

Original Article

Evaluation of the Psychometric Properties of the Cognitive Test Anxiety Scale in Turkish University Students

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Abstract

The aim of this study was to investigate the psychometric properties of the 23-item Cognitive Test Anxiety Scale in Turkish university students. In this study, the 23-item, one-dimensional Cognitive Test Anxiety Scale which was adapted to Turkish by Bozkurt et al. (2017), was examined. The sample of the methodological research consists of 458 volunteers studying at a nursing faculty. Validity tests were carried out with criteria dependent validity analysis, exploratory and confirmatory factor analysis, discriminant validity analysis, split half reliability and significance tests of 27% lower-upper group difference. Reliability tests were performed with Cronbach's alpha value, item-total score correlation and test-retest reliability test. The single factor model explained 50.2% of the variance related to the scale. The scale's Kaiser-Meyer-Olkin value was .962, Barlett's sphericity test was $\chi^2=6902.4$, $p=.001$. Confirmatory factor analysis fit indices ($X^2(\text{CMIN})/\text{df}=4.422$, CFI =.887, NFI =.859, TLI=.872, RMSEA=.087) were able to confirm the model. The results of exploratory and confirmatory factor analysis showed that The Cognitive Test Anxiety Scale was a valid tool for assessing the cognitive exam anxiety among university students with the single-factor structure. The scale has a distinctive feature in subjective perception and objective measurements of the cognitive exam anxiety among university students. The Cronbach's alpha value was .95, and t test results are significant for 27% lower-upper differences. The reliability coefficient obtained by Spearman-Brown Split Half Reliability Coefficient was calculated as .82 ($p=0.001$) for the total scale. Item-total score reliability and test-retest ($r=.946$) analyzes showed that the scale has followed an internally consistent structure in the current sample. The single dimensional 23-item Turkish version of the Cognitive Test Anxiety Scale has psychometric properties suitable for determination of cognitive exam anxiety in university students.

Key words: Cognitive test anxiety; test anxiety scale; university student; psychometrics

Introduction

Exams, that are an indicator of performance and success, are important concern for individuals of all ages and groups. Test anxiety can occur before, during and after the test for various reasons, Factors such as previous negative experiences, beliefs, cultural backgrounds, family attitudes, self-judgments and self-confidence, concerns about being labeled and evaluated as unsuccessful, externally oriented expectations and uncertainty to come with failure in the future, will affect test anxiety (Devito & Kubis 1983; Erozkan, 2004; Bodas & Ollendick 2005; Xie, et

al, 2019). In cases where test anxiety is not managed effectively; physical, emotional, cognitive and social outcomes occur (Cassady 2004). Physical symptoms frequently include symptoms such as hypertension, nausea, sweating and headache; emotional symptoms include anger, hopelessness, shame, guilt, frustration and feelings of fear (Casbarro 2005; Poorman, et al, 2009). Common cognitive symptoms of test anxiety are negative thoughts such as comparison thoughts, attitudes of self-comparison with others, difficulty in gathering and maintaining attention, having a block in thought, difficulty in removing negative thoughts

from previous minds. This whole process gives the individual a mentally hard time and as a result may cause symptoms and diseases such as depression, suicidal ideation, sleep and appetite changes, conversion (Poorman, et al, 2009). The same symptoms are among the reasons for predisposing of test anxiety as reinforcement. Due to this cause-and-effect cycle, test anxiety that cannot be effectively interfered is constantly experienced again (Devito Kubis 1983).

While some individuals feel anxious about the exam, they can focus their attention better and use the situation as an opportunity to improve themselves (Schwarzer 1988); others cannot perform well enough due to this anxiety (Duty, et al, 2016; Nunez-Pena Bono 2019). Despite the intense efforts, negative experiences decrease people's functionality, working skills, cognitive skills and motivations such as storing and remembering information and prevent them from reflecting their potential (Poorman, et al, 2009).

