TEST ANXIETY INVENTORY (TAI): VALIDIZATION AND PSYCHOMETRIC PROPERTIES OF CZECH VERSION

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Abstract

This study details the development and validation of a Czech language version of the Test Anxiety Inventory (TAI). The TAI instrument has been created to allow acquisition of empirical evidence on the two above-mentioned components in practical situations. This measurement tool addresses identification of worry and emotionality during tests. Spielberger et al. (1978) created TAI (Test Anxiety Inventory), a self-report based scale used for measuring both test anxiety factors. According to Spielberger (1980), TAI was designed to measure anxiety in high school and university students. It consists of two subgroups: measurement of worry (TAI-W) and measurement of emotional distress (TAI-E). In our research, we assess psychometric properties of the TAI scale and test the scale among student population in the Czech Republic and we also debate options of application of this method on respondents at the lower limit of the recommended age. In this study, the TAI scale was adapted and administered to a sample of 185 students aged 12 to 15 years. The aim of this study was to examine factor structure and explore the psychometric properties for Czech version of Test Anxiety Inventory. Alpha reliability values for different scales of TAI (TAI-Worry, and TAI-Emotionality) ranged was 0.877 (TAI-E) and 0.851 (TAI-W). The correlation between the two subscales measured by the Pearson correction coefficient is positive and very strong ($r = 0.769$) and statistically significant ($p < .001$). The two-factor structure consisting of TAI-Worry and TAI-Emotionality components showed acceptable discriminant validity and internal reliability. The item analysis and both exploratory and confirmatory factor analyses were made showing that Czech TAI Scale has acceptable psychometrical properties and can be used in Czech school children.

Keywords: Test Anxiety Inventory (TAI), Anxiety, Student, Confirmatory factor analysis, explanatory factor analysis.

1 INTRODUCTION

An interesting yet still rather underrated type of school anxiety is so called test anxiety. In general, results of empirical research have brought agreement on the fact that test anxiety comprises two aspects: worry (distraction from the actual test, intrusive thoughts) and emotionality (somatic signs of anxiety, such as racing heart, nausea) in situations where tests are concerned (Liebert & Morris, 1967). In individuals with increased test anxiety, negative experience with tests and/or poor results in tests may affect future expectations. Regrettably, these negative cognitions result in lack of focus on present issues, which increases probability of poor performance in tests. Persistent worry and inability to process and memorize information during examinations are sometimes called an empty. This phenomenon affects a subgroup of anxious students who are able to prepare sufficiently for their tests but due to an empty they are unable to perform well enough in the actual stressful situation (Covington & Omelich, 1987). Furthermore, physiological signs related to test anxiety also have a disruptive effect. Students with test anxiety may often have somatic symptoms, such as muscle tension, accelerated heart rate, and upset stomach (Deffenbacher, 1986). Physiological overarousal prevents students from concentrating on examinations, increasing probability of failure (Holroyd, Westbrook, Wolf & Badhorn, 1978). Nevertheless, research has suggested that, rather than emotionality, worry is to blame for poor performance in tests (Deffenbacher & Hazaleus, 1985).

In test anxiety, where it is distinguished between cognitive and emotional components, multidimensional concepts tend to be applied, which address mainly implications of test anxiety on performance in examinations. One of these examples is the concept of test anxiety suggested by I. G. Sarason (1989), identifying four test anxiety components: tension, somatic symptoms, worry, and irrelevant thoughts during an actual test. Another example is the pattern introduced by Hodapp (1995), where the following components are considered: worry, emotionality, interference, and lack of confidence.

In school environment we find it important to distinguish between interference models and deficit models. Interference models address factors interfering with student's performance (worry, emotionality, lack of concentration). These models are mainly studied in situations in school where the anxious individual has adequate knowledge for the test but their performance is affected by irrelevant thoughts and worry. If the deficit lies in individual's knowledge, deficit models are applied. Interference models refer mainly the situation during the actual test (test stage). During tests, the student's anxiety interferes with their ability to draw and use knowledge which has already been acquired. Test anxiety negatively affects mainly concentration. Individuals with high anxiety level divide their attention among variables concerning themselves and variables related to the actual task. They focus on worry related to their performance, expectations of punishment, performance of their fellow-students, etc. Researchers defending deficit models (Culler, Holahan, 1980) work on the assumption that poor performance in students with test anxiety can be caused by two types of deficit: a) inadequate knowledge of the studied subject or study habits, or b) deficit in test skills.

