Toros Üniversitesi Sosyal Bilimler Dergisi

Negative Attitudes toward Robots Scale: Validity and Reliability of Turkish Version

Robotlara Karşı Negatif Tutumlar Ölçeği: Türkçe Versiyonunun Geçerlilik ve Güvenirliği

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Abstract: *Rapidly developing technology has made great progress in robot design and production. One of the reflections of this vision is the social robots that can communicate. The study of the interaction between robots and people, which increase their visibility in everyday life and business life in many developed countries of the world, is very important in terms of acceptance and efficient production of this technology. To this end, Nomura and colleagues developed the Negative Attitudes towards Robots scale. In this study, it is desired to adapt this scale to Turkish. The data obtained from the students of five universities in Istanbul were investigated through internal consistency coefficient, confirmatory factor analysis, and discriminant validity. As a result of the study, it was observed that the 14 items in the scale were divided into 3 factors. According to the confirmatory factor analysis, the fit index values of the model have acceptable values. Cronbach's alpha internal consistency reliability coefficients were reliable for three subscales, and there was discriminant validity. This study shows that Turkish version of Negative Attitudes toward Robots Scale is a reliable and valid measurement tool regardless of robot type. The creation of a Turkish version of this scale, which measures an important effect in the interaction of human robots, will also open up the work to be done in this area with Turkish samples.*

Keywords: *Attitude, Robot, Technology, Human Robot Interaction*

Öz: *Hızla gelişen teknoloji robot dizaynı ve üretimlerinde büyük bir ivme kaydetmiştir. Bu ivmenin yansımalarından biri de iletişim kurabilen sosyal robotlardır. Hali hazırda dünyanın birçok gelişmiş ülkesinde gündelik yaşamda ve iş yaşamında görünürlüklerini arttıran robotlarla insanlar arasında kurulacak olan etkileşimin incelenmesi, bu teknolojinin kabullenilmesi ve verimli şekilde üretilebilmesi açısından oldukça önemlidir. Bu amaç doğrultusunda, Nomura ve meslektaşları Robotlara Karşı Negatif Tutumlar ölçeğini geliştirmiştir. Bu çalışmada ise bu ölçeğin Türkçeye adaptasyonu yapılmak istenmiştir. İstanbul'da bulunan beş üniversitenin öğrencilerinden elde edilen veri ile iç tutarlılık katsayısı, doğrulayıcı faktör analizi ve ayrışma geçerliliği incelenmiştir. Araştırma sonucunda ölçekte bulunan 14 madde 3 faktöre bölünmüştür. Doğrulayıcı faktör analizi sonucuna göre modelin uyum indeksi kabul edilebilir değerlere sahiptir. Cronbach'ın alfa iç tutarlılık güvenilirlik katsayıları üç alt ölçek için de güvenilirdir ve ayırıcı geçerlilik sağlanmıştır. Bu çalışmayla robot tipine bağlı kalmaksızın Robotlara Karşı Negatif Tutumlar Ölçeği'nin Türkçe versiyonunun güvenilir ve geçerli bir ölçüm*

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aracı olduğunu göstermektedir. İnsan robot etkileşiminde önemli bir etkeni ölçen bu ölçeğin Türkçe versiyonunun oluşturulması bu alanda yapılan çalışmaların Türk örneklemlerle yapılmasının da önünü açacaktır.

Anahtar Kelimeler: *Tutum, Robot, Teknoloji, İnsan Robot Etkileşimi*

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1. INTRODUCTION

Although the history of the concept of "Robot" (Capek, 1920), a Czech word for "compulsory labor", is quite old (Nomura, Suzuki, Kanda, & Kato, 2006); the visibility of robots has increased since the mid-20th century (Ray, Mondada, & Siegwart, 2008). This increase is continuing rapidly. The basic production purpose of the robots is to function as an agent to do work that does not attract people's attention (Takayama, Ju, & Nass, 2008). Given the data of the World Robotic Federation, industrial robots will be produced in 2020, twice as much as in 2017 (IFR, 2017). Foresight on future years suggests that robots will become an important part of people's daily lives (Gates, 2007). It is thought that robots, which can be extended from military production to industrial environments and even domestic use, will do many jobs (Katz & Halpern, 2014). These have already begun to be designed for many jobs such as elderly care (Do, Pham, Sheng, Yang, & Liu, 2018), therapy for autistic children (Richardson, et al., 2018), house cleaning (Santini, 2018) and so on. These jobs are added every year with new ones.

