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THE TEST RELATED NEGATIVE COGNITIONS SCALE: A KEY PIECE OF THE PUZZLE IN UNDERSTANDING THE RELATIONSHIP BETWEEN TEST ANXIETY AND PSYCHOLOGICAL RESOURCES

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Abstract

The present study aims to develop a valid and reliable scale to assess test-related negative cognitions of adolescents and examine whether these negative cognitions mediate the relationship between psychological resources (self-esteem and resilience) and test anxiety. A total of 446 participants were included in Study I (58.20% female, average age 15.69) and 466 (66.7% female, average age 15.06) in Study II. The data collection instruments included the Test-Related Negative Cognitions Scale (TRNCS), the Test Anxiety Inventory, the Brief Resilience Scale, and the Two-Dimensional Self-Esteem Scale. The study showed that the TRNCS, consisting of 15 items, explains 68% of the total variance and has a Cronbach alpha (α) value of 0.92. Confirmatory factor analysis revealed that items were fitted to four factors, and standardized item loadings ranged from .59 to .94. TRNCS is a valid and reliable tool for measuring students' test-related negative cognitions. Results indicated that test-related negative cognitions mediated the relationships between psychological resources and test anxiety. Based on the cognitive behavioral therapy model's understanding of the mutual influence of psychological resources, negative thought patterns, and anxiety, it is recommended that interventions aimed directly at identifying

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and addressing test-related negative cognitions may be effective in reducing test anxiety.

Keywords: test anxiety, negative cognitions, adolescent, resilience, self-esteem.

In modern education, it is commonplace for tests to be used as a decision-making tool, and individuals may encounter testing with regularity from early childhood until late adulthood. However, academic exams are a significant source of stress for many children and adolescents (Ergene, 2003; McDonald, 2001). Test anxiety, a common response to the stress of academic examinations (Brodersen, 2017; Gibson, 2014), is a form of anxiety that specifically pertains to the situation an individual experiences before, during, and after an evaluative situation (Zeidner, 1998; 2014). It refers to the subjective experience of intense physiological, cognitive, and/or behavioral anxiety symptoms that affect test performance before or during the test. Physiological arousal, tension, intrusive thoughts, intense worry, and mental disorganization typically characterize it (Sawka-Miller, 2011). Test anxiety interferes with learning through deficiencies in encoding, organization, and storage (Cassady, 2004). Students with test anxiety are easily distracted by cognitive tasks and have difficulty understanding relatively simple instructions and questions (Zeidner, 2014). Test anxiety, which often has destructive consequences in learning and achievement environments, is quite common (Roos et al., 2021). Related studies have estimated the prevalence of test anxiety for school-age children to be between 10% and 40% (McDonald, 2001; Putwain & Daly, 2014). The study conducted in Turkey regarding the prevalence of test anxiety revealed that among the student population surveyed, 19% exhibited low levels of test anxiety, 42% displayed moderate levels, and 39% were found to have high levels of test anxiety (Yıldırım, 2008). Elevated levels of test anxiety among students have been empirically linked to diminished academic performance (Cassady & Johnson, 2002; Putwain & Daly, 2013) and academic achievement in comparison to their peers exhibiting lower levels of test anxiety (Peleg, 2009). As a matter of fact, meta-analysis results also showed that high test-anxious students cannot perform their real performance due to their anxiety (Hembree, 1988; Seipp, 1991; von der Embse et al., 2018). However, students with test anxiety confront not only academic challenges but may also encounter concomitant mental health issues (Huntley et al., 2019; Soares & Woods, 2020). It was found that test anxiety is associated with depression, hopelessness, low self-esteem, trait anxiety, and suicidal ideation (Kavakçı et al., 2014; King et al., 1995; Peleg, 2009). Accordingly, it can be said that intensive test anxiety negatively affects students' academic, social, and psychological development.