Even though some researchers also include lack of self-efficacy in these components and correlation analyses show links between these indicators, researchers have recently been in agreement on the conclusion that self-efficacy and test anxiety are different constructs (Keith et al. 2003). However, both indicators affect individual's performance during tests.

The research carried out over the last 40 years suggests that test anxiety is connected with several maladaptive phenomena (Brown et al., 2011), poor study habits (Sanghvi, 1995), low study outcomes (Chapell et al., 2005), as well as perfectionism (Eum & Rice, 2011). Research with the goal of identification and description of school anxiety has been carried out on various educational levels, including elementary schools (Cheek, Bradley, Reynolds, & Coy, 2002), upper secondary schools (Manley & Rosemier, 1972) and high schools (Sud & Sujata, 2006).

A special instrument has been created to allow acquisition of empirical evidence on the two above-mentioned components in practical situations. This measurement tool addresses identification of worry and emotionality during tests. Spielberger et al. (1978) created TAI (Test Anxiety Inventory), a self-report based scale used for measuring both test anxiety factors. According to Spielberger (1980), TAI was designed to measure anxiety in high school and university students. It consists of two subgroups: measurement of worry (TAI-W) and measurement of emotional distress (TAI-E). There are eight items in TAI-W, the inventory for measuring worry, eight items in TAI-E, the subscale focusing emotionality, and four items in TAI-T, a subscale for measuring total anxiety score. The respondents choose from the following options in Likert's four point scale: (1) almost never, (2) sometimes, (3) often, or (4) almost always. The values of the Cronbach Alpha coefficient of the original TAI were as follows: 0.96 for TAI-T, 0.91 for TAI-W, and 0.91 for TAI-E. Even though some reviewers (Gierl &Rogers, 1996; Ware, Galassi, & Dew, 1990) recommended to

remove TAI-T, Conetta and Tryon (1983) and DeVito (1984) came to the conclusion that TAI is nowadays the best psychometric assessment tool for anxiety testing. Darliuk (2005) applied TAI on 166 students, aged between 14 and 18. The values of reliability measured with the alpha coefficient for this version were 0.92 for TAI-T, 0.88 for TAI-E, and 0.84 for TAI–W. In his large-scope research, Ali (2012) tested TAI in 1,845 high schools. First, the tool was translated to Urdu, and then it was standardised. Both essential structures of the scale proved adequate validity and reliability.

In our research, we do not only attempt to assess psychometric properties of the TAI scale and to test the scale among student population in the Czech Republic, but we also debate options of application of this method on respondents at the lower limit of the recommended age.

2 METHODS

2.1 Research Participants

The research involved 189 pupils (98 girls and 91 boys, aged between 13 and 15) from a group of randomly chosen elementary schools in the Czech Republic. The questionnaire was distributed in randomly chosen classes and responded in the pen-and-paper method. The survey was anonymous and it took 45 minutes. The administrators had acquired informed consent from the parents of all the participants. There was no reward motivating the participation.

2.2 Research Methods

All the participants filled in the TAI questionnaire form (Spielberg, 1980) translated to Czech. The TAI questionnaire is designed for students aged 14 and more. In our research we did not test only psychometric properties of the Czech version, but also validity for the lower limit of the age range. The tool includes two subscales (W – worry: 8 items, E – emotionality: 8 items), including the total of 20 items. The respondents expressed their attitude through Likert's scale, including 4 options: (1) almost never, (2) sometimes, (3) often, and (4) almost always.

The translation of the scale followed the following process. First, all 20 items of the TAI questionnaire (Spielberg, 1980) were translated independently by two of the article's co-authors. Then we compared the outcomes and discussed differences to agree on the final version which was then given to a translator without knowledge of the original English version. The translator translated the form back to English and compared his outcome with the original version. Then he commented the differences between the original and the outcome of the back translation, and suggested edits in the Czech version. At this stage, a group of experts involving one independent expert and two co-authors of the article. The group had the original version of the form, both first-stage Czech translations, the version translated back to English, and ideas for edits suggested by the translator. The group compared both versions of the back translation and found only minimal discrepancies which do not affect the meaning of the items.

Hypotheses and data analysis

The main goal of the research was to test psychometric properties of the Czech version of the TAI tool and adapt it for the purpose of identification of the neglected area of test anxiety in students of the final year in high schools and in university students. We tested the basic two-component version which distinguishes between two levels of experiencing anxiety, cognitive (W- worry) and emotional (E - emotionality).

For testing psychometric properties of the scale we applied methods of exploratory and confirmatory factor analysis. The reliability of the tool was tested with Cronbach Alpha coefficient and through exploratory factor analysis to verify that there is no other load to the item than their corresponding factor. The secondary objective was to apply Welsch's t-tests to detect possible gender-related difference in response. Confirmative factor analysis was applied using the R package (R Core Team, 2014).

3 RESULTS

3.1 Scale Reliability

The inner consistency of the subscales was measured with Cronbach Alpha. The result suggests that consistency of the subscales is high. Both subscales (W and E) show good inner consistency with the value of Cronbach Alpha over 0.85 (see Table 1).

Table 1. Scale reliability. Results for Worry and Emotionality factor

Scale Reliability Statistics – scale W; E	
	Cronbach's α
scale W	0.851
scale E	0.877

Note. α = Cronbach's alpha of respective scale

In the Emotionality subscale the correlation of all the items is higher than 0.48 and Cronbach Alpha is over 0.8 (Table 2).

Table 2. TAI Reliability. Results for W factor. Numerical summaries, correlation to scale, and the effect on internal consistency are shown for each item

Item Reliability Statistics				
				if item dropped
	mean	**sd**	**item-rest correlation**	**Cronbach's α**
03W	2.12	0.951	0.479	0.847
04W	2.45	0.910	0.593	0.833
05W	1.93	0.956	0.637	0.828
06W	2.24	0.868	0.553	0.838
07W	2.19	0.936	0.606	0.831
14W	2.15	0.800	0.599	0.833
17W	2.18	1.029	0.618	0.830
20W	2.26	1.012	0.646	0.826

In case of the W subscale (worry) the correlation of the items is over 0.57 and Cronbach Alpha is over 0.8 (Table 3).

Table 3. TAI Reliability. Results for E factor. Numerical summaries, correlation to scale, and the effect on internal consistency are shown for each item

Item Reliability Statistics				
				if item dropped
	mean	**sd**	**item-rest correlation**	**Cronbach's α**
02E	2.43	0.865	0.615	0.864
08E	1.95	0.931	0.673	0.858
09E	2.53	0.946	0.638	0.862
10E	2.50	0.917	0.575	0.868
11E	2.21	0.918	0.567	0.869
15E	2.34	0.973	0.686	0.856
16E	2.64	0.907	0.659	0.859
18E	2.16	1.031	0.685	0.856

The results suggest good inner consistency of both subscales and individual items, and we can state that W and E scales are two independent factors, which corresponds with the theoretical backgrounds and with the original version of the questionnaire (Spielberg, 1980).

3.2 Exploratory Factor Analysis

Mutual correlation of both subscales measured with the Pearson correlation coefficient is positive and strong enough (r=0.769), as well as statistically significant p >0.01 (Table 4).

Table 4. Pearson Correlation Coefficient between the Parts of the TAI

Correlation Matrix				
			Tai.W	**Tai.E**
Tai.W		Pearson's R	—	0.769
		P-Value	—	< .001
Tai.E		Pearson's R		—
		P-Value		—

The scatter of the values can also be checked in the scatter plot (Figure 1).

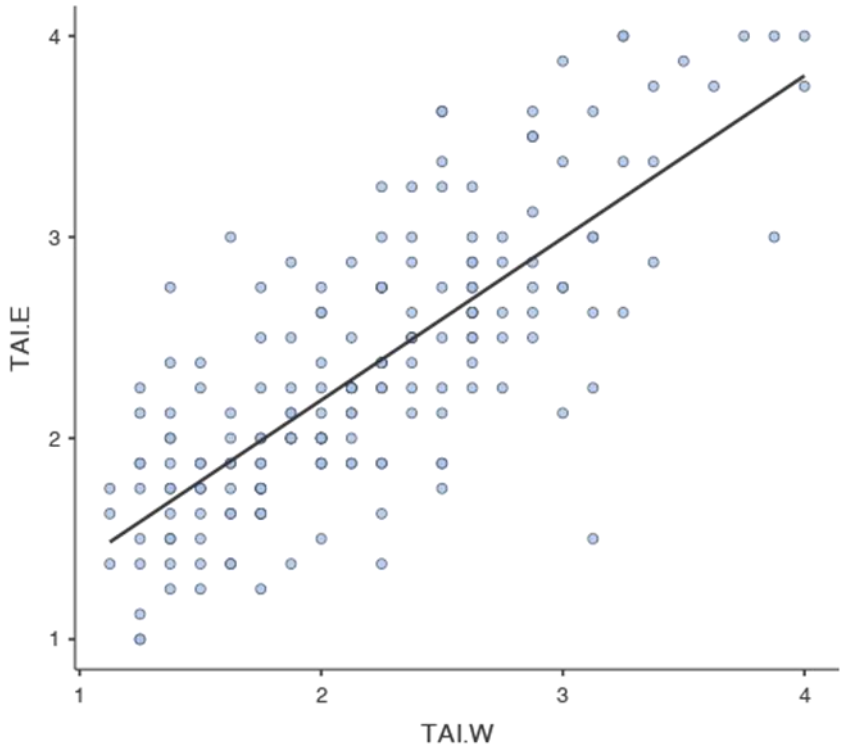

Figure 1. The scatter plot value of TAI

3.3 Confirmatory Factor Analysis

In order to assess to what extent our data correspond to the theoretical model, we carried out a confirmatory factor analysis in which we used three calculation indices: chi-square/degrees of freedom ratio, RMSEA (Root Mean Square Error of Approximation), and CFI (Comparative Fit Index).

The results suggest that the load of the items in correlation to the factors is in all the cases higher than 0.5, which proves that all the items are strong factor indicators (Table 5).

Table 5. Factor loading of TAI

Factor Loadings					
Factor	**Indicator**	**Estimate**	**SE**	**Z**	**p**
Factor W	03W	0.501	0.0684	7.32	< .001
	04W	0.592	0.0623	9.50	< .001
	05W	0.651	0.0647	10.06	< .001
	06W	0.524	0.0606	8.63	< .001
	07W	0.618	0.0638	9.69	< .001
	14W	0.533	0.0544	9.80	< .001
	17W	0.644	0.0714	9.01	< .001
	20W	0.751	0.0662	11.34	< .001
Factor E	02E	0.589	0.0581	10.14	< .001
	08E	0.643	0.0622	10.34	< .001
	09E	0.651	0.0632	10.30	< .001
	10E	0.554	0.0637	8.70	< .001
	11E	0.547	0.0639	8.57	< .001
	15E	0.764	0.0618	12.37	< .001
	16E	0.627	0.0606	10.34	< .001
	18E	0.739	0.0680	10.86	< .001

All three comparative indices suggest good match (Table 6).

Table 6. Confirmatory Factor Analysis of TAI

Test for Exact Fit		
χ^2	**df**	**p**
214	103	< .001

Fit Measures				
			RMSEA 90% CI	
CFI	**TLI**	**RMSEA**	**Lower**	**Upper**
0.913	0.899	0.0767	0.0622	0.0911

Note. X^2 = Goodness of Fit Index; Df = Degrees of freedom; RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index.

Chi-square divided by degrees of freedom ratio equals 2.08, which correlates with the recommended level (Hooper et al., 2008). Comparative indices CFI and TLI should be close to 1 or exceed 0.9, which is exactly what happens (Hu and Bentler, 1999). RMSEA slightly exceeds the recommended limit of 0.07 (Hooper et al., 2008). The two-factor model we tested therefore shows a very good match (Figure 2).

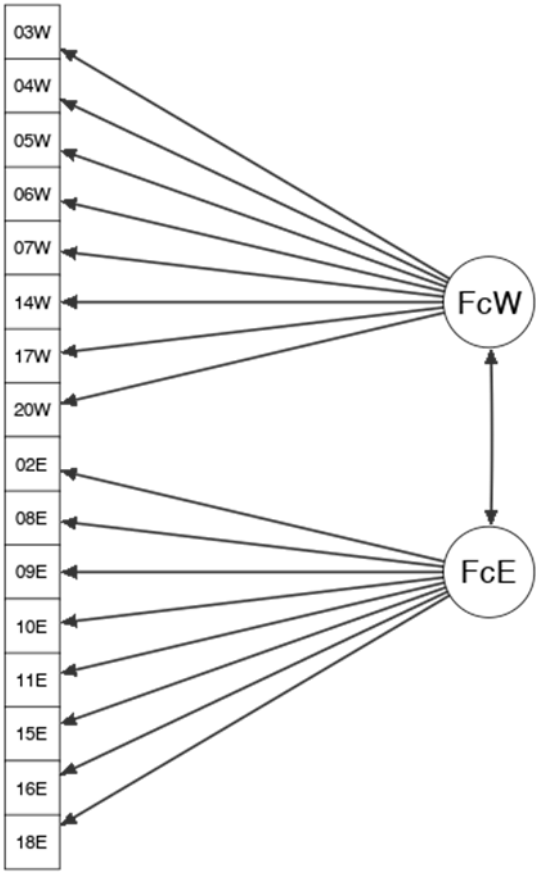

Figure 2. Confirmatory Factor analysis of two factor model of TAI

4 DISCUSSION

Despite the fact that the test anxiety scale has existed for dozens of years and has been a subject to a significant amount of verification, there has been no Czech version available or standards set in the Czech Republic. In our research, we essayed verification of reliability and validity of the scale in children at the lower limit of the age standard for whom the test was designed. We examined to what extent the scale can be used in children of lower age and whether it would be possible to use it in children in the final year of elementary school and younger high school students. In previous research, the scale showed more than adequate psychometric properties in university and junior and senior high school students. As in our environment there is no similar tool for measuring test anxiety in children aged between 14 and 16, we decided to verify whether it would be possible to use TAI scale.

We have observed that in children at the lower limit of the recommended age the scale shows very good inner consistency measured with Cronbach Alpha, where inner consistency of both subscales was higher than 0.80. The items in individual subscales in relation to the given scale correlated positively, in levels exceeding 0. 48 (E) and 0.57 (W). As shown through the Pearson correlation coefficient, the mutual correlation between both subscales was also high (0. 77) and statistically significant ($p < .001$). The outcome data correspond with the research where the model was tested in university students and the scale also shows good-quality psychometric properties in younger respondents.

With respect to the fact that we tested the questionnaire in children at the lower limit of the age standard, we decided to support verification results not only by exploratory factor analysis, but also by CFA confirmative indices. We applied three models: chi-square/degrees of freedom ratio, RMSEA (Root Mean Square Error of Approximation) and CFI (Comparative Fit Index). Surprisingly, all three factors showed relatively good match, with only the value of RSMEA slightly exceeding the recommended level of 0.07 (Hooper et al., 2008). The two-factor model we used suggests a very good match, especially with respect to the specifics of the target group.

We can therefore state that the Czech version of the TAI tool has high-quality psychometric properties. The

research showed rather adequate reliability and validity of the tool. All the statistical indicators we used have proved that the translated Czech version of the scale confirms the results of the questionnaire author (Spielberg, 1980). We can also recommend applying the tool on respondents at the lower limit of the recommended age scope standard. The output shows that younger respondents understand well individual items in the form and are capable of adequate response. In connection with the above-mentioned facts we have proved that the TAI tool has very good properties in its original, unrevised version consisting of 20 items, and it can be used as part of set of diagnostic tools for measurement of anxiety during performance. The TAI scale can also be applied in research regarding identification of aspects arousing fear of school and school anxiety, which are related to development of motivation to perform well at school.

5 LIMITATIONS OF THE STUDY

The main limitation of our study lies in the fact that collection of data took place in classrooms, which might have influenced response from the students. Another factor which might have brought slight misrepresentation of the output is that not all elementary schools were involved, but only 10 schools were chosen for the research. As the sample is not very large, further in-depth analysis will be carried on before setting norms. Within the in-depth analysis, more measures will be taken, which is supposed to guarantee more thorough external validity.

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