between manifest function and latent function (Merton, 1968). Latent function is unintended and unrecognized while manifest function is known to everyone (Chaudhry & Venugopal, 2004, p.55). Latent functions can be beneficial as well as harmful (OpenStax, 2012). The utilization of AI and robotics technology in various fields such as education, health, defense, agriculture, and space exploration demonstrates its functionality within the social structure. An example application has been suggested that "Earth AI" would be useful in addressing issues such as agriculture, climate change, or biodiversity (Heiner & Nguyen, 2018). The technology in question will provide people with fast service. AI-supported education will help teachers provide more beneficial education to children (Executıve Offıce of The Presıdent, 2016). In this context, elements such as providing savings and convenience can be considered functionally significant for the technology in question.

It is known that as technologies develop and are renewed, people's perceptions about the subject may change in line with their needs, expectations, concerns, fears or concerns. Perception is described as the process by which individuals attribute significance to objects and occurrences in their surroundings (Şimşek et al., 2007). The perception process is influenced by a multitude of factors, with the most basic being the individual's unique characteristics (Şimşek et al., 2007, p.94). Risk is subjective in nature because risk perceptions differ among individuals (Williams & Narendran, 1999, p.104). Risk perception, which is a socially constructed reality, is related to discourses, that is, it is relative (Griner, 2002, pp. 151-153). In other words risk perception refers to how individuals make sense of dangerous or risky situations, how they meet, what they think and what their judgment is (Özkan, 2005, p.33). Function perception is the function that an element in the system performs or is thought to perform (perceived) in a positive way (OpenStax, 2012).

The perception of artificial intelligence function is defined as meeting the needs of society and individuals and being accepted as useful. Artificial intelligence risk perception is defined as the fear and anxiety that the use of this technology creates in societies and individuals. It is the evaluation of the good or bad results that are thought to be caused by artificial intelligence and robots, shaping the perception of risk and function, according to individuals. Artificial Intelligence and Robotic Technology Perception Scale items include individuals' perceptions of the risks and functions of using this technology.

MATERIALS and METHODS

The Objective and Significance of the Research

The objective of this search is to create a measurement instrument with demonstrated validity and reliability, intended for assessing individuals' perceptions regarding both the functionality and risks associated with artificial intelligence and robotics technology. The problem of the research is: "Does the Artificial Intelligence and Robotics Technology Perception Scale developed for individuals provide valid and reliable measurement?"

The literature review reveals a notable absence of existing measurement tools designed to evaluate perceptions concerning artificial intelligence and robotics technology. In this context, there is a need for the improving of a measure tool related to the subject. The significance of this research lies in the creation of a measurement tool with established validity and reliability, aimed at assessing individuals' perceptions of both the risks and functionality associated with AI and robotics technology. Moreover, it is expected that this study will contribute to filling a void in the current literature. The data obtained from this study is important as it will enable new researches and shed light on the sociology literature.

Study Constraints:

This research is limited to the characteristics measured by the Artificial Intelligence and Robotics Technology Perception Scale.

This research is limited to 460 participants.

Assumptions of the Study:

It is assumed that the participants in the study completed the scales sincerely and in line with the research topic.

It was assumed that the questions used during the research were sufficient for data collection.

Study Group

Participants from various demographic structures were recruited to ensure the validity of the scale in different groups. In this context in this study, since it was aimed to develop a scale, individuals of different ages, occupations, education and gender, living in large or small cities, formed the research group within the scope of exploratory and confirmatory factor analysis. First, 238 volunteer participants were reached at the rate of 5 times the number of items for EFA. Secondly, 222 volunteer participants with different qualifications were reached for CFA. In two separate analyzes, two separate groups were studied, in other words, the study groups of both stages consisted of different people. The age range of the people in the EFA group was between 18-61 years, with 141 (59.2%) females and 97 (40.8%) males, with an average age of 35.68 years (±9.12). The age range of the people in the CFA group was between 18-61 years, with 117 (52.7%) females and 105 (47.3%) males, with a mean age of 33.81 (±9.29) years.

Instruments for Data Gathering

In this research, data were gathered using the "Personal Information Form" (PIF) and "Artificial Intelligence and Robotic Technology Perception Scale" created by the searcher. PIF is an information form created to determine some population statistics info of the volunteers participator in the research. This form included questions containing demographic information about education and income level, profession, city, age and gender. There are also questions such as the perceived level of knowledge regarding the technology in question and the status of following the developments. The Artificial Intelligence and Robotic Technology Perception Scale, developed by the researcher, is a 5-point Likert-type scale comprising 26 items. The scale measures the perception of risk and function towards AI and robotics.

Data Collection

The swift advancement of AI and robotics technology and its inclusion in social life necessitated the proliferation and diversification of social research in this field, and it has been determined that there is a limited scale in the relevant literature. The stages in the literature (Şahin & Boztunç-Öztürk, 2018, p.191; Karakoç & Dönmez, 2014, p.41, 42; Rust & Golombok, 1997) were used while creating and developing scale items. In line with the determined purpose, an in-depth research was carried out by examining the books, journals, articles, theses and papers related to the subject in the literature, and a draft form was prepared in line with the information obtained. This draft form was examined by specialist lecturers from different departments of different universities. After receiving specialist opinion, some items were taken out from the draft and a 45-item trial form was created by changing some items. Scope validity relies on obtaining objective results, emphasizing the importance of both the quality and quantity of experts. Specifically, the ideal ratio of experts should range from 5 to 40 (Ayre ve Scally, 2014). This aspect has been taken into account in the scale study. In order to decide on the content validity of this design form, it was presented to the specialist opinion again. For this, a group of field specialists consisting of 4 specialists from the Department of Sociology, 1 from the Measurement and Evaluation Department, 3 from the Guidance and Psychological Counseling Department, 2 from the Psychology Department, 1 from the Department of Social Studies Education, and 1 from the Turkish Language Department, was formed. Following this, validity indices for the items as well as content validity rates were computed based on feedback received from specialists. The 47-item scale, which was finalized in accordance with the specialist opinion, was made ready for application.

It was given importance to make each item in the item pool consisting of 47 items simple and comprehensible, as in the literature (Karakoç & Dönmez, 2014, p.41). Artificial intelligence and robot technology perception scale trial form was designed in Likert type, which can express 5 different thoughts. "Strongly Disagree", "Agree", "Undecided", "Agree" and "Strongly Agree" options were presented to the volunteers and they were asked to tick one of these options. A pilot study was conducted on 15 volunteer participators who have the potential to represent the target audience so as to receive take feedback on the understandability of the items in the AI & R. Perception Scale and the application time of the scale. Afterwards, the volunteer participators were discussed about the items and their opinions on the clarity of the items were taken, and it was determined that no change was needed. The scale trial form was administered to a total of 460 volunteer participants.

Analysis of Data

The objective purpose of this study was to create a scale. As a result, information was gathered to perform both EFA and CFA. In the research, the data obtained from the statistical analysis of Artificial Intelligence and Robotic Technology Perception Scale were entered into the Microsoft Office Excel program in computer environment and Lisrel 8.80, IBM SPSS Statistics and v26.0 package were benefited. Both EFA and CFA was benefited for construct validity, and Cronbach Alpha Internal Consistency Coefficient technique was benefited for reliability analysis. To calculate the mean, one first needs the individual scores for each item on the scale for both the upper and lower 27% groups. After getting these scores, the average of each group is found. Then, the means of the upper and lower groups are compared for each scale item to examine the difference.The predictive power and distinctiveness levels of the total scores of the items of the scale were determined using the Independent Sample t-Test, and the difference between the averages of the 27% upper and lower groups for each scale item was examined.

RESULTS

Findings Obtained in Scale Development Scope

In the part of consequences acquired within the scope of scale development, the results for the content validity, construct validity, reliability analysis and item analysis of the developed scale are presented.

Scope Validity of the Scale

Scope validity is a measurement used to determine whether the measurement instrument covers all aspects of the intended subject or concept. In other words, it's an analysis of the breadth and depth of the measurement instrument (Ayre & Scally, 2014). For assessing the scope validity of the items in the scale, of qualitative data obtained in accordance with the opinions of experts, CVR and CVI were calculated. Thus, qualitative data has been transformed into quantitative data. For this process, CVR was calculated and followed by CVI. First of all, the Lawshe technique (Yurdugül, 2005), in which the item is suitable, the item is suitable but the item should be corrected and the item removed, was used to defined the content validity of the scale to be developed, and the control forms with the ratings were distributed to a group of 12 people including different field specialists. CVR is computed by subtracting one from the proportion of specialists who selected the option "The item is appropriate" about the items in the scale to the half of the all of specialists who gave their opinion on the item (Yurdugül, 2005, Ayre & Scally, 2014; Lawshe, 1975), taking into account the calculations made by Lawshe (1975), with the significance level of α=.05 and the content validity criterion (CVR) value of 12 specialists was .56 . While the content validity rates of the items in the scale, except for the 22nd, 31st, 32nd, 33rd, 36th and 37th items, were between 1 and .67, the content validity rate of the six items was lower than the minimum value. These six items were included in the scale in line with the regulations made by the specialists and the item count was raised from 45 to 47. When the CVI (Yeşilyurt & Çapraz, 2018) value obtained by taking the average of the CVR values, it was determined that the CVI value was greater than the CVR value, and from this point, it can be stated that the content validity of the items is statistically significant. After all the steps related to the content validity of the scale were completed, the scale was finalized and the application phase was started.

Construct Validity

The draft scale form was planned according to a 5-point Likert scale and transformed into a form to be applied on volunteers. The mean of each item has calculated by summing up the scores for each response option and then dividing by the total number of responses. In this way, previously mentioned the construct validity of the 47-item scale was determined. The scale was implemented to the participators by sharing the link prepared on Google Form between May-August 2021. Initially, EFA was conducted to obtain data regarding the structure of the factors measured by the measurement tool (Saraçlı, 2011, p.23). In order to analyse with the data set acquired within the extent of EFA, both the sample size should be sufficient and the data should be suitable for factor analysis (Karaman, 2015, p.57). Given the guideline that a sample size of 5 times the number of existing items should be attained for an EFA (Child, 2006), a research group comprising of 238 people was reached for the 57-item draft scale form so as to meet the sample size criteria, and data were obtained from them. In order to assess the suitability of the dataset for factor analysis, by looking at the results of the sample adequacy criterion, the Bartlett Test of Sphericity was performed and the Kaiser-Meyer-Olkin (KMO) value was calculated. Based on the reference that the KMO criterion is excellent when it is above 90, it is good when it is between 80-90 (Kaiser, 1974, p.35), in the analysis of 47 items, the Kaiser-Meyer-Olkin (KMO) value was 90 and the Bartlett sphericity test result was meaningful ($\chi 2=7178.58$, sd= 1081, $p<0.001$). Both the KMO values higher than .60 and the Bartlett test being meaningful indicate that the data are appropriate for factor analyzis and also show that the sample size is enough (Büyüköztürk, 2020, p.136). Considering that the cross-correlation values of the items in the scale in the anti-image matrix should be greater than 50 (Çakır, 2014, p.8), it is understood that the calculated rates are between .64 and .94 and these rates meet the reference criterion. Those with an eigenvalue above 1 are considered as 1 factor (Karaman, 2015, p.33), the number of factors was determined within the extent of EFA using the approach determined by Kaiser (1960). The eigenvalue is a measure used in factor analysis to assess the amount of variance explained by each factor. It represents the amount of variance accounted for by that factor. In accordance with this method, the eigenvalue is calculated by summing the squares of the factor loadings for each factor, and the significance of the variance explained by each factor is crucial in calculating the ratio and determining the number of factors. In this context, as the eigenvalue increases, the variance explained by the factor also increases, indicating a linear relationship between them (Patır, 2009, p.71). Considering the factor analyzis of 47 items, it was noticed that these items had a 9-factors structure with an eigenvalue major than 1, and the variance value described by this 9-factor structure was 66.41%. Promax rotation technique was used to detect the factor structure of the scale and Principal Components Analysis was applied. The rotation process is applied to reveal a simple structure by simplifying either the rows or columns of the arranged factor loading matrix (Saraçlı, 2011, p.23). First of all, it is determined which rotation operation will beperformed. Therefore, the correlation between factors was examined. And since the factors are thought to be interrelated, oblique rotation, a variant of Promax, was used. A kappa value is calculated in the Promax rotation method, and it is stated that this value is 4 as the best solution for the analysis (Tabachnick & Fidell, 2015). In this research, a kappa value of four was computed.

Items 15 and 21, whose factor loadings were below .30 in the first rotation and the difference between the load values for more than 1 factor was less than .10, were removed from the scale. In the second rotation, the 11th, 18th and 29th items whose factor loadings were below .30 and the difference between the load values in more than 1 factor were less than .10 were removed from the scale. In the third rotation, the 10th, 23rd and 41st items whose factor loadings were below .30 and the difference between the load values in more than 1 factor were less than .10 were taken out of the scale. In the fourth rotation, items 7 and 9, whose factor loadings were below .30 and the difference between load values for more than 1 factor were less than .10, were removed from the scale. In the fifth rotation, the 6th, 8th, 38th and 39th items whose factor loadings were below .30 and the difference between the load values in more than 1 factor were less than .10 were removed from the scale. In the sixth rotation, items 27, 31 and 34, whose factor loadings were below .30 and the difference between the load values for more than 1 factor were less than .10, were removed from the scale. In the seventh rotation, 12th, 13th, 14th and 16th items whose factor loadings were below .30 and the difference between load values in more than 1 factor were less than .10 were removed from the scale. As a result of the rotations, the scale turned into a structure consisting of 26 items with 4 factors. EFA procedures were repeated on the obtained 26-item form. In consequence of the factor analyzis performed for the 26-item form of the Artificial Intelligence and Robotic Technology Perception Scale, KMO (.90) and Bartlett values ($\chi2$=3470.73, sd= 325, $p<0.001$) were found to be appropriate. Information on these values is summarized in Table 1.

Table 1. KMO and Bartlett Sphericity Test chart

Kaiser-Meyer-Olkin (KMO) Sample adequacy		.90
Bartlett Significance Test	Approximate chi-square	3470.73
	Degrees of Freedom	325
	Significance Level	.00

It was determined that the cross-correlation of the scale items in the anti-image matrix took values ranging between .83 and .94 and was sufficiently large above .50. When the table of common variances (Table 2) is investigated, it is indicated that the common variance values vary between .50 and .78 and meet the .50 criterion.

Tablo 2. Common Variances table (Communalities)

Number	Scale Items	Common Variance Value (Extraction)
1	Item 1	.61
2	Item 2	.59
3	Item 3	.61
4	Item 4	.61
5	Item 5	.50
6	Item 17	.60
7	Item 19	.51
8	Item 20	.67
9	Item 22	.63
10	Item 24	.78
11	Item 25	.63
12	Item 26	.58
13	Item 28	.50
14	Item 30	.58
15	Item 32	.70
16	Item 33	.56
17	Item 35	.63

18	Item 36	.63
19	Item 37	.58
20	Item 40	.68
21	Item 42	.76
22	Item 43	.62
23	Item 44	.72
24	Item 45	.72
25	Item 46	.62
26	Item 47	.58

With the 26-item form of the scale, principal components analysis and scree plot were performed and the construction of the scale was to be revealed.

Table 3. Explained Total Variance Table

	Baseline eigenvalues			Loads sum of squares		
	Total	Variance Percentage	Cumulative Percentage	Total	Variance Percentage	Cumulative Percentage
1	7.81	30.05	30.05	7.81	30.05	30.05
2	5.04	19.40	49.44	5.04	19.39	49.44
3	1.55	5.97	55.42	1.55	5.97	55.42
4	1.47	5.68	61.09	1.48	5.68	61.10
5	.93	3.57	64.65			
6	.87	3.33	68.00			
7	.77	3.00	71.00			
8	.72	2.80	73.80			
9	.68	2.61	76.37			
10	.63	2.44	79.00			
11	.58	2.25	81.10			
12	.54	2.10	83.14			
13	.48	1.83	84.97			
14	.47	1.80	86.77			
15	.45	1.71	88.49			
16	.40	1.52	90.00			
17	.36	1.38	92.00			
18	.33	1.21	99.00			
19	.31	1.20	94.00			
20	.30	1.11	95.00			
21	.26	1.00	96.00			
22	.25	.96	97.00			
23	.24	.92	98.00			
24	.21	.80	99.00			
25	.19	.73	99.33			
26	.17	.66	100.00			

The explained total variance was shown in Table 3. Considering the result of Principal Component Analyzis, a 4-factors construction having an eigenvalue exceeding than 1 was obtained, which describes 61.10% of the total variance. It is accepted that the upwards of the rates of varience, the powerfuler the factor structure of the scale (Tavşancıl & Keser, 2002, p.87). It was determined that the first factor had 7.81 eigen value and 30.05% variance, the second factor had 5.04 eigen value and 19.40% variance, the third factor had 1.55 eigen value and 5.97% variance, and the fourth factor had 5.68% variance with 1.48 eigenvalue. This supports the view that the all variance clarified by a factor should not be fewer than 5% (DeVellis, 2014).

Looking at Figure 1, it is seen that the scree plot of the eigen value also indicates four factors. The scree plot is a chart used to identify the dominant factors when determining the number of factors in EFA. (Koçak, Çokluk & Kayri, 2016, p.336). As shown in the graph, the eigenvalues are plotted on the vertical axis, while the number of factors is represented on the horizontal axis. From this point of view, the point where the eigenvalue drops below 1 indicates the number of factors.

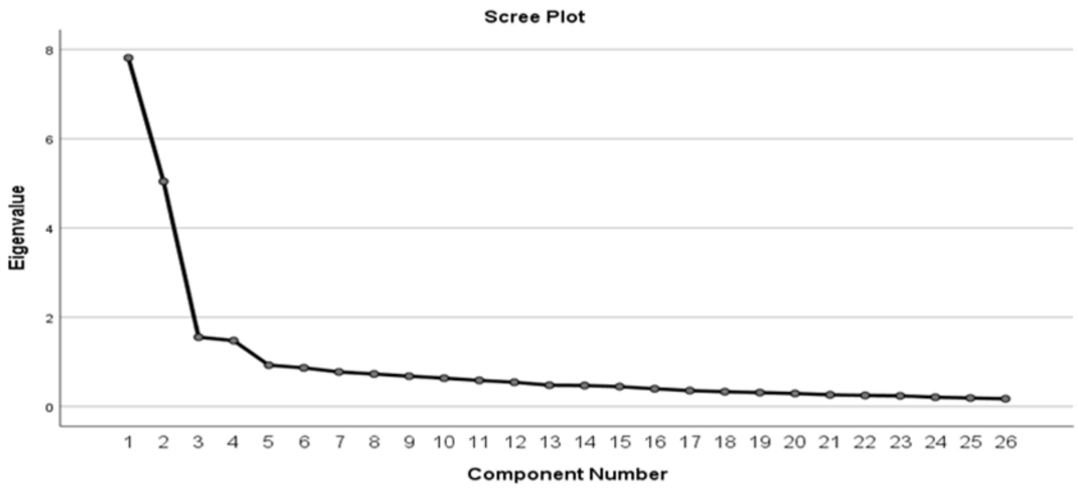

Figure 1. Scree Plot

Based on the result obtained as a outcome of the EFA process, the numbers of the scale items were readjusted, and the results are as follows when the item and distribution loads of the 26-item final version of the AI & R. Perception Scale in Table 4 were examined.

Table 4. Item and Distribution Loads of AI & R. Perception Perception Scale

Scale Item numbers	Factor Loads			
	1	2	3	4
M1	.79			
M2	.76			
M3	.80			
M4	.76			
M5	.57			
M6		.86		
M7		.44		
M8		.55	.37	
M9		.80		
M10		.82		
M11		.80		
M12		.72		
M13			.68	
M14			.72	
M15			.82	
M16			.70	
M17			.68	
M18			.80	
M19			.81	
M20				.72

M21				.89
M22				.83
M23				.84
M24				.82
M25				.72
M26				.56

It is seen that there are five items in the first factor and that the 1st, 2nd, 3rd, 4th and 5th items constitute one dimension and the factor load values of the items replace among .57 and .80. When these items were examined, it was determined that the expectations and benefits of individuals regarding AI & R. technology were related to the social level and it was named as the "Social Function Perception" factor. It is seen that there are 7 items in the second factor and the sixth- seventh- eighth- ninth- tenth- eleventh- twelfthitems constitute one dimension. Item 8 has a sufficient factor load value under the fourth factor. Considering the dimension in which the item has the highest value and considering that the difference between the values of the loads between these dimensions is .10 and above it explains that dimension better (Büyüköztürk, 2020, p.135), item 20 was considered under 3rd factor. It is observed that the factor load values of the scale items ranged between 0.44 and 0.86. When these items were investigated, it was defined that the expectations and benefits of individuals regarding AI & R. technology were related to the individual level and were named as the "Personal Function Perception" factor. It is seen that there are 7 items in the third factor and the 13th, 14th, 15th, 16th, 17th, 18th and 19th items constitute one dimension and it was finalised that numerical values of factor loads of the scale items were among .68 and .82.When these items were examined, it was determined that the concerns and concerns of individuals regarding AI & R. technology were related to the social level and were named as the "Social Risk Perception" factor. It is observed that the fourth factor comprises 7 items, namely the 20th, 21st, 22nd, 23rd, 24th, and 25th items. The 26th items form a dimension, with factor loadings of the scale items ranging from 0.56 to 0.89.When these items were examined, it was determined that the apprehension and concerns of individuals regarding AI & R. technology were related to the individual level and were named as the "Personal Risk Perception" factor.