Test anxiety is a multidimensional construct with more than one interrelated component (Gibson, 2014; Roos et al., 2021). Firstly, Liebert and Morris (1967)

conceptualized test anxiety as a two-component construct of worry and emotionality. The worry aspect involves negative thoughts, beliefs, or cognitive patterns linked to the potential of test failure, whereas the emotionality aspect is connected to the feelings and physiological sensations experienced in the body (Akinsola & Nwajei, 2013; Cassady, 2004; Cizek & Burg, 2006). Over the years, several measurement tools have been developed to assess test anxiety and its dimensions. Historically, two-factor measurement tools, including emotionality and worry (Spielberger, 1980), have diversified with multidimensional measurement tools. In the literature, there are measurement tools that include worry and test-irrelevant thinking as a cognitive dimension, bodily symptoms and tension as an emotional dimension (Sarason, 1984), thoughts as a cognitive dimension, autonomic reactions as an emotional dimension, and off-task behaviors as a behavioral dimension (Wren & Benson, 2004). Similarly, theoretical developments of test anxiety have evolved parallel with the measurement. In the deficit model, test anxiety is attributed to a deficiency in the knowledge and skills necessary to perform well in evaluative situations (Tobias, 1985). Lowe et al. (2008) suggested a framework for the biopsychosocial model of test anxiety. Thus, they have employed social and educational contexts such as family and school in understanding test anxiety. After that, Segool et al. (2014) used statistical modeling to propose a cognitive-behavioral framework for test anxiety. This framework includes a systematic interaction of cognitive processes and perceptions, learning experiences, demographic characteristics, social and cultural context, and the contingencies present in the environment. Besides that, meta-analyses have indicated that the link between test performance and test anxiety is generally more strongly related to cognitive factors than emotional dimensions (Hembree, 1988; Seipp, 1991; von der Embse et al., 2018). As a matter of fact, meta-analyses and systematic literature reviews on interventions for test anxiety have concluded that cognitive, behavioral, or cognitive-behavioral interventions with study skill training are effective (Ergene, 2003; Hembree, 1988; Huntley et al., 2019; Soares & Woods, 2020).

Test Anxiety and Negative Cognitions

According to the cognitive-behavioral model, people's emotions, behavior, and physiology are influenced by their perception of events, and negative thoughts cause negative emotions (Beck, 2021). The cognitive processes mediate the behavioral and emotional responses of the person to stressful evaluation situations (Beck, 2021; Tabur et al., 2024; Zeidner, 2014). When a student evaluates the testing process as potentially dangerous and beyond their competence and coping resources, the interaction between the student and the testing environment will be assessed as stressful and anxiety-provoking (Zeidner, 1998). In the Self-Referent Executive Processing (S-REF) model (Zeidner & Matthews, 2005) test-anxious students assess testing situations as personally significant. In situations where failure is a possible

outcome, these students apply inefficient coping strategies that will reduce their negative emotions rather than the possibility of failure. Thus, the behavioral, emotional, and cognitive components of test anxiety create a self-perpetuating cycle of anxiety as stated in other test anxiety models (Flaxman et al., 2003; Lowe et al., 2008; Zeidner, 1998).

High-test-anxious students experience more negative cognition and subjective distress before, during, and after the test (Beidel & Turner, 1988). Negative thoughts related to the test can be exemplified as a lack of confidence in self-performance, preoccupation with humiliating thoughts of the self, feeling unprepared for the test, and making false interpretations of the self (Cassady & Johnson, 2002; Zeidner, 1998). Students have negative thoughts about their skills in studying and taking tests, and their academic competence (Zeidner & Matthews, 2005). With the fear of failure, students may think that the worst possible outcome will occur and that they will not pass the exam (for instance, "If I fail this exam, my entire life will be deemed a failure."). Students may overgeneralize one poor performance to predict future failures (for instance, "I will fail all the tests I take."). They also have negative thoughts about comparing themselves with their peers and how other people, like parents and teachers, will evaluate the test result. Beyond the individual and social factors related to the test, students may also have negative thoughts about the test arrangements, like test conditions, and time constraints (Hembree, 1988; Putwain, 2008; Putwain, 2009; Putwain et al., 2010). These negative cognitions increase test anxiety by triggering maladaptive coping behavior (von der Embse et al., 2013). Students with academic procrastination have more test anxiety, fear of humiliation, irrational and negative thoughts (Bolbolian et al., 2021). Test-anxious students divide their attention between self-related (task-irrelevant) and task-relevant thoughts and display relatively more negative and task-irrelevant thoughts than others. These thoughts prevent students from focusing on the test and reduce their performance (Hollandsworth et al., 1979; Pekrun et al., 2002; Lowe, 2018; Wine, 1971). As a result, negative thoughts about before, during, and after the test continue the cycle of test anxiety.