There are some questions about these robots that can even change the life style of society in general (Takayama, et al., 2008). What jobs can robots do, what jobs should be allowed to do for them, and which jobs require collaboration between people and robots? Technological developments will determine how much work robots can do, and we will find out when it's time. However, a clear answer can be given by adding cultural and social explanations as to what jobs robots can be allowed to do and in which jobs they can collaborate with people (Takayama, et al., 2008). In fact, the proper interaction between humans and robots is another challenge that robot designers and developers try to solve (Dario, Guglielmelli, & Laschi, 2001). How much will people accept these robots in their daily lives? What kind of perception do people have about robots, positive or negative (Ray, et al., 2008)? How should the changes be made in the designs so that people can easily adopt the robots (Tsui, Desai, Yanco, Cramer, & Kemper, 2011)? In order to understand these, the suspicions and prejudices of robots should be examined (Tsui, et al., 2011). After they are understood, both engineering and scientific ideas can be produced and applied on how to change prejudices and attitudes in people's minds (Nomura, et al., 2006).

An examination of the relationship between people and robots is very important in terms of the appearance, behavior and social effects of robots (Nomura, Suzuki, Kanda, & Kato, 2005). Taking this precaution into account, Nomura and colleagues (2006) suggested that humans have the same sensitivity to communication with robots as they do with humans, without distinguishing between human and robot (Tsui, et al., 2011). In this line, they developed a psychological scale to measure people's attitudes towards robots which is called as Negative Attitudes toward Robots Scale. This scale can measure the attitudes of people under three factors: negative attitude toward interaction with robots, negative attitude towards social effects of robots, and negative attitude toward emotions interacting with robots. Thus, the high score on this scale indicates that the negative attitude towards robots is high (Nomura, Suzuki, Kanda, & Kato, 2006b).

Based on personal, cultural, or family factors, the individual has an idea and value that is constant and persistent relative to an object, person, institution, or subject and is called as an attitude that affects behavior in this direction (Chaplin, 1999). Attitude is one of the most basic aspects of social psychology (Katz & Halpern, 2014); because when a person's attitude is positively developed, his behavior changes (Fazio, Powell, & Williams, 1989). So, if we understand the individual's attitude towards robots, we can develop it according to our needs and we can make the interaction of the person with the robot more efficient (Erebak & Turgut, 2018).

This scale has been translated into different languages such as Dutch, Mexican, Chinese , German (see, Bartneck, Suzuki, Kanda, & Nomura, 2007), and Portuguese (Piçarra, Giger, Pochwatko, & Gonçalves, 2015). Gender (Nomura, Kanda, Suzuki, & Kato, 2008), age (Nomura, Kanda, Suzuki, & Kato, 2004), culture (Bartneck, et al., 2007), and also the experience of persons with robots (Bartneck, et al., 2008) were found related to NARS (Negative Attitudes toward Robots Scale) results. Nevertheless, there is not enough information about the structural properties of NARS reflected in communities outside the Japanese sample (Piçarra, et al., 2015). Although the power to predict people's behavior against robots is still controversial, it is an effective measure of people's acceptability of robots in general and their attitude towards robots, given the other scales that exist. It is particularly useful because NARS does not assume any particular situation about how the robot will work and how it looks (Piçarra, et al, 2018).

Industrial robots are used in factories already in Turkey. In addition, robots are beginning to be advertised in public spaces recently. Turkey's vision regarding the future and the increasing importance of technology in working life, will further increase the visibility of the robots. In particular, it is worth noting that the increasing use of robots in working life as well as all over the world can show itself in Turkey. Therefore, it is especially necessary for employees to be adapted to robot technology and to accept it. In this respect, translating NARS into Turkish, which measures the attitude towards robots, is important both in terms of enabling employees to improve their attitudes towards robots and in providing research data on the adaptability of robotic technologies to Turkish culture.

2. METHOD

2.1. Preliminary Study

2.1.1. Language Adaptation and Content Validity

The scale was translated into Turkish by the researchers of this study independently of each other. Later, the researchers compared the translations they had made and prepared the items of the scales in reconciliation for the other stages.

In the second stage, English and Turkish items of scale were sent to 11 specialists. The experts scored each item between 1 and 10 (1 = totally inappropriate, 10 = perfectly appropriate), and they gave a translation suggestion if any. These specialists consist of 9 academicians from Psychology and Organizational Behavior departments of universities and 2 experts working in the private sector, one of whom is from technology and other human resources consulting. Experts have provided feedback on the clarity and inclusion of the Turkish translation. The scores from the experts were analyzed by Kendall's W concordance analysis (Kendall's W = 0.426, p <.001). These results show that there is a concordance among the scorers.

In the third stage, the translation suggestions from the specialists were examined, especially the feedbacks on the items which were below 8 points, were taken into consideration. In the final stage, a pilot study was conducted with 50 undergraduate students. Participants were asked to give feedback on items that were difficult to understand. As a result of this work, 0.77 Cronbach’s alpha value was obtained. With feedbacks, arrangements were made on the materials where necessary.

2.2. Main Study

2.2.1. Sample and Procedure

During the spring of 2018, 304 undergraduate students were selected from 5 universities in Istanbul, most of whom were Psychology (N = 134) and Business Administration (N = 94) students. The scales were delivered as paper-based to 290 people and internet-based to 14 people. The average age of participants was 22. While 191 of the participants were female, 111 were male, and 2 were unreported.

2.2.2. Measures

The scales used in this study were scored on a 6-point Likert scale (1 = strongly disagree, 6 = strongly agree).

2.2.2.1. Negative Attitudes toward Robots Scale

This scale measures the degree of attitude that people have about robots in their daily lives. The short name is NARS. It was developed by Nomura and colleagues (2006). The original scale which contains 14 items, is scored in a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). It includes 3 sub-dimensions: negative attitudes toward interaction with robots (NARS interaction), negative attitudes toward social influence of robots (NARS influence), and negative attitudes toward emotions in interaction with robots (NARS emotions). As a result of the study with Japanese participants, Cronbach's alpha value was 0.78 for the first dimension, 0.78 for the second dimension and 0.65 for the third dimension. Nomura et al. (2006) granted permission for the Turkish translation of the scale.

According to the reliability analysis result, the total Cronbach's alpha value of the scale is 0.83 in this study. For sub-dimensions, Cronbach's alpha value was 0.79 for the first dimension, 0.83 for the second dimension and 0.71 for the third dimension.

2.2.2.2. Technological Innovativeness

This five-item scale was developed by Parasuraman and Colby (2001). It measures how far an individual perceives himself as a forefront in technology adoption. This scale, one of the sub-scales that measure the individual's technological readiness, is independent of the other subscales (Parasuraman & Colby, 2001). In the original study, Cronbach's alpha value was 0.83. Aksoz (2016) translated it into Turkish and extracted 1 item to reach Cronbach's alpha value of 0.83. In this study, the Cronbach's alpha value of the 5-item scale was 0.80.

3. RESULTS

3.1. Construct Validity

Confirmatory factor analysis was performed to evaluate construct validity of NARS. Discriminant validity was then tested with correlations between NARS total score and sub-dimensions and technological innovativeness scale. The Kaiser-Meyer-Olkin (KMO) coefficient value of 0.847 was used to determine if the sample needed to perform the factor analysis of the Turkish version of the NARS was sufficient. In addition, the Barlett's Sphericity Test, which was used to determine if the correlation matrix of items was appropriate for factor analysis, showed that the resultant scale is suitable for factor analysis ($\chi 2$ = 1580.179; df = 91; $p <.001$).

3.2. Confirmatory Factor Analysis (CFA)

A three-factor model of NARS was tested with CFA. Before the covariance between error terms was fixed, all observed variables were significantly loaded with appropriate factors (range: 0.35-0.84). However, this model was found to be outside the acceptable range according to the goodness of fit index $\chi 2$ / df = 3.324, CFI = 0.887, GFI = 0.90, RMSEA = 0.88 and SRMR = 0.07. Subsequently, the modification indexes of the model were investigated and the theoretically acceptable error terms were allowed to relate to each other. Accordingly, the error terms of NARS item 7 and 8 have been associated. In addition, item 2 (the word "robot" means nothing to me) has been removed in the dimension of attitudes towards interaction with robots (see Appendix 1). After these corrections suggested by the modification indices and theoretically appropriateness, the model was retested. As can be seen in Figure 1, the variables observed in the model to which the relevant error terms are associated are fitted to the appropriate factors (range: 0.55-0.84). The three-factor structure of Fig. 1 was also found to have more acceptable goodness of fit indices $\chi 2$ / df = 2.835, CFI = 0.924, GFI = 0.922, RMSEA = 0.078 and SRMR = 0.064. It is seen that the three-factor structure of NARS is supported in this study because the ratio of chi-square value to degrees of freedom is smaller than 3 and the compliance indices obtained from confirmatory factor analysis indicate an acceptable fit. As a result, CFA has shown that the factors that constitute latent variables measure observed variables reliably.

3.3. Discriminant Validity

In the context of discriminant validity, while low correlations are needed for unrelated constructs, negative correlation is expected for related but opposite constructs. Theoretically, technological innovativeness emphasizes how one is forefront in following the technology of the individual. Conversely, NARS measures the negative attitude towards robots that are technological products. Therefore, in terms of technological approach, technological innovativeness can be regarded as a contrary construct to NARS. The results of the analysis made in line with this idea, there were weak or moderately significant negative correlations among technological innovativeness and the total score and sub-dimensions of the NARS. Only, the dimension of NARS influence found unrelated to technological innovativeness (see Table 1). These results indicate discriminant validity.

Table 1. The Correlations among Variables

	1	2	3	4	5
1 NARS	-	. 794**	. 895**	. 444**	-. 189**
2 NARS Interaction		-	. 598**	. 098	-.194**
3 NARS Influence			-	.152**	-.097
4 NARS Emotions				-	-.170**
5 Technological Innovativeness					-

**. Correlation is significant at the 0.01 level (2-tailed).

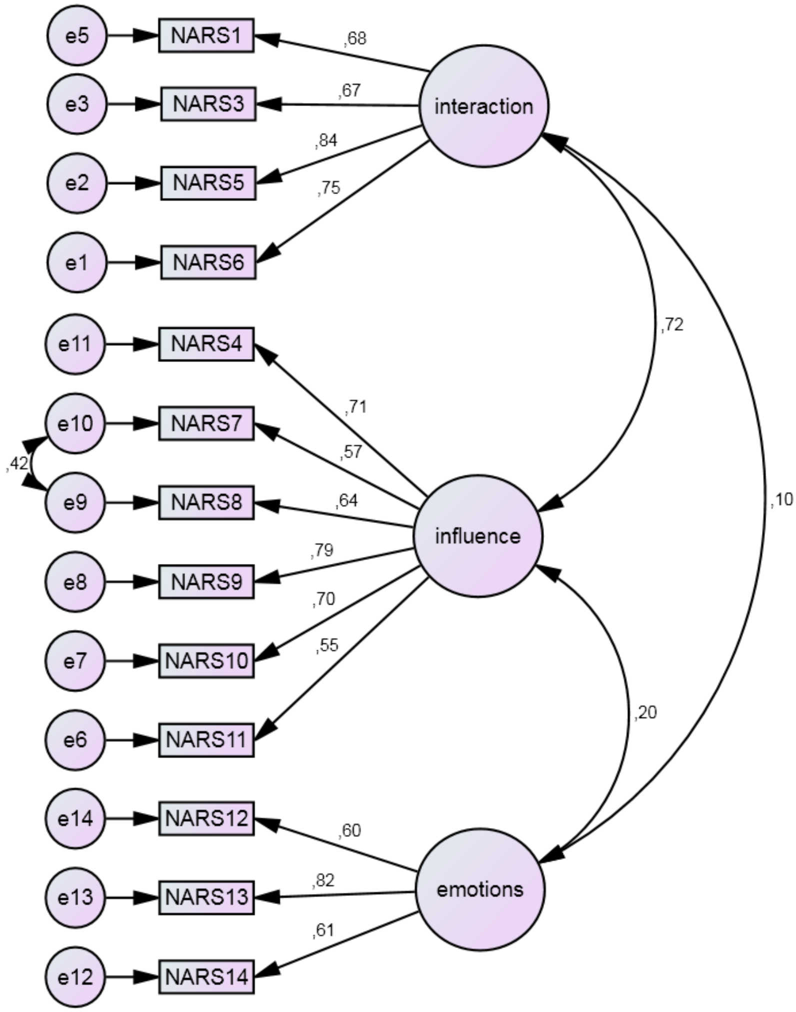

Figure 1. Structure of the Final Turkish Negative Attitudes toward Robots Scale

4. DISCUSSION AND CONCLUSION

In this study, Negative Attitudes towards Robots Scale was translated into Turkish and the validity and reliability of the new version were investigated. For this purpose, first, the KMO test and the Bartlett Sphericity test were applied. Because of the tests, it is understood that the data to be used for factor analysis is appropriate, and significant relationships are established between the variables.

The internal consistency coefficients of the Turkish version of the NARS scale were 0.83 for the whole scale, 0.79 for the NARS interaction, 0.83 for the NARS influence, and 0.71 for the NARS emotions. The internal consistency coefficients in the original study of Nomura et al. (2006) were reported to be $\alpha = 0.75$ for the NARS interaction; $\alpha = 0.78$ for the NARS influence; and $\alpha = 0.64$ for the NARS emotions. In addition, the fit indexes obtained from confirmatory factor analysis in this study are similar to those obtained in the original study (GFI =0.900, AGFI =0.856, and RMSEA =0.080) of the scale Nomura et al. (2006). Furthermore, the negative correlation between technological innovativeness and the total score of the NARS and the sub-dimensions of the NARS showed the presence of discriminant validity.

This study shows that the Turkish version of NARS is a reliable and valid scale. This scale, which may be used in everyday life or working life is estimated to be very useful. In addition, it may help design and development of robot technologies for Turkish users.

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Appendix 1. Robotlara Karşı Negatif Tutumlar Ölçeği

a. Robotlarla Etkileşime Girilen Durumlara Dair Negatif Tutumlar

1. Robotları kullanmak zorunda olacağım bir iş verilseydi, kendimi tedirgin hissederdim.
2. Başkalarının önünde bir robot kullansaydım, kendimi gergin hissederdim.
3. Bir robotun önünde durmak bile beni gergin hissettirirdi.
4. Bir robotla konuşurken aşırı şüpheli olurdum.

b. Robotların Sosyal Etkisine Dair Negatif Tutumlar

1. Robotların bir şeyler hakkında hüküm vermesi düşüncesi beni rahatsız ederdi.
2. Robotların gerçekten duyguları olsaydı, kendimi tedirgin hissederdim.
3. Robotlar canlı varlıklar haline dönüşürse, bazı kötü şeyler olabilir.
4. Robotlara çok fazla güvenirsem, kötü bir şey olabilir diye düşünüyorum.
5. Robotların çocuklar üzerinde kötü etkileri olacağından endişe duyuyorum.
6. Gelecekte robotların topluma hükmedeceğini düşünüyorum.

c. Robotlarla Etkileşim İçindeyken Duygulara Dair Negatif Tutumlar

1. Robotlarla konuşacak olsam kendimi rahat hissederdim.
2. Robotların duyguları olsaydı, onlarla arkadaşlık kurabilirdim.
3. Duyguları olan robotlarla birlikte olmak beni rahat hissettirirdi.