Background

The perception of success and failure is evaluated based on the instant results obtained from the exams, and causes many physiological and psychological problems for students at every stage of education (Erozkan 2004). Research reveals that test anxiety is an important risk factor for physical and psychological wellbeing for students at any level of education and training, starting from primary school to university degree (Ergene 2003; Cassady 2004; Segool et al. 2013; Unalan et al. 2017). It is inevitable for the youth in Turkey to experience a high level of test anxiety, as they live in a society that emphasizes success and competition in academic life and are subject to an unstable system and a controversial evaluation process (Erozkan 2004). Academic success is important at the university. Students experience intense anxiety about their academic success due to the financial and moral burden of living away from the family, the obligation to start working and anxiety to graduate as soon as possible (Thomas, et al, 2018). Test anxiety in university students is affected by gender, graduated high school, university entrance exam scores and parents' education level (Erozkan 2004; Peleg, et al, 2016). The prevalence of above-average test anxiety for university students has been determined in the range of 20-35% in international studies (Driscoll, et al, 2009; Alvarez, Aguilar-Parra Lorenzo 2012; Huntley et

al. 2019). Research reveals that test anxiety is increasingly experienced as a physical and mental health problem in university students (Chapell et al. 2005; Szafranski, Barrera Norton 2012).

Research Questions and Aim: It is the research question to be answered as a result of the research whether the Cognitive Test Anxiety Scale (CTAS), which its validity and reliability has been accepted by adapting to Turkish, is psychometrically appropriate to measure cognitive exam anxiety among university students. Through this research, it was planned to obtain the cumulative results in larger groups of the scale, by testing the psychometric properties for university students. The purpose of this study is to determine the psychometric properties of the CTAS among university students.

Methodology

Participants: This methodological and descriptive research has been designed in the universe of 1040 students that are continuing their education in a nursing faculty. No scientific method was used in sample selection and 458 students were willing to participate in the study. Who fulfilled the measurement tools completely, constituted the sample of the study. Representation power of the sample is acceptable for the construct validity analysis of the scale, in order to meet the conditions of not being below 200 and providing at least 10 observations per item (23 items x 10 = 230 observations)(as cited in Capik 2014). The sociodemographic characteristics related to the sample were determined. The mean age of the students is 21.67 ± 1.89 years, 82.2% are women, 83.2% have siblings, 33.4% are mostly living in counties/towns and 63.1% are upper segment high school graduates. In 60.6% of students' academic grade is 2.50-2.99 (quad-system), 32.5% perceive their own academic success at a medium level.

Measurement Tools

Introductory Information Form, CTAS and Test Anxiety Inventory (TAI) were applied as data collection tools.

Introductory Information Form: A descriptive 16-question form that will provide access to the necessary data on the socio-demographic (such as age, gender) and academic (i.e. academic achievement level) variables was developed by the research team.

Cognitive Test Anxiety Scale: It is a 25-item measurement tool that aims to determine the psychometric features of Turkish university students. It was developed by Cassady et al. (2002) to assess the cognitive dimension of test anxiety under the name of Cognitive Test Anxiety Scale-Revised. In accordance with the factor analysis of Turkish adaptation (Bozkurt, Beycan Ekitli, Thomas Cassady 2017), it was considered to exclude items from the scale which number 22 and 24. Those items' factor loads were found below .30 and as a result of that scale was adapted to Turkish as 23 items. The data collected from 1075 students studying in high school were randomly divided into two groups and exploratory factor analysis was applied of the first group (n = 536). In the factor analysis, the Kaiser-Meyer Olkin (KMO) coefficient value is 0.96 and the result of the Barlett test is 10597.48. The one-dimensional model was decided by applying promax rotation with principal components analysis. Confirmatory factor analysis was applied to the second group (n=539) using 23 items and a single dimension. Fit indices were determined as CFI = .988, TLI = .987, CTAS = .041 and SRMR = .053. While the test-retest reliability was $r = .88$ and the internal consistency coefficient was .91 in the original scale, in the scale adapted to Turkish the test-retest reliability was found as $r = .94$ and internal consistency coefficient as .93. The scale is evaluated with a 4-point grading (1 = not suitable for me at all; 4 = very suitable for me) and consists of one dimension (min = 23, max = 92). A final cognitive test anxiety score is obtained by sum all the scores of the CTAS items. There is no reverse coded item and cut-off score of the scale. As the total score obtained from the scale increases, so the cognitive test anxiety levels are considered to be increased (Bozkurt, Beycan Ekitli, Thomas Cassady 2017).

Test Anxiety Inventory (TAI): The scale used to comparison the validity of a similar scale is a subjective assessment tool developed by Spielberger (1980) to measure the level of anxiety related to exams. Adaptation of the twenty-item TAI to Turkish was performed by Albayrak-Kaymak (1987). The inventory measures negative feelings and thoughts related to test and evaluation. Inventory is interpreted based on the total score and two sub-dimension scores; worry, and emotionally. Worry is the dimension of expectations and thoughts covering the cognitive components of test anxiety.

Emotionally subscale includes sensory physiological responses, system responses and physical experiences in the test environment. As the average score obtained from the scale increases, it is accepted that the levels of worry, emotional symptoms, and exam anxiety increase (Oner Kaymak 1987).

Data Collection: The research data were collected at time intervals that were not expected to cause any change in test anxiety (at times that would not cause anxiety in midterm and final tests). Students were provided with the necessary time to apply the measurement tools on their own with a paper and pen. Tools performance completed within 15 minutes. Similarly, the academic evaluation periods of the students were taken into consideration in the process of collecting the posttest application. Before the data were collected from the students, information was given about the scope of the research and the tests to be applied.

Data Analysis: Validity Studies: In the process of determining scale validity, exploratory factor analysis (EFA), single factor confirmatory factor analysis (CFA), criterion validity and discriminant validity were used on the same sample. Koyuncu and Kilic (2019) cited that construct validity analyzes can be performed on the same data. The suitability of the data for exploratory factor analysis was tested by Kaiser-Meyer-Olkin (KMO) and suitability of multivariate normal distribution by Bartlett's propositions. Data's globality and the consistency of item variability was accepted ($p = 0.962$, $X^2 = 6902.4$, $p < 0.05$). Since the factor analysis of the scale allows correlation between items, the delta coefficient was examined under the correlation conditions of 0.001 points using oblique rotation methods. In the second step, in the SPSS AMOS 26.0 program, single factor confirmatory factor analysis (CFA) was applied and $X^2(\text{CMIN})/\text{df}$, CFI, NFI, and RMSEA were examined (Koyuncu and Kilic 2019). Criterion validity analysis (related criterion validity) was performed and TAI was used as a criterion. The relationship between TAI and CTAS scores was investigated using Pearson's product-moment correlation coefficient. For the validity of discrimination; the state of experiencing anxiety (before, during and after the test period) which is subjectively expressed as not being managed effectively, was used as the determining condition. The difference between the distribution of CTAS scores of students with and without test anxiety was

examined with the significance test of the difference in independent groups (Mann Whitney U test). Within the scope of discrimination analyzes, having the 27% lowest and the 27% highest score according to total scale scores distribution was examined by the significance of the difference in independent groups Mann Whitney U test. Before the data analysis, the distribution of normality was tested by the Kolmogorov-Smirnov analysis.

Reliability Studies: In reliability evaluation of the scale the internal consistency was tested. Cronbach's alpha coefficient was calculated using item total score reliability and Spearman-Brown split half reliability coefficient. In the second step, test-retest was applied to 22 students out of the sample within a four-week interval, and Pearson's product-moment correlation analysis was performed after distribution to normal was confirmed with Shapiro Wilk ($p > 0.05$) test. In the research, statistical significance level was accepted as $p < 0.05$.

Ethical Considerations: Permission for implementation of research was obtained from the relevant nursing faculty deanery. The purpose of the research was explained to the students, an explanation was made that their identity would be kept confidential, that the participation was on a voluntary basis and that the data would not be used for any other purpose. Written consent was obtained from the students. Twenty six students participated in test-retest applications were asked to specify their nicknames in the data collection forms in the pretest application and the data was collected by guaranteeing that this information would not be used for any other purpose other than to match the data to be received in the posttest application. The required utilization permit was obtained from Bozkurt who adapted the CTAS to Turkish, and there was no requirement for obtaining permission for TAI.

Results

Validity Results: In order to test the validity of the scale within the scope of measuring the related concept, the correlation between CTAS and TAI scores was compared. In the sample of university students, a weak linear correlation was determined between CTAS and the TAI total and the sub-dimensions' scores. The highest relationship was achieved with the Worry sub-dimension covering the cognitive dimension of the test anxiety (Table 1). These findings showed that the scale had valid external features that can

measure the cognitive dimension of the test anxiety in university students. Exploratory factor analysis was performed within the scope of construct validity analysis. It was found three dimensions with Eigenvalue above 1.0. When the effect of factors on variance loads was examined, the three-dimensional variance structure has explained 56.8% of the total variances; also it was determined that the single-factor structuring has carried a variance weight of 50.2% of the total (Table 2)(Figure 1-2). For this reason, the one-dimensional model structure has been accepted.

The fit indices obtained in the confirmatory factor analysis of the one-dimensional model of the scale are presented in Table 3 ($X^2(\text{CMIN})/\text{df}=4.422$, CFI = .887, NFI = .859, TLI = .872, RMSEA = .087). On the basis of indices other than TLI, the results of confirmatory factor analysis considered to be sufficient for the validation of the model.

For examination of the discriminant validity of CTAS; before and during the test, the distributions of CTAS scores were analyzed in groups that experienced anxiety about tests and did not. It was determined that the mean scores of the groups differed statistically significantly ($p < 0.05$) in three different times, in groups with and without exam anxiety, and in this context, the scale was valid in a distinctive way (Table.4).

In order to test the discriminating ability of the scale, students within the %27 lowest and the %27 highest CTAS score were examined in terms of the significance of difference on the basis of groups. The mean scores were examined by the Mann Whitney U test since the distribution did not conform to homogeneity distribution (Table 5). The scale showed distinctive internal consistency according to the Z test value ($p = 0.001$) calculated for the lower and upper 27% groups.

Reliability Results: Internal consistency of the scale was tested with Cronbach's alpha coefficient. Cronbach's alpha value that includes 23 items of the scale was .95. The reliability coefficient obtained by the Spearman-Brown split-half reliability coefficient was calculated as .82 ($p = 0.001$) for the total scale. Corrected-item and item-total correlations were calculated for each item. Item reliability correlation coefficients ranged from .23 to .71 ($p < 0.05$). In only one item the coefficients below 0.4 showed that this scale had an internally consistent structure in the current sample.

Within the scope of test-retest reliability, dependent group scores of CTAS were examined at various times. According to the results of the Pearson's product-moment correlation analysis carried out on 22 students out of the sample that

conformed to the homogeneity distribution, there was a very strong linear relationship between scores ($r = .946$, $p = 0.001$). Results show that there is no time-based change in scores, and there is a stability between test scores.

Table.1. Criterion Validity Results (n=458)

CTAS MEAN SCORES		n	r	p
TAI Mean Scores	Total Scale	458	0.454	0.001
	Worry	458	0.476	0.001
	Emotionally	458	0.409	0.001

* Pearson's product-moment correlation analysis

Table.2. Exploratory Factor Analysis Factor Loads (n=458)

Items	Load		Load
12.	.821	18.	.685
15.	.807	6.	.681
8.	.793	13.	.670
9.	.788	21.	.657
11.	.782	10.	.653
16.	.767	19.	.646
3.	.751	4.	.634
5.	.748	14.	.622
17.	.718	23.	.615
2.	.710	22.	.515
7.	.701	20.	.369
1.	.696	Total Variance	.502

Table.3. Fit Index Values for Confirmatory Factor Analysis

Fit Index	Index Value	Acceptable Fitting*
$\chi^2(\text{CMIN})/\text{df}$	4.422	≤ 5 Anderson & Gerbing, 1984 ^a
df	224	
CFI	.887	$\approx .90$ Bentler, 1990 ^b
NFI	.859	$\geq .80$ Hooper et al., 2008 ^a
TLI	.872	$\geq .80$ Hu & Bentler, 1999 ^a , Bryne, 2011 ^c
RMSEA	.087	$.80 \leq \dots < 1.00$ MacCallum et al., 1996 ^a , Fabrigar et al., 1999 ^b

^a as cited in; Koyuncu, İ. & Kilic, AF. (2019) The use of exploratory and confirmatory factor analyses: a document analysis. Education and Science 44(198):366. ^b as cited in; Kim, H. & et al. (2016) Confirmatory and Exploratory Factor Analysis for Validating the Phlegm Pattern Questionnaire for Healthy Subjects. Evidence-based complementary and alternative medicine : eCAM, 2016, 2696019. ^c as cited in; Elderoglu, MM. (2017) Factor analysis and use of validity exploratory and confirmatory factor analysis in social sciences. Istanbul University Journal of the School of Business 46 (special issue): 81.(in Turkish)

Table.4. CTAS Distinctive Validity Analysis Results (n=458)

CTAS Mean Score		n	$\bar{X} \pm Ss$	MWU / Z	p
Before Test	Having test anxiety	157	56.66±14.54	MWU:1772.00	p=0.001
	Not having test anxiety	301	49.95±15.24	Z:-4,391	
During Test	Having test anxiety	83	57.94±14.71	MWU:11379.0	p=0.001
	Not having test anxiety	375	51.00±15.19	Z:-3,835	
After Test	Having test anxiety	87	56.72±14.35	MWU:12460.00	p=0.001
	Not having test anxiety	371	51.20±15.37	Z:-3,311	

* MWU= Mann Whitney U analysis

Table.5. CTAS Mean Score’s Distribution of 27% Lower and Upper Group (n=246)

CTAS Mean Score	n	$\bar{X} \pm Ss$	MWU / Z	p
27% Upper Group	123	71.66±7.69	MWU:0.000	p=0.001
27% Lower Group	123	33.50±5.02	Z:-13,562	

* MWU= Mann Whitney U analysis

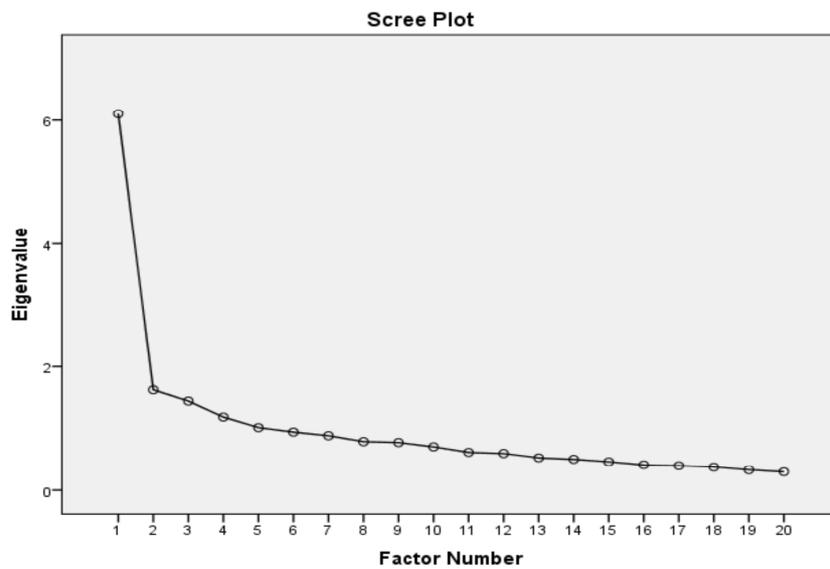


Image 1. Exploratory Factor Analysis Scree-plot Graphic Drawn by the Eigenvalues of the Factors

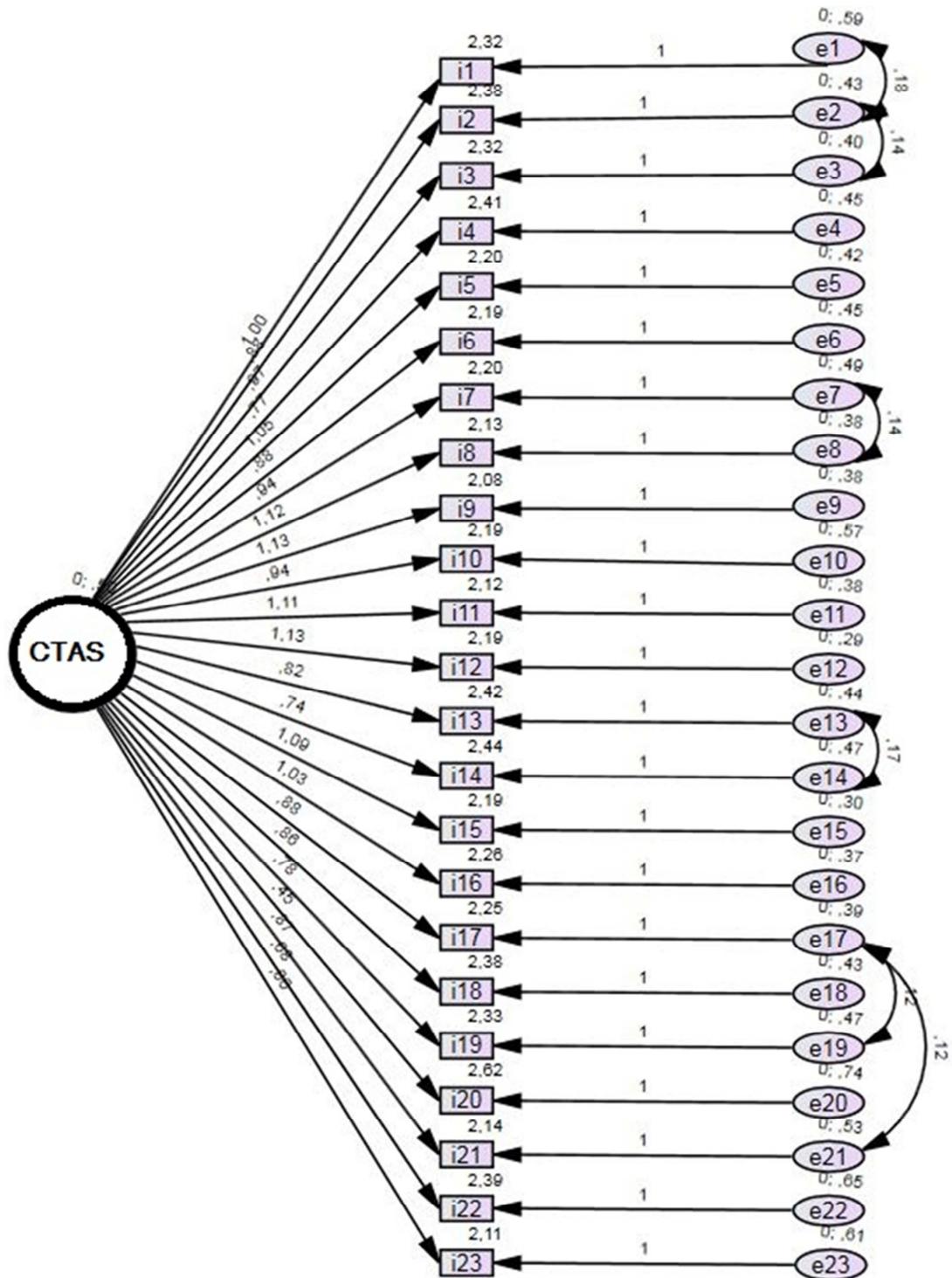


Image 2. Confirmatory Factor Analysis One-Dimensional Factor Distribution

* The arrows drawn between the two items indicate that the items were modified.

Discussion

In this study, the psychometric properties of the Cognitive Exam Anxiety Scale (CTAS), which was adapted to Turkish by Bozkurt et al. (2017), on 458 university students, consisted of nursing undergraduate students were examined. This scale is a measurement tool developed to evaluate students' cognitive test anxiety levels.

Within the scope of validity tests; results of the exploratory factor analysis revealed that CTAS offers a one-dimensional structure and that the scale is compatible with the results obtained in the Turkish adaptation study (Bozkurt, Beycan Ekitli, Thomas and Cassady 2017). As can be seen in Table 2, items were gathered under one factor as in the original scale and this structure has explained 50.2% of the total variance. This ratio between 40.0-60.0% is considered sufficient (Tavsancil 2014; Buyukozturk 2014). The item factor loads of explanatory factor analysis are listed between .37 and .82. CTAS demonstrates similar characteristics in the Argentinean adaptation studies of Furlan et al. (2009). Distinct from the results, Baghei et al.'s research findings (2014) provided a multidimensional structure for scale's 14-item short form. These results can be interpreted as cultural differences in the cognitive structure of the test anxiety have originated from the geographic features of the Middle East (Bodas Ollendick 2005). Fit indices of the confirmatory factor analysis can be said to be sufficient to accept the single-factor model. When these values are examined, it is seen that the $X^2(\text{CMIN})/\text{df}$ value is 4.422. It can be said that the obtained value is less than 5.0. and this result is acceptable (as cited in; Cokluk, Sekercioglu and Buyukozturk 2012; Kim et al. 2016; Koyuncu and Kilic 2019). CFI (comparative fit index) value is .887, NFI (normed fit index) value is .859, TLI (Tucker Lewis non-normed fit index) value is .872, and RMSEA (root mean square error of approximation) is .087. The RMSEA value indicates that the one-dimensional structure of the CTAS is acceptable and can yield valid results. In this study, the fact that the TLI value (.872) is considered compatible but since it could not reach the threshold values required for the good fit can be considered due to the sample size (Simsek 2007). When fit indexes are evaluated generally; the model presented is considered as an acceptable model (as cited in; Cokluk, Sekercioglu and Buyukozturk 2012; Kim et al. 2016; Koyuncu and Kilic 2019).

In order to determine the validity of CTAS in university student, the relationship between score distributions was examined by using TAI, which is one of the most widely used tools for evaluating test anxiety in the national and international arena. It was determined that the CTAS was linearly related to the TAI scores determined for criterion validity and it was established the strongest relationship with the Worry sub-dimension, which reflects the cognitive component of test anxiety. In consistent with the Turkish adaptation of the scale (Bozkurt, et al 2017), these findings were interpreted as a valid tool that can measure the cognitive dimension of test anxiety in university students.

Within the scope of discriminant validity tests, the perceptions of experiencing test anxiety at different times were accepted as distinctive conditions. In these subjective statements, independent groups were created from if experiencing anxiety before, during and after the exams. The differences in CTAS scores between two groups were examined. The group, who experienced test anxiety, had a statistically significantly higher score. Along with these results; the Z values, which show the significance of the difference between the lower 27% and the upper 27% groups, are proof of the discrimination of the items (Buyukozturk 2014). Similarly, Furlan et al. (2009) stated that the scores of CTAS were increasing significantly in students that expressed subjective anxiety.

Within the scope of the reliability tests, internal consistency studies were carried out with the Cronbach's alpha coefficient. One-dimensional CTAS alpha value was determined as .95. Having this value of .70 and above is considered sufficient for the reliability of the measurement tool (Buyukozturk 2014). According to the results obtained, the scale has a high degree of internal consistency. It was determined that the split half reliability of the scale showed a high and linear relationship with each other (.82). While the items total score reliability demonstrates the presence of three items with a value below .50 on the basis of items, as is it was accepted that the scale provided a structure with internal consistency. CTAS's test-retest reliability coefficient was determined as .93 ($p=0.001$) in Turkish adaptation study (Bozkurt, et al, 2017), whereas it was found as .78 ($p < 0.01$) in Furlan et al.'s study (2009). In this study when the difference between the scores of CTAS applied to dependent groups at intervals of

four weeks for test-retest reliability was analyzed statistically; it was determined that the scores in the first and last application have shown a moderate and linear relationship with each other ($r = .53$, $p = 0.006$). In line with these findings, the scale was considered to have immeasurably high reliability against time (Cronbach's $\alpha > .70$) (Tavsancil 2014). It is thought that the evidence of the scale in the sample of the university students will fill the important gap in the field. In this context; it is important that high expectation related to academic and clinical success to be tested in university students, where they can be associated with the burden of life and the responsibility of others. Test anxiety is known to be an important problem for nursing students and is experienced much more severely than in their peers in other departments of the university (Brewer 2002; Driscoll, et al, 2009; Duty, et al, 2016; Stojanovic et al. 2018; Poorman, Mastorovich Gerwick 2019). Intensive course and practice pace, high academic and clinical expectations, burden of own life and others, and chronic stress are among the main causes of test anxiety in nursing students (Quinn Peters 2017). For nurses, working under conditions where professional advances continue through certification and evaluation processes and where the clinical work environment creates a continuous assessment and performance process with patients, patient relatives and other partners of the healthcare team (Sagkal et al 2017; Poorman, et al, 2009) it is important to be able to realize this associated risk beginning from the studentship years (Duty, et al, 2016).

Limitations: It was accepted as an important limitation since research was carried out only in a certain faculty sample. Similarly, it will be useful to provide new data on the validity and reliability of the CTAS through new investigations carried out in different and larger sample groups. No potential conflict of interest and acknowledgement was reported by the authors.

Conclusion: The Cognitive Exam Anxiety Scale can be accepted as a psychometrically appropriate measurement tool in evaluating the cognitive component of test anxiety in university students. The tool possesses a one-dimensional, distinctive and consistent structure.

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