Although many researchers have identified negative thoughts as an important component of test anxiety (Díaz et al., 2001; Wine, 1971; Wong, 2008), few studies have measured negative thinking directly. In the study conducted by Wong (2008) on test anxiety and the cognitive triad, dysfunctional attitudes, irrational beliefs, and automatic thoughts, The Automatic Thoughts Questionnaire developed by Hollon and Kendall (1980) was used. However, this questionnaire was developed to measure negative automatic thoughts associated with depression. The Positive and Negative Thoughts Checklist, developed by Galassi et al. (1981), which aims to measure the frequency of positive and negative thoughts about a particular exam, is designed to be used to collect real-time data about students' thoughts during the exam. In the study conducted by Putwain et al. (2010), examining the role of cognitive distortions in the relationship between test anxiety and exam performance,

it was found that cognitive distortions in the academic field had a fully mediating role. The Children's Negative Cognitive Error Questionnaire (Leitenberg et al., 1986) used in this study measures the cognitive distortions of catastrophizing, overgeneralization, personalization, and selective abstraction. The sub-dimensions of the survey consist of six hypothetical scenarios in academic, social, and sports areas, and only the academic sub-dimension was used in the mediation analysis. The Cognitive Test Anxiety Scale developed by Cassady and Johnson (2002), which focuses on the cognitive aspect of test anxiety, has been adapted to many cultures and countries. However, initially developed as a unidimensional scale, the scale showed a multidimensional structure when adapted to the Argentinian sample (Furlan et al., 2009). The shortened version of the scale was adapted to the Persian sample, and the number of items was changed (Baghaei & Cassady, 2014). In the Turkish adaptation of the scale, items that did not have sufficient factor loadings were removed, and a unidimensional structure was obtained (Bozkurt et al., 2017). In the study of Németh and Bernáth (2023), conducted on a Hungarian sample, the scale was reported as a three-dimensional structure, including general anxiety, freezing, and fear of failure. As a result, questions remain regarding the scale's factor structure.

Psychological Resources

Psychological resources can be defined as entities that are valued either intrinsically or as a means to achieve valued ends (Hobfoll, 2002). Individual psychological resources refer to individual characteristics, traits, skills, and abilities contributing to well-being, stress resistance, and adaptation. These resources are actively utilized by individuals who face stressors and difficulties. Taking a test, with its before and after process, is a stressful situation that students try to cope with by activating their psychological resources (Feldman et al., 2015; Zeidner, 1998). Self-esteem, as an aspect of the self linked to resilience, is one of the individual psychological resources most strongly associated with test anxiety (Hembree, 1998; von der Embse et al., 2018). Students who possess sufficient resources are anticipated to hold positive beliefs regarding their capacity to effectively navigate a challenging examination scenario (Zeidner, 1998). According to cognitive-behavioral theory, it has been suggested that maintaining positive beliefs regarding oneself, the world, and the future can facilitate healthy adaptation and cultivate self-esteem (Beck, 1967) through the activation of positive automatic thoughts, which serve as a buffer against the impact of stress, ultimately enhancing resilience (Ingram & Wisnicki, 1988; Lightsey, 1996; McCann et al., 1988). Conversely, negative automatic thoughts can be a mediator of the effects of personality vulnerability factors, life events, and difficulties on mood (Kopala-Sibley & Santor, 2009). These thoughts can lead to self-criticism, anxiety, and depression, further reinforcing the individual's low self-esteem (Fennel, 1998). However, individuals with low self-

esteem evaluate daily events more negatively and perceive negative events as more personally important (Campbell et al., 1991). Likewise, resilience measures have also been found to have a negative correlation with negative cognitive constructs such as pessimism, self-blame, and denial (Smith et al., 2008). Negative thinking styles such as self-blame, rumination, blaming others, and catastrophizing have been found to play an important role in the relationship between the experience of negative life events and reporting symptoms of depression and anxiety (Garnefski et al., 2001). Also, these negative thinking styles have been found negatively correlated with resilience in patients with depression and/or anxiety disorders (Min et al., 2013).

Self-esteem

In the literature, self-esteem consists of definitions that historically emphasize the individual's self-evaluation, the cognitive process of self-definition, and the positive or negative affective degree regarding these aspects that define oneself. Afterward, self-esteem was defined in terms of the individual's worthiness and competence (Mruk, 2013). Tafarodi and Swann (2001) defined self-esteem as a two-dimensional structure, including all these elements: self-liking and self-competence. Self-liking entails evaluating oneself as a social entity, either positively or negatively. This overarching characteristic ultimately boils down to one's enduring, comprehensive perception of their value within society. Furthermore, self-competence refers to how one evaluates oneself as an active force, a deliberate entity capable of achieving desired results through the exertion of their will. It encompasses the general inclination towards viewing oneself either positively or negatively as a force of influence and effectiveness. According to Ferkany (2008), self-esteem can play an important role in developing the confidence and motivation necessary for students to be academically successful. When faced with a daunting or challenging task, students with self-doubt may have difficulty engaging with or concentrating on it to the extent necessary to complete it successfully. However, test anxiety and self-esteem are mutually interrelated, with each impacting the other (Dan & Raz, 2015). Hembree (1988) found that test anxiety has an inverse relationship with students' self-esteem. Martos et al. (2021) reported that higher levels of psychological resources, such as self-esteem, are associated with lower levels of test anxiety.

Many studies stated that there is a negative relationship between test anxiety and self-esteem, but the role of test-related negative cognitions in this relationship has not been thoroughly investigated (Barutçu Yıldırım & Demir, 2020; Fathalla, 2018; Peleg, 2009; Xie et al., 2019). Peleg (2009) found that disturbing thinking is related to test anxiety and self-esteem. On the other hand, Xie et al. (2019) stated that self-esteem has an indirect effect through control beliefs and a direct effect on math anxiety.

Resilience

Resilience is the ability to adapt and bounce back from adversity, threats, or significant sources of stress. It involves the capacity to withstand and recover from difficult situations, challenges, or setbacks. Resilience, effectively coping with and overcoming obstacles when they arise, is a dynamic process that can be developed and strengthened over time (Masten, 2021). In the educational context, resilience contributes to individuals' ability to assess their own strengths in the face of various academic and psychosocial challenges and demands (De La Fuente et al., 2017; Parlak et al., 2022). Pupils with resilience may be poised to outperform in demanding testing scenarios by upholding a confident belief in their abilities. They can sustain their motivation and perseverance or effectively manage adverse emotions, internal concerns, and external distractions that could impede their performance (Martin & Marsh, 2006). Hayat et al. (2021) found that self-efficacy's effect on test anxiety is mediated by resilience. Additionally, research shows that individuals with lower levels of resilience tend to experience higher levels of cognitive test anxiety (Lim & Chue, 2023). Similarly, although studies point to a negative relationship between test anxiety and resilience (Fathalla, 2018; Hayat et al., 2021; Liu et al., 2021; Trigueros et al., 2020), the role of test-related negative cognitions in this relationship has not been examined.

The Present Study

Students struggling with test anxiety tend to have more negative thoughts than others (Hollandsworth et al., 1979; Jolly et al., 2021; Maloney et al., 2014). Clinical experience of test anxiety emphasizes the importance of identifying and changing negative thoughts (Alibak & Alibak, 2021; Brown et al., 2011; D'Alelio & Murray, 1981; Demirci & Erden, 2016; Miloseva, 2012). Considering the literature on test anxiety, determining the negative thoughts of individuals related to testing can be important in understanding test anxiety and providing change. In addition, studies showed that self-esteem and resilience predict test anxiety negatively (Fathalla, 2018; Hayat et al., 2021; Trigueros et al., 2020; Xie et al., 2019). On the other hand, although it is known that self-esteem and resilience are related to negative cognitive structures (Campbell et al., