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**Measuring test anxiety and investigating its  
individual and interpersonal background factors**

**Theses of the doctoral dissertation**

**Doctoral School of Psychology**

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## **1. Theoretical background and hypotheses**

Test anxiety is usually defined as anxiety experienced in academic or evaluative situations (Embse et al., 2018). The investigation of test anxiety is particularly warranted because it is related to many factors influencing students' mental health (Hembree, 1988; Encandela et al., 2014; Steinmayr et al., 2016) and can cause difficulties in terms of performance in exams (Cassady and Johnson, 2002; Embse and Hasson, 2012), often reflected in lower academic performance (e.g. Harris et al., 2019; Silaj et al., 2021). In order to design and implement interventions to support highly test-anxious students and eliminate their disadvantages, it is essential for practitioners to first be able to identify those struggling with test anxiety, a process that requires the use of reliable and valid measures, as well as a deeper understanding of the test anxiety construct and its underlying factors. Therefore, the aim of my doctoral research was twofold: on the one hand, I aimed to adapt a scale measuring test anxiety to Hungarian and examine its factor structure, and on the other hand, I intended to investigate some of the background factors of test anxiety, including individual, family and peer group characteristics, focusing on variables for which little or no empirical evidence is available regarding their role in test anxiety. In this dissertation, I present the results of a total of four studies.

The first and second studies aimed to prepare the Hungarian adaptation of the Cognitive Test Anxiety Scale (CTAS) and analyse the psychometric properties of the Hungarian version of the scale. The only test anxiety measure available in Hungarian is the TAI (Spielberger et al., 1980; Sipos et al., 1988), which was adapted for students in primary schools. Since university students are particularly affected by test anxiety (Naveh-Benjamin et al., 1997), it is important to have a test anxiety questionnaire that is well suited for this age group. The CTAS is a scale designed specifically for university students and heavily focuses on the cognitive aspect of test anxiety that is found to be more closely related to poor performance (Cassady & Johnson, 2002). However, the empirical results regarding the one-dimensional factor structure of the CTAS proposed in previous studies (e.g., Cassady and Johnson, 2002; Furlan et al., 2009) are not entirely clear (e.g., Furlan et al., 2009), and different theoretical approaches suggest that cognitive test anxiety is a multi-component construct (e.g., Lowe et al., 2008; Sarason, 1984). Therefore, a Hungarian adaptation of the CTAS and a revision of the one-dimensional factor structure suggested by previous studies (e.g., Cassady and Johnson, 2002; Furlan et al., 2009) are warranted. In Study 1, we aimed to (1) analyse the factor structure of the

CTAS, (2) test the reliability of the scale, and (3) analyse the associations between CTAS scores and validating variables to gather validity evidence for the interpretation of test scores (Reeves and Marbach-Ad, 2016). A further important consideration regarding the interpretation of CTAS scores may be whether the construct measured by the scale is trait-like or state-like phenomenon. Given that psychological states are more likely to vary depending on the context than traits (Heatherton & Polivy, 1991), and evaluative situations are known to influence scores on state-test anxiety scales (Zeidner, 2007), the effect of the antecedents of test administration may be informative in this regard. The relative stability of CTAS scores across different exam-related situations has been supported by the results of a previous study (Cassady, 2001), but to our knowledge, the extent to which the scale scores reflect the current states of subjects or to what extent they fluctuate when situations related and non-related to tests are compared have yet to be empirically tested. Therefore, the next important aim of Study 1 was to (4) clarify whether cognitive test anxiety measured by the CTAS should be considered a trait or a state. To do so, the possible effect of an exam completed immediately before administering the CTAS was tested. The main aim of Study 2 was to confirm and extend the results of Study 1 conducting analyses on data gathered from an independent sample. Therefore, we aimed to perform a confirmatory analysis to test the factor structure of the CTAS revealed in Study 1 (5), to re-examine the reliability of the questionnaire (6), and to present further evidence on the validity of the interpretation of the CTAS scores (7) by including new validating variables, focusing specifically on different aspects of anxiety. Finally, we sought to further clarify the results of Study 1 regarding the trait or state nature of the constructs measured by the CTAS and its subscales. Therefore, we investigated whether (in addition to the tests immediately taken before administering the CTAS in Study 1) exams taken during the week prior to, or upcoming exams during the week after responding the items of the scale could influence CTAS scores (8).

In the third study, a joint analysis of family and personal correlates of test anxiety was conducted: we aimed to investigate the associations between family cohesion, self-esteem and test anxiety among university students. Previous research has drawn attention to the importance of family characteristics, including cohesion, during this life period, often referred to as emerging adulthood (Arnett, 2000; Cheung et al., 2019; Guassi Moreira & Telzer, 2015). In addition, empirical results from prior studies have demonstrated that many family characteristics are associated with test anxiety among adolescents (Peleg et al., 2016; Ringeisen and Raufelder, 2015), but less is known about

how university students' proneness to test anxiety is related to the extent of cohesion experienced in the family of origin, and it is unclear which intrapersonal variables mediate this relationship. In previous studies, low global self-esteem has been shown to be an important predictor of test anxiety (e.g. Embse et al., 2018; Xie et al., 2019), but less is known about the relationship between contingent self-esteem and test anxiety. However, based on the self-worth theory of performance goals (Covington, 2000), the control-value theory (Pekrun, 2006) and a few empirical results on the relationship between test anxiety and domain-specific contingencies of self-worth (Lawrence & Smith, 2017; Lawrence & Williams, 2013), the association between the two variables seems to be supported. Furthermore, results from several studies have shown that family characteristics (e.g., cohesion) are related to an individual's self-esteem (Guassi Moreira and Telzer, 2015; Jagers et al., 2015), however, it is unclear whether global self-esteem or contingent self-esteem mediates the relationship between family cohesion and test anxiety. In the third study, we hypothesized that (9) global self-esteem was negatively related to test anxiety, (10) contingent self-esteem was positively related to test anxiety, and the relationship between adaptive family cohesion and test anxiety was mediated by global self-esteem and contingent self-esteem, with family cohesion being a positive predictor (11) of the former and a negative predictor (12) of the latter. Finally, we aimed to examine how demographic moderator variables influence these relationships. Given that young adult men perceive themselves as more independent from their family of origin compared to women of similar age (Lopez et al., 1988), and considering that the co-residence of emerging adults and their family of origin is generally associated with more interaction and higher intensity of the relationship compared to living apart (Ward and Spitze, 2007; White and Rogers, 1997), we hypothesized that the relationships between family cohesion and the intrapersonal variables (global self-esteem, contingent self-esteem, and test anxiety) were stronger for females compared to males (13) and for university students living together with their family of origin compared to those living apart (14).

In the fourth study, the role of peer factors and social comparisons in the peer group was investigated among primary and secondary school students, specifically, the associations between friends' academic achievement and test anxiety were tested. Results from previous studies showed that the peers' academic achievement and social comparisons within a school or classroom impact academic self-concept (Becker and Neumann, 2017; Fang et al., 2018) and performance-related emotions, including anxiety

(Pekrun et al., 2019), a phenomenon also known as the "big-fish-little-pond-effect" (BFLPE). In addition, there is a large body of evidence on the importance of friends' characteristics (including their academic performance) regarding various aspects of students' school life, including their academic self-concept (Keyserlingk et al., 2020; Kretschmer et al., 2018). However, less is known about the relationship between friends' academic performance and students' test anxiety. Previous studies supported the relationship between performance goal orientation and test anxiety (Eum and Rice, 2011; Yang and Taylor, 2013), and pointed out that performance goals influence the association between social comparisons and negative performance-related emotions (Régner et al., 2007). The question arises whether this moderating effect holds for the relationship between social comparisons and test anxiety. Therefore, the main objective of Study 4 was to investigate how the academic achievement of school friends is related to students' test anxiety besides an aspect of self-evaluation: global self-esteem. We also assumed that (15) friends' academic achievement was a positive predictor of test anxiety (16) and a negative predictor of global self-esteem when controlling for the individual's own academic performance. Furthermore, we hypothesized that global self-esteem (17) was negatively related to test anxiety (18), and partially mediated the association between test anxiety and friends' academic performance. We also aimed to investigate the moderating role of performance goal orientation in the relationship between friends' academic achievement and test anxiety, hypothesizing that the association would be stronger in the case of students with high performance goal orientation (19).

## **2. The Hungarian adaptation of the CTAS and investigation of its factor structure: Study 1 and Study 2**

Due to the similarity of the two studies regarding the research questions, the methods and statistical analyses used, and the interplay of the results, the two studies are presented in parallel.

### **2.1. Method**

In Study 1, a total of 691 university students (354 female, 323 male, 14 respondents did not specify their gender), aged 18-32 years ( $M = 20.94$ ,  $SD = 2.12$ ) participated. Not all of the total sample of 691 participated in all parts of the study, and

different subsamples were created for certain analyses (e.g., test-retest reliability, validity testing, trait-or-state study). In order to analyse the influence of the antecedents of test administration, thereby the trait or state nature of cognitive test anxiety as measured by the CTAS, 155 respondents who had already completed the CTAS at some point of the semester were asked to do so again at the end of the semester. For some of the respondents, this was done during the last lecture of the course ("lecture" group;  $n = 73$ ), and for the others immediately after the end-of-semester exam at the end of the course ("exam" group;  $n = 82$ ). This arrangement allowed us to compare the CTAS scores of the two groups and the two measurement times.

In Study 2, 299 university students (218 female, 77 male, 4 respondents did not specify their gender) participated. The average age of respondents at the time of the study was 21.8 years ( $SD = 2.98$ ). In order to analyse the influence of the number of preceding or upcoming exams, respondents indicated the number of exams they had taken in the seven days before and the number of exams they were expecting to take in the seven days after the completion of the survey.

Both Study 1 and Study 2 were based on self-report measures. Participants completed questionnaires including the Cognitive Test Anxiety Scale and scales intended to measure variables that were used to assess validity. The measures used in each study are summarized in Table 1.

**Table 1**

Questionnaires used in Study 1 and Study 2, as well as their original authors

			Study 1	Study 2
Cognitive Test Anxiety Scale	CTAS	Cassady & Johnson, 2002	✓	✓
State-Trait Anxiety Inventory	STAI	Spielberger et al., 1970	✓	✓
Abbreviated Math Anxiety Scale	AMAS	Hopko et al., 2003	✓	✓
Test Anxiety Inventory	TAI	Spielberger et al., 1980	X	✓
Fear of Negative Evaluation Scale	FNE	Watson & Friend, 1969	X	✓
Rosenberg Self-Esteem Scale	RSES	Rosenberg, 1965	✓	X
Global Self-Efficacy Scale	GSES	Schwarzer & Jerusalem, 1995	✓	X

## **2.2. Main results**

### **2.2.1. Investigation of the factor structure**

To examine the factor structure, we first performed an exploratory factor analysis in Study 1 using WLSMV estimation and Geomin rotation. Based on the results, a total of 20 items and three factors were retained at the end of the item selection process. The first factor was interpreted as general worry (“I worry more about doing well on tests than I should”), the second as freezing up “At the beginning of a test, I am so nervous that I often can’t think straight.”), and the third as fear of failure “During tests, I find myself thinking of the consequences of failing”).

To examine the fit of the model identified from the EFA results, a confirmatory factor analysis was performed using WLSMV estimation on another subsample of Study 1 (whose data were not included in the EFA) ( $n = 250$ ). The model showed excellent fit based on the criteria suggested by Hu and Bentler (1999):  $\chi^2(167) = 335.24$ ;  $CFI = .95$ ;  $TLI = .95$ ;  $RMSEA = .06$  [.05-.07];  $WRMR = 0.97$ . In Study 2, the measurement model defined in Study 1 was tested on data gathered from another independent sample ( $N = 299$ ), and the fit indices were found to be adequate in this case as well:  $\chi^2(167) = 337.55$ ;  $CFI = .96$ ;  $TLI = .95$ ;  $RMSEA = .07$  [.06, .07];  $WRMR = 1.02$ .

### **2.2.2. Reliability analysis**

Based on the Cronbach's alpha and McDonald's omega indicators, the internal consistency of the CTAS subscales and the full scale was found to be adequate in both Study 1 and Study 2.

The temporal stability of CTAS scores, i.e. test-retest reliability, which was investigated using a 4–6 week interval between test administration points, was also high. The results on the reliability of the CTAS are presented in Table 2.

**Table 2**

Cronbach's alpha and McDonald's omega values for the internal consistency of the CTAS subscales, and the results of Spearman correlation analyses for test-retest reliability

	Study 1				Study 2			
	internal consistency		test-retest		internal consistency		test-retest	
	$\alpha$	$\omega$	$\rho$	$p$	$\alpha$	$\omega$	$\rho$	$p$
general worry	0,86	0,85	0,83	< 0,001	0,84	0,84	0,81	< 0,001
freezing up	0,84	0,84	0,82	< 0,001	0,87	0,86	0,84	< 0,001
fear of failure	0,81	0,81	0,68	< 0,001	0,82	0,83	0,71	< 0,001
CTAS total score	0,92	0,92	0,86	< 0,001	0,92	0,92	0,85	< 0,001

### 2.2.3. Validity evidence based on relationships with other constructs

Correlations among total CTAS scores, test anxiety subscales, and validation variables were computed to provide additional validity evidence for the interpretation of test scores. The validating variables included general state and trait anxiety, math anxiety, global self-esteem, self-efficacy and academic achievement in Study 1. Almost all correlations were low to moderate, highly significant, and in the expected direction. The relationship of test anxiety with the two dimensions of the AMAS scale was stronger for math evaluation anxiety ( $\rho = .42, p < .001$ ) than for learning math anxiety ( $\rho = .23, p < .001$ ) which is of particular relevance for the interpretation of scores. The most noticeable differences among CTAS subscales were found with respect to their associations to indicators of academic performance: only freezing up and fear of failure were significantly correlated with these variables, and the relationships were slightly stronger for the for the GPAs of the last semester (freezing up:  $\rho = -.29, p < .001$ ; fear of failure:  $\rho = -.18, p = .004$ ) and the maturity exam in the case of freezing up (freezing up:  $\rho = -.28, p < .001$ ; fear of failure:  $\rho = -.11, p = .004$ ) than for the the GPAs of the final academic year at secondary school (freezing up:  $\rho = -.18, p < .001$ ; fear of failure:  $\rho = -.12, p = .004$ ).

In Study 2, the validity of the interpretation of CTAS scores was analysed investigating their relationships with different forms of anxiety, namely general trait anxiety, social anxiety, math anxiety and two dimensions of test anxiety measured by the TAI scale. All validating variables showed significant positive relationships with all three subscales and the total score of the CTAS. The weakest relationship was found between the CTAS freezing up dimension and learning math anxiety ( $\rho = .22, p = .006$ ), while the strongest relationship was found between the CTAS total score and the TAI emotionality



subscale ( $\rho = .76, p < .001$ ). Overall, the CTAS total score and its subscales were most strongly correlated with the two dimensions of the TAI. While freezing up and fear of failure were slightly more strongly correlated with the worry subscale of the TAI (freezing up:  $\rho = .66, p < .001$ ; fear of failure:  $\rho = .65, p < .001$ ) compared to emotionality (freezing up:  $\rho = .64, p < .001$ ; fear of failure:  $\rho = .59, p < .001$ ), general worry was more strongly associated with the latter (worry:  $\rho = .56, p < .001$ ; emotionality:  $\rho = .72, p < .001$ ).

#### **2.2.4. The nature of cognitive test anxiety: the effect of administration context**

In Study 1, two-way mixed analyses of variance were conducted to investigate whether CTAS scores are affected by responding the items immediately after completing an exam, i.e., whether a current exam experience influences the levels of test anxiety reported by respondents. With respect to the influence of the antecedent of administration, no significant main effects of group or measurement time or interactions were found in the case of the total CTAS score, or the scores of certain subscales

In Study 2, we tested whether the experience or anticipation of test situations during a longer period (seven days) before or after the administration of the questionnaire influenced the level of test anxiety measured by the CTAS. To do this, participants were assigned into groups according to two criteria (Have you had an exam in the past seven days? Will you have an exam in the upcoming seven days?) and their scores on the CTAS scales were compared using two-way independent ANOVA. Significant differences were only found regarding the fear of failure subscale and the total score, and only between groups based on the *last* week's exams: those who had participated in an exam situation during the last seven days before the exam had on average higher scores on these dimensions (fear of failure:  $F(1) = 11.20; p = .001; \eta p^2 = .04$ ; CTAS total score:  $F(1) = 3.89; p = .049; \eta p^2 = .01$ ). The main effect of groups based on upcoming exams and the interaction of these two dimensions did not prove significant for either subscale or total scale score.

### **2.3. Discussion**

One of the main objectives of Study 1 and Study 2 was to thoroughly analyse the factor structure of the CTAS. The results of Study 1 revealed a three-dimensional solution, which was confirmed by the analyses in Study 2. This model differs from the CTAS models proposed in previous studies (Cassady and Finch, 2014; Cassady and

Johnson, 2002; Furlan et al., 2009), but the cognitive test anxiety dimensions identified in the present study are not without precedent: they are in line with the components presented in several previous studies (Covington, 1985; Lowe et al., 2008). The first dimension, general anxiety, contains items that are less specific in content than the other two factors, and rather describe the overall degree to which the individual feels excited, anxious or calm about the exam situation (e.g., “While taking a test, I feel confident and relaxed”). The second factor, freezing up, refers to situations in which students are unable to organize their thinking or effectively retrieve information from memory due to the anxiety experienced during tests or exams. This dimension includes items such as “During a course examination, I get so nervous that I forget facts I really know”. Finally, the fear of failure scale consists of statements that express the expectation of poor performance and its negative consequences, such as “When I take a test that is difficult, I feel defeated before I even start”.

The CTAS scales demonstrated high internal consistency and temporal stability according to our data, and the relationships with validating variables provided important evidence for the validity of the interpretation of CTAS scores. The most noticeable difference between CTAS dimensions can be observed in their associations with indicators of academic achievement: only freezing up and fear of failure scores were significantly related to academic achievement, with the former (in which reduced performance is a core element of the interpretation) showing slightly stronger associations. One possible explanation may be that the items of the first subscale also cover aspects of test anxiety (e.g. uneasiness, lack of calmness) that might, to some extent, facilitate performance (Alpert and Haber, 1960) and, therefore, the association is not clearly negative.

Finally, the results on the influence of the administration context suggest that CTAS scores were affected neither by an exam completed immediately before responding CTAS items, nor the upcoming exams *expected during seven days following the administration of the CTAS*. However, the CTAS total score, as well as scores on the fear of failure (and the freezing up) dimension were found to differ across groups based on exams taken during seven days prior to completion. In all three cases, higher levels of anxiety were found in the case of participants who took part in at least one evaluative situation during the week prior to test administration. This result raises further questions about the general worry dimension, which differed from the other two subscales in this respect.

### **3. Associations between family cohesion, self-esteem and test anxiety: Study 3**

#### **3.1. Method**

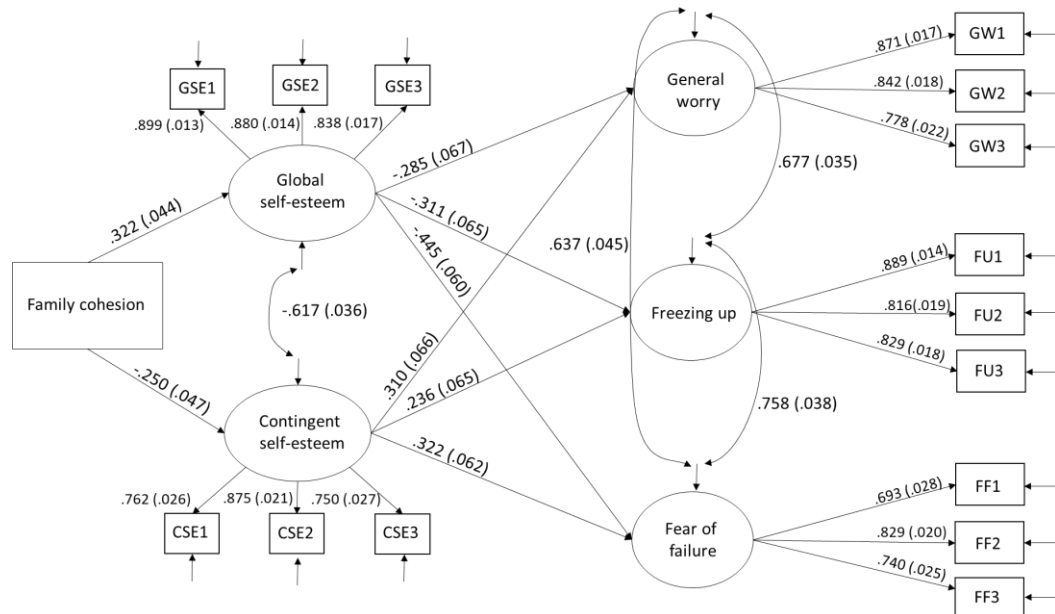
A total of 487 participants, aged between 18 and 25 years ( $M = 20.90$ ,  $SD = 1.41$ ), university students, 352 women and 130 men (five participants did not specify their gender), agreed to participate in the study. Data were collected using self-report questionnaires. Respondents completed the Cognitive Test Anxiety Scale (CTAS; Cassady and Johnson, 2002), Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965), Contingent Self-Esteem Scale (CSES; Johnson and Blom, 2007), Family Adaptability and Cohesion Evaluation Scale IV (FACES; Olson, 2011).

#### **3.2. Main results**

The relationships described in the hypotheses were analysed using structural equation modelling (SEM). The model demonstrated adequate fit according to the different indicators ( $CFI = .97$ ,  $TLI = .95$ ,  $RMSEA = .06$ ,  $SRMR = .04$ ,  $\chi^2 = 252.37$ ,  $p < .001$ ). The results of the structural model are presented in Figure 1. Based on the SEM results, the three dimensions of test anxiety were negatively predicted by global self-esteem and positively predicted by contingent self-esteem. Family cohesion was positively related to global self-esteem and negatively associated with contingent self-esteem. The direct paths between cohesion and test anxiety were not found to be significant, however, the indirect relationships between the two variables via global self-esteem and contingent self-esteem were.

**Figure 1**

*Structural model of the associations of family cohesion, global and contingent self-esteem, and test anxiety. N = 470*



Note: Standardized beta coefficients and their standard errors (in parentheses) are presented in the figure. For clarity of presentation, nonsignificant direct paths ( $p > .05$ ) between family cohesion and test anxiety dimensions are not shown.

GSE: Global self-esteem, CSE: Contingent self-esteem, GW: General worry, FU: Freezing up, FF: Fear of failure: global self-esteem, FÖ: conditional self-esteem, A: general anxiety, L: freezing, K: fear of failure

Multigroup analyses were conducted to examine the moderating effects of gender and co- residence. When examining gender groups, no significant difference was found between the constrained (in which paths were constrained to be equal across both groups) and unconstrained models (in which all path coefficients were freely estimated) ( $\Delta\chi^2 [12] = 8.52, p = .743$ ), suggesting that the model is similar for men and women. Comparing groups based on residence, no significant difference between the fully constrained and unconstrained models ( $\Delta\chi^2 [12] = 8.22, p = .767$ ) were found either.

### 3.3. Discussion

A primary finding of this study is that in addition to global self-esteem being negatively associated with test anxiety, which is aligned with prior research (Dan et al., 2014; Sarı et al., 2018), contingent self-esteem was also found to be a significant predictor of test anxiety, suggesting that students whose self-esteem is based on their competence worry more about examinations than their peers. The SEM results also supported our hypothesis regarding the mediating role of global self-esteem and contingent self-esteem

in the family cohesion-test anxiety relationship. The mediating role of self-esteem can be interpreted as follows: adaptive family cohesion influences test anxiety by increasing global self-esteem and decreasing conditional self-esteem. Families that provide an adequate extent of emotional closeness and autonomy, thereby contribute to an increase children's level of self-esteem, presumably true self-esteem. As a result, these children do not need to gain self-worth through external factors (i.e., contingent self-esteem); therefore, they will be less prone to test anxiety than their peers. The analyses suggest that the contributions of family cohesion to test anxiety are in the case of men and women, as well as for emerging adults living with or apart from their family of origin. The lack of differences between groups based on co-residence may be explained by the fact that our results on the associations between family cohesion, self-esteem and test anxiety do not primarily reflect the current influence of family relationships, but rather their impact during earlier development.

#### **4. The interrelations of students' test anxiety, self-esteem and friends' academic achievement: Study 4**

##### **4.1. Method**

Adolescents aged between 13 and 19 years were recruited from 5 schools and 26 school classes to participate in our study. Data gained from 323 students were summarized in the final database. 46.4% of the respondents were male, 52.1% were female and 3.1% did not indicate their gender. Participants answered questions on demographics (e.g., gender), education (e.g., school grades, how long they have been at the given school), friendships (e.g. how many friends they have in class) and the grades they and their closest friends most frequently get in six subjects. In addition, they completed the following questionnaires: Test Anxiety Inventory (TAI, Spielberger et al., 1980), Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965), Goal Orientation Questionnaire (Pajor, 2015).

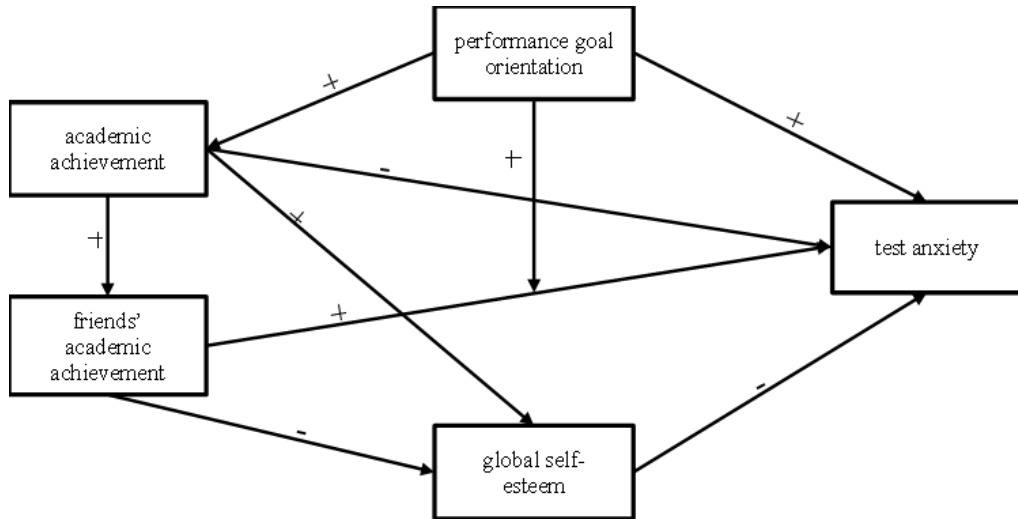
##### **4.2. Main results**

To test the hypotheses, two versions of the model shown in Figure 2 were tested using path analysis. The two versions of the model used different indicators of friends' academic achievement: friends' grade point average (Model 1) or the proportion of

unfavourable domain-specific comparisons with friends was included in the analysis (Model 2).

**Figure 2**

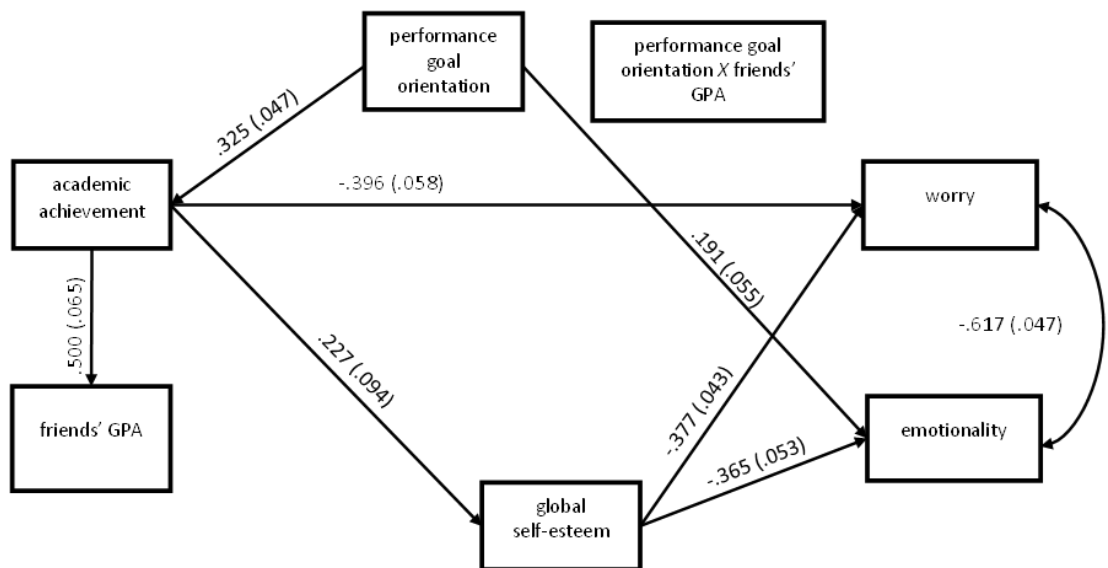
The conceptual model tested in study 4



In Model 1 (Figure 3), we hypothesized that there would be both a direct and indirect (via self-esteem) relationship between friends' GPA and test anxiety when controlling for the respondent's own academic performance.

**Figure 3**

Results of the path analysis using GPA as the indicator of friends' achievement (Model 1)



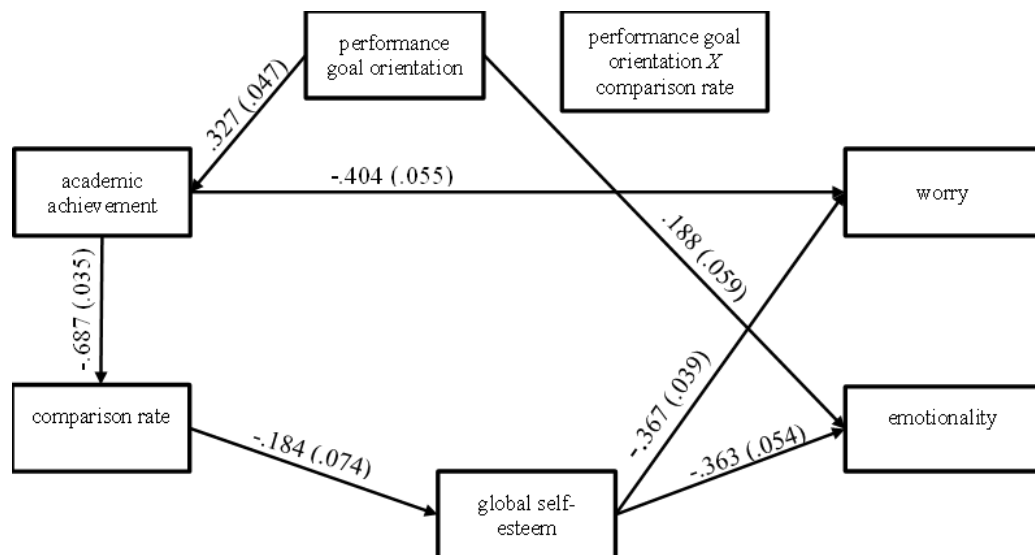
The standardized beta coefficients and their standard errors (in parentheses) are shown in the figure. For clarity, only significant relationships are shown.

The model demonstrated excellent fit according to the criteria suggested by Hu and Bentler (1999):  $CFI = .99$ ,  $TLI = .98$ ,  $RMSEA = .04$  [.00-.10],  $SRMR = .03$ ,  $\chi^2 / df = 7.46/5$ . Global self-esteem negatively predicted both dimensions of test anxiety to the same extent and was found to mediate the association between academic achievement and both dimensions of test anxiety (indirect effects: worry  $\beta = -.086$ ,  $S.E. = .040$ ,  $p = .033$ ; emocionalit as:  $\beta = -.083$ ,  $S.E. = .039$ ,  $p = .034$ ). Besides, worry was directly associated with academic achievement as well. Performance goal orientation was found to positively predict emotionality and academic achievement. Furthermore, it was indirectly and negatively related to worry via academic achievement ( $\beta = -.129$ ,  $S.E. = .030$ ,  $p < .001$ ). However, neither the relationship between friends' GPA and test anxiety or self-esteem, nor the association between the performance goal orientation-friends' GPA interaction term and test anxiety reached significance at the  $p < .05$  level. 35.1% of the variance of worry and 17.5% of emotionality was explained by the model (worry:  $R^2 = .351$   $S.E. = .058$ ,  $p < .01$ ; emotionality:  $R^2 = .175$   $S.E. = .047$ ,  $p < .01$ ).

Results of the other path analysis (Model 2) in which comparison rate was used as an indicator of friends' achievement are presented in Figure 4.

**Figure 4.**

Results of the path analysis using comparison rate as the indicator of friends' achievement (Model 2)



Note. Standardized beta coefficients and their standard errors (in parentheses) are presented in the figure. For clarity, only significant relationships are shown.

Except for the indicator of friends' school performance, Model 2 was identical to Model 1 and demonstrated adequate fit indices ( $CFI = .99$ ,  $TLI = .94$ ,  $RMSEA = .07$  [.01-.12],  $SRMR = .04$ ,  $\chi^2 / df = 11.51/5$ ). The general pattern and strength of associations were

similar to those in Model 1. The main difference was that comparison rate did predict global self-esteem which mediated the association between comparison rate and both aspects of test anxiety (worry:  $\beta = .068$ ,  $S.E. = .029$ ,  $p = .019$ ; emotionality:  $\beta = .067$ ,  $S.E. = .030$ ,  $p = .027$ ). In Model 2, 34% of the variance of worry and 16.8% of emotionality was explained by predictors (worry:  $R^2 = .340$   $S.E. = .048$ ,  $p < .001$ ; emotionality:  $R^2 = .168$   $S.E. = .044$ ,  $p < .001$ )

### 4.3. Discussion

The first two hypotheses regarding the associations between friends' achievement and test anxiety, as well as the mediating role of self-esteem in this connection, were partially supported. Friends' grade point average, which was used as an indicator of friends' academic achievement in Model 1, did not predict either self-esteem or test anxiety when students' own grades were taken into account. Regarding Model 2, in which comparison rate was used as an indicator of friends' academic performance instead of their GPA, results were overall more consistent with our preliminary hypotheses. Although the comparison ratio did not directly predict either aspect of test anxiety, the results suggest that high rate of comparisons students felt like falling behind their friend was associated with lower self-esteem and thereby higher their test anxiety. Thus, our results support an indirect relationship between comparison rate and test anxiety, as well as the mediating role of global self-esteem, but not a direct association. Thus, summarizing the results of Models 1 and 2, we conclude that the contrast effect related to the BFLPE phenomenon can be observed when investigating the associations between friends' school performance and students' global self-esteem and test anxiety. Furthermore, an important finding is that not the absolute value of friends' grades was related to students' lower self-esteem and higher test anxiety but lower levels of their own achievement and the high rate of comparisons they felt like being outperformed by their friends. Our results did not support our hypothesis regarding the moderating role of performance goal orientation in the friends' academic achievement-test anxiety relationship, suggesting that results regarding the non-existence of direct association between these variables prevail regardless of students' performance goal orientation level. However, performance goal orientation was related to both aspects of test anxiety: negatively and indirectly to worry, while positively and directly to emotionality.



## **5. Conclusion**

The research presented in this dissertation extends existing scientific findings in several ways. The dissertation provides methodological considerations on the measurement of test anxiety: the studies extend the knowledge of an already widely used measurement tool and suggest the possibility of a new approach to its application, the validity of which has been supported by several studies presented in the dissertation. The investigation of the usability of the scale in question in different contexts and with different antecedents raises further methodological aspects that may be worth exploring, even in relation to other questionnaires. Furthermore, the results presented in this dissertation contribute to further conceptual clarification of test anxiety, especially cognitive test anxiety, and to a more precise understanding of the phenomenon and its nature. Furthermore, the results bring us closer to explaining what makes individuals prone to test anxiety: in particular, the inclusion of two factors in the investigations provided new findings compared to previous research, namely the new aspect of self-esteem, contingent self-esteem, and the rate of unfavourable comparisons with friends. In addition to identifying the background factors, the results of this dissertation also contribute to a deeper understanding of the relationship between predisposing factors and test anxiety through the investigation of the role of different mediator and moderator variables.

## **6. Limitations and future directions**

However, the studies presented in this thesis have several limitations, including the potential bias arising from convenience sampling and self-report data, the correlational nature of the analyses, and the limitations of drawing conclusions about causality in each study. It is also important to note that in each of the studies, trait test anxiety, i.e. the tendency to test anxiety, was examined, but the actual level of anxiety experienced in a particular situation (state anxiety) may be influenced by a number of additional, mainly environmental, factors. In addition, there are variables in all four studies that would have been worth investigating further but were beyond the scope of the present research. These include, for example, the importance of additional family characteristics, parental attitudes, expectations, involvement or the importance of self-differentiation in the context of examining the role of family cohesion and self-esteem. In the context of the

relationship between friends' school performance and test anxiety, it would have been worth considering factors such as the characteristics of friendships (e.g. reciprocity) or attitudes towards comparison domains (e.g. interest, motivation). An important target for future research could be to examine these factors together with issues such as the reasons for differences between general worry and the other two CTAS dimensions.

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## **8. List of publications**

### **8.1. Publications related to the topic of the dissertation**

- Németh, L., & Bernáth, L. (in press). The Nature of Cognitive Test Anxiety: An Investigation of the factor structure of the Cognitive Test Anxiety Scale. *Educational Assessment*.
- Németh, L., & Bernáth, L. (2022). The Mediating Role of Global and Contingent Self-Esteem in the Association Between Emerging Adults' Perceptions of Family Cohesion and Test Anxiety. *Journal of Adult Development 29*(3), 192–204.
- Németh, L., Koncz, Á., & Bernáth, L. (megjelenés alatt). Újabb eredmények a Kognitív Vizsgaszorongás Kérdőív magyar változatának pszichometriai jellemzőivel kapcsolatban. *Alkalmazott Pszichológia*.

## **8.2. Conference presentations related to the dissertation topic**

- Németh L., Bernáth L. (2018). A CTAS (Cognitive Test Anxiety Scale) magyar adaptációja. A Magyar Pszichológiai Társaság XXVII. Országos Tudományos Nagygyűlése. Budapest, 2018. május 31. – június 2.
- Németh, L., Bernáth, L. (2019). A vizsgaszorongás, önértékelés és családi tényezők összefüggéseinek vizsgálata egyetemi hallgatók körében. A Magyar Pszichológiai Társaság XXVIII. Országos Tudományos Nagygyűlése. Debrecen, 2019. május 30-június 1.
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## **8.3. Publications not related to the topic of the dissertation**

- Bernáth L., N. Kollár K., Németh L. (2015). A tanulási stílus mérése. *Iskolapszichológia* 36. Budapest: Eötvös Kiadó.
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## **8.4. Conference presentations not related to the topic of the dissertation**

- Bernáth L., Krisztián Á., Németh L., Kovács A. (2017). Az AMAS (Abbreviated Math Anxiety Scale) magyar adaptációja. A Magyar Pszichológiai Társaság XXVI. Országos Tudományos Nagygyűlése. Szeged, 2017. június 1-3.
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