The scale consisting of 26 items and 4-factor construction from the EFA result was tested with CFA. CFA determines whether there is a sufficient level of connection between the factors and what kind of relationship there is between the variables and the factors. In addition, the independence of the factors among themselves and the level of sufficiency in explaining the model of the factors are tested with CFA (Erkorkmaz, Etikan, Demir, Özdamar, & Sanisoğlu, 2013, p. 211). According to the construction acquired as a result of EFA, a Path Diagram was created through the Lisrel 8.80 program. In Table 5, the model fit index acquired as a result of the DFA process is summarized.

Table 5. Model Fit Indices Obtained from CFA

χ^2/sd	GFI	AGFI	CFI	NFI	NNFI	IFI	RMSEA	SRMR	PNFI	PGFI
3.27	.75	.70	.93	.92	.91	.92	.10	.07	.80	.63

When the correction index recommended in line with the program is investigated, it was noted that there was a relationship between the errors of items M17 and M18, as well as items M20 and M21. So as to improve the model, the corrections recommended by the program were made by taking specialist opinion. Associating the errors between these items made the model significantly more compatible with the data. Table 6 displays the acceptable and perfect fit values (Hu & Bentler, 1999) for the fit indices examined to assess the adequacy of the tested model, along with the fit index scores obtained from CFA following adjustments.

Table 6. Perfect and Acceptable Fit Values for Fit Indices Examined in the Study and Fit Index Values Obtained from CFA

Examined Fit Index	**Perfect Fit Standards**	**Acceptable Fit Standards**	**Obtained Fit Index**	**Result**
χ^2/sd	$0 \leq \chi^2/sd \leq 2$	$2 \leq \chi^2/sd \leq 3$	2.39	Acceptable Fit
GFI	.95 ≤ GFI ≤ 1.00	.90 ≤ GFI ≤ 95	.80	Close to Acceptable Fit Criterion
AGFI	.90 ≤ AGFI ≤ 1.00	.85 ≤ AGFI ≤ .90	.76	Close to Acceptable Fit Criterion
CFI	.95 ≤ CFI ≤ 1.00	.90 ≤ CFI ≤ .95	.95	Perfect Fit
NFI	.95 ≤ NFI ≤ 1.00	.90 ≤ NFI ≤ .95	.91	Acceptable Fit
NNFI	.95 ≤ NNFI ≤ 1.00	.90 ≤ NNFI ≤ .95	.94	Acceptable Fit
IFI	.95 ≤ IFI ≤ 1.00	.90 ≤ IFI ≤ .95	.95	Perfect Fit
RMSEA	.00 ≤ RMSEA ≤ .05	.05 ≤ RMSEA ≤ .08	.08	Acceptable Fit
SRMR	.00 ≤ SRMR ≤ .05	.05 ≤ SRMR ≤ .10	.07	Acceptable Fit
PNFI	.95 ≤ PNFI ≤ 1.00	.50 ≤ PNFI ≤ .95	.82	Acceptable Fit
PGFI	.95 ≤ PGFI ≤ 1.00	.50 ≤ PGFI ≤ .95	.66	Acceptable Fit

χ^2=694.14, *sd*=290

At what time the Path Diagram in Figure 2 is analyzed it is understood that the factor load values of the items vary among .32 and .91, what this, these values are above .30, they meet this criterion and the numerical values of the loads of the item factors are at a good level.

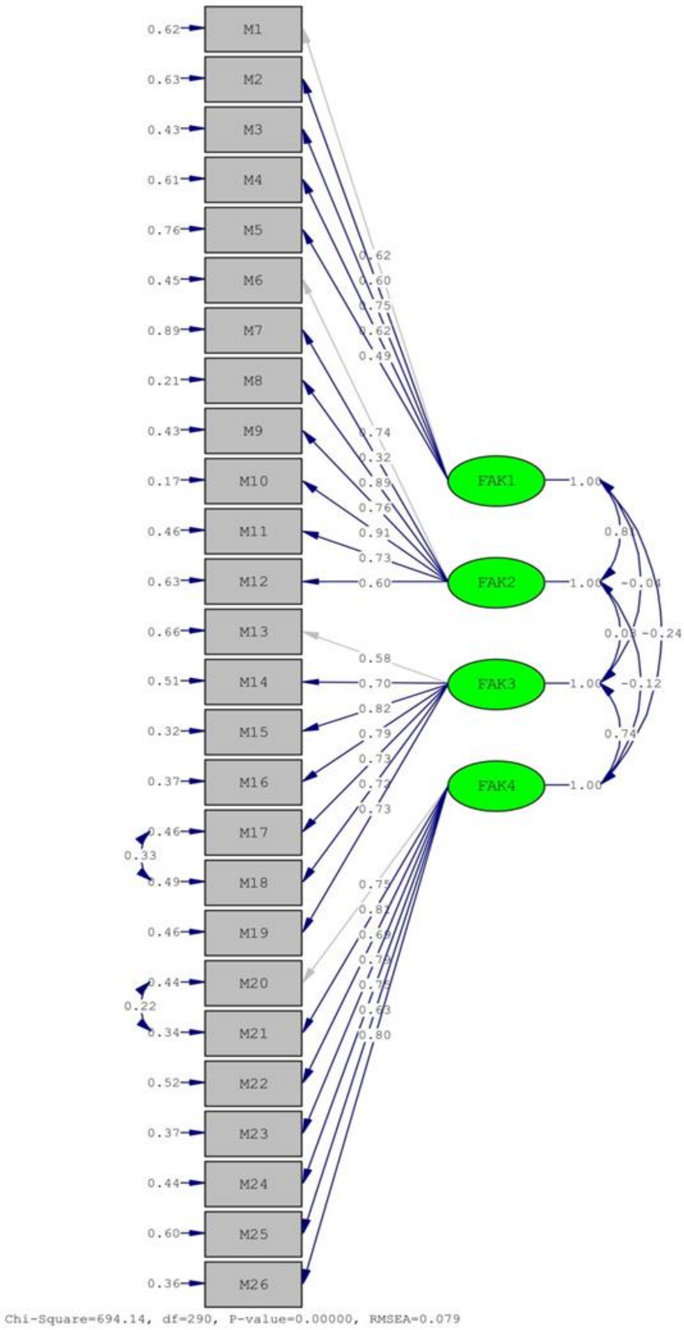

Figure 2. Path Diagram and Factor Loads for Artificial Intelligence and Robotics Perception Scale

At what time Table 6 and Figure 2 are analyzed it was determined that the chi-square and degrees of freedom values gotten as a outcome of CFA are $\chi2$=694.14, sd=290. The $\chi2$/sd ratio was used instead of the chi-square statistic, because this statistic is immediately affected by the size of the sample (Çapık, 2014, p.200). In this direction, it is seen that it is obtained as $\chi2$/sd=2.39. When considering the fit criterion values, a ratio falling between 2 and 3 indicates an acceptable fit. RMSEA value, which is a measurement of approximative harmony in the main mass (Çapık, 2014, p.200) was found as 08 which is in the acceptable range of values . As the SRMR value, which means the square root of the standardized mean squared error, approaches zero, it is understood that the tested model shows better fit (Çapık, 2014, p.200). SRMR value. It can be said that it is in the acceptable range of values as 07.
It was seen that the GFI value was .80 and the AGFI value, which is an adjusted GFI value considering the sample size (Sümer, 2000, p.60), was .76. PGFI is the corrected version of GFI. It can be said that this value is acceptable as .66. CFI and IFI were determined as .95. It can be said that these values correspond to perfect fit. It was seen that the NFI value was .91 and the NNFI value was .94, which

was among the acceptable fit criteria. It can be stated that the PNFI value, which is the corrected version of NFI, is acceptable as .82. Considering the acceptable and perfect fit criteria, it is seen that the fit level of the 4-factor version acquried of CFA is sufficient. It can be said that the four factors and the 26-item model obtained from the sample fit well with the data and were confirmed in accordance with to the fit statistics obtained from the CFA.

Credibility Analyzis of the Scale

Cronbach alpha internal consistency coefficient technic, which is widely used in the context of reliability analysis of AI and Robotic Technology Perception Scale, was used. Seventh table indicates the outcomes acquired from the credibility analyzis.

Table 7. Credibility Analysis Results of AI and Robotics Perception Scale

Factor	Item Number	Internal Consistency (Cronbach Alfa)	
		EFA Group	CFA Group
Perception of Social Functioning	5	.80	.74
Perception of Personal Functioning	7	.87	.86
Perception of Social Risk	7	.88	.89
Personal Risk Perception	7	.91	.90
Total Function Perception	12	**.89**	**.89**
Total Risk Perception	14	**.93**	**.93**

The internal consistency of the 26-item scale was assessed in both the samples subjected to EFA and CFA. Reliability analysis for the EFA group of the scale was applied using 238 data. Cronbach's alpha internal consistency coefficients in the EFA group were found to be .80 for the "Perception of Social Functioning" factor, .87 for the "Perception of Personal Functioning" factor, .88 for the "Perception of Social Risk" factor, and .91 for the "Personal Perception of Risk" factor. Reliability analysis was also conducted for the CFA group of the scale using data from 222 participants. The Cronbach alpha internal consistency coefficients which discovered for the subscales in the CFA group were .74 for the “Perception of Social Function” factor, .86 for the “Perception of Personal Functioning” factor, .89 for the “Perception of Social Risk” factor, and .90 for “Personal Risk Perception”. The internal consistency coefficients of the scale items covering total function perception and total risk perception were examined separately for both EFA and CFA participators and according to the results, the Cronbach's alpha internal consistency coefficients of the total function perception scale items were discovered to be .89 for both. When the Cronbach alpha internal consistency coefficient values were inspected, it was identified that the total risk perception scale items were .93 for both groups. When Table 7 is examined based on the criterion that the Cronbach's alpha internal consistency coefficient, which indicates the total credibility of a scale, should be .70 and above (Kılıç, 2016, p.47), it is observed that the scale items and sub-dimensions surpass this criterion, with values exceeding .70.

Item Analyzis of the Scale

In this section, the predictive power and discrimination levels of the total score of the AI & Robotic Technology Perception Scale were determined, and the relevant statistics are summarized in Table 8.

Table 8. Item Analysis Results for AI & R. Perception Scale

Scale Items	Adjusted Item Total Correlation	Average	Mean	Standard Deviation	*T*
Item 1	.58	$Upper_{\%27}$	4.85	.40	15.20**

		Lower$_{\%27}$	3.11	1.20	
Item 2	.58	Upper$_{\%27}$	4.89	.32	11.47**
		Lower $_{\%27}$	3.66	1.15	
Item 3	.66	Upper$_{\%27}$	4.77	.57	16.71**
		Lower$_{\%27}$	2.62	1.31	
Item 4	.60	Upper$_{\%27}$	4.31	1.05	16.78**
		Lower$_{\%27}$	1.98	1.13	
Item 5	.42	Upper$_{\%27}$	4.77	.64	10.11**
		Lower$_{\%27}$	3.34	1.45	
Item 6	.62	Upper$_{\%27}$	4.88	.43	13.49**
		Lower$_{\%27}$	3.11	1.39	
Item 7	.40	Upper$_{\%27}$	4.25	1.18	11.38**
		Lower$_{\%27}$	2.49	1.25	
Item 8	.73	Upper$_{\%27}$	4.80	.44	22.15**
		Lower$_{\%27}$	2.60	1.01	
Item 9	.71	Upper$_{\%27}$	4.72	.52	15.45**
		Lower$_{\%27}$	3.02	1.11	
Item 10	.80	Upper$_{\%27}$	4.88	.33	19.53**
		Lower$_{\%27}$	2.94	1.05	
Item 11	.69	Upper$_{\%27}$	4.75	.52	18.32**
		Lower$_{\%27}$	2.89	1.01	
Item 12	.59	Upper$_{\%27}$	4.85	.44	12.16**
		Lower$_{\%27}$	3.42	1.23	
Item 13	.56	Upper$_{\%27}$	4.77	.58	14.97**
		Lower$_{\%27}$	3.14	1.07	
Item 14	.64	Upper$_{\%27}$	4.74	.57	15.54**
		Lower$_{\%27}$	2.96	1.14	
Item 15	.75	Upper$_{\%27}$	4.78	.52	17.11**
		Lower$_{\%27}$	2.98	1.06	
Item 16	.68	Upper$_{\%27}$	4.80	.57	15.11**
		Lower$_{\%27}$	3.17	1.06	
Item 17	.72	Upper$_{\%27}$	4.88	.33	21.77**
		Lower$_{\%27}$	2.72	1.06	
Item 18	.70	Upper$_{\%27}$	4.86	.47	18.77**
		Lower$_{\%27}$	2.84	1.11	
Item 19	.64	Upper$_{\%27}$	4.83	.47	16.87**
		Lower$_{\%27}$	2.98	1.13	
Item 20	.75	Upper$_{\%27}$	4.85	.50	23.65**
		Lower$_{\%27}$	2.31	1.09	
Item 21	.80	Upper$_{\%27}$	4.76	.58	25.32**
		Lower$_{\%27}$	2.14	.99	
Item 22	.68	Upper$_{\%27}$	4.44	.98	18.70**

		Lower%27	2.05	1.04	
Item 23	.75	Upper%27	4.83	.51	26.01**
		Lower%27	2.26	.98	
Item 24	.75	Upper%27	4.64	.76	24.93**
		Lower%27	2.00	.90	
Item 25	.62	Upper%27	4.65	.86	18.55**
		Lower%27	2.27	1.14	
Item 26	.71	Upper%27	4.86	.37	23.10**
		Lower%27	2.58	1.04	

**p<.001

When discussing the item-total correlation, it's important to note that a high positive value, typically .30 and above, indicates adequate distinctiveness for the item (Büyüköztürk, 2020, p.183). This situation highlights the importance of item-total correlation in assessing the distinctiveness of individual items in a scale or questionnaire. As can be seen a high positive correlation, typically above .30, indicates that the item is sufficiently distinct and contributes meaningfully to the overall measurement construct. Furthermore, a negative correlation suggests that the item may not be appropriately aligned with the construct being measured.

The item-total correlation explaining the connection among the item and the total score of the scale is introduced in table number 8, and it is observed that the values in this table range from .42 to .80 and meet the .30 criterion. So as to define the grade of competence in distinguishing individuals in terms of the characteristics evaluated by the 26 items in the scale, item analyzis was aplied by looking at the distinction among the averages of the upper and lower groups in the 27% segment. The scores of the participators whose total scores were calculated were ordered from the largest to the smallest. 124 individuals, comprising the top 27% of the 460-person group, were identified as the upper group, and 124 people, constituting the last 27%, were determined as the subgroup. The difference between the means of the lower and upper 27% groups was evaluated using independent sample t-tests for each scale item. This provides a measure of central tendency, indicating where the bulk of the data points lie. Looking at Table 8, it is understood that the t-values of the item scores of the 27% subgroups and 27% upper groups are between 10.11 (p<.001) and 26.01 (p<.001) and all of them are significant.

DISCUSSION

Since artificial intelligence and robot technology are rapidly progressing and their effects are beginning to be seen in people's social and individual lives, the "AI & R. Technology Perception Scale" has been developed to measure people's perceptions of developments in AI and robotics. Existing literature reviews reveal a scarcity of research on this particular topic and it has been seen that there is a need to develop a new measurement tool for how individuals who experience this technological development more and more every day add meaning to artificial intelligence and robot technology. Developing a measurement tool with proven reliability and validity to measure individuals' perceptions of artificial intelligence and robots, and bringing them to the sociology literature underscores the significance of the study. AI & R. Perception Scale is based on risk perception and function perception. In this context, fear or anxiety caused by the disadvantages that may occur as a result of the use of AI and robots, the risk perception of AI and robot technology, the situation of meeting the expectations and needs of the individuals and benefiting from the advantages that may arise as a result of the use of AI and robots, AI and robot technology function perception were described.

While developing a scale, there are some stages to be followed, and the developed scale must meet the criteria of validity and reliability. In this context, first of all, the content and construct validity of the AI & R. Perception Scale was tested within the content of validity. For content validity, the draft scale form was submitted to specialist opinion, and CVI and CVR values were calculated. It was determined that six items of this form were lower than the reference range (.56) with CVR , these items were corrected by taking professional view, and a 47-item scale form was arranged by adding items to the scale. For the purpose of finalize the items in the scale form, a pilot study was conducted on 15 volunteer participators who have the potential to represent the target group, and it was determined that no changes were needed. The fact that no changes were required as a result of the pilot study reveals that the scale items effectively reflect the intended structures. After the scale is finalized the form was applied to the volunteer participators for construct validity. Both CFA and EFA were done to define the construct validity of the scale. Promax rotation was used to define the factor structure of the 47-item draft. Consequently, this process, the number of factors of the scale became 4 and the number of items became 26. According to the EFA procedure, the scale's KMO (.90) and Bartlett values ($\chi2$=3470.73, sd= 325, p<0.001) were found to be appropriate.The items collected in four factors and the theoretical framework regarding the contents of these items were named as Social Function Perception, Social Risk Perception, Personal Function Perception and Personal Risk Perception. After the EFA process, CFA was performed on 26 items and the four-factor structure. Considering the literature (Hu & Bentler, 1999), it was established that the tested model was adequate, with fit indices falling within the range of excellent and acceptable fit values. The fact that the item factor loads are above .30 indicates that the reference criterion is met and the item factor payloads are at a fine level. Considering the results of the fit criteria reached after CFA, it is understood that the fit level of the scale, which consists of 26 items and a four-factor structure, is sufficient. Based on this data, it can be said that the Artificial Intelligence and Robotic Technology Perception Scale ensures construct validity. With regard to dependability scrutiny the internal consistency of the scale items covering the total function and risk perception was tested with the data groups in which EFA and CFA processes were done.

When the numerical ratios belonging to the two groups were examined, it was established that the Cronbach's alpha internal consistency coefficients of the general function perception items were .89 and the Cronbach's alpha internal consistency coefficients of the general risk perception items were .93. A Cronbach's alpha coefficient of .89 for general function perception and .93 for general risk perception indicates high internal consistency reliability for both scales. Essentially, these coefficients suggest that the items within each scale consistently measure the underlying construct they intend to assess. In this case, the items measuring general function perception and general risk perception are reliably tapping into their respective constructs with high consistency. Considering the fact that the Cronbach's alpha internal consistency coefficient (Kılıç, 2016, p.47) is generally accepted as .70 and above, it is understood that AI & R.Perception Scale has a high and adequate level of dependability. Based on this information, it is evaluated that the AI & R. Perception Scale is reliable. When the results of the item analysis are examined, it is noticed that the rectified item-total correlation of the scale is among .42 and .80, and considering the criterion that the values found in the literature should be .30 and above (Büyüköztürk, 2020), it is noticed that the scale meets the .30 criterion. The rectified item-total correlation values falling within the range of .42 to .80, it's evident that the items in the AI & R. Perception Scale are showing a strong correlation with the total score of the scale. This further supports the reliability of the scale, as it indicates that each item is contributing meaningfully to the measurement of AI and risk perception. By the same token, so that define the level of discrimination of the 26 items , the item analysis was made by taking the difference of the group mean of the lower and upper groups in the 27% of the voluntary participators as reference. And all of the t-values for the item score difference were significant. Based on this data, it is seen that each item in the Artificial Intelligence and Robotic Technology Perception Scale is sufficient to distinguish people in terms of the measured feature, in other words, the predictive power and discrimination level of the total score of this scale are high.

RESULT and SUGGESTIONS.

1. The adequacy of the AI and Robotic Technology Perception Scale in terms of content validity, the CVI value was found as .76 in parallel with the feedback and suggestions given by 12 specialists, and it was determined to be adequate in terms of content validity.

2.As a result of the EFA, a 4-factor structure comprising 26 items, each with an eigenvalue exceeding 1, was identified. This structure accounts for 61.10% of the total variance in the data.However, it was concluded that the KMO (.90) and Bartlett values ($\chi2$=3470.73, sd= 325, p<0.001) were significant.

3. In line with the data obtained with CFA, the model consisting of 26 items and 4 factors obtained from EFA was confirmed, and the fit indices obtained with CFA were between acceptable and perfect fit criteria.
4. The four-factor structure of the AI & R. Perception Scale was named as "Perception of Social Function", "Perception of Personal Function", "Perception of Social Risk", and "Perception of Personal Risk".
The items in the scale describe the risk and function perceptions of people towards AI and robot technology.
5. The Cronbach Alpha internal consistence coefficients computed for the AI & R. Perception Scale were found to be greater than .70 for the sub-sizes and the total point, and it was concluded that the Artificial Intelligence and Robot Technology Perception Scale and its sub-dimensions were reliable at a satisfactory level.
6. The distinction among the averages of the 27% lower and upper groups created for the Artificial Intelligence and Robotic Technology Perception Scale was significant for each item, and it was concluded that each item was sufficient to distinguish people in terms of the characteristic it measured.
7. According to the item analyzes of the Artificial Intelligence and Robotic Technology Perception Scale, it was observed that the corrected item-total were in accordance with the criteria in the literature.
As a consequence of all numerical calculations, it has been seen that this scale can detect risk and function perception towards artificial intelligence and robot technology and is a valid and reliable measurement tool in this context. The content of the AI & R. Perception Scale which improved in this study can be expanded by adding new sub-items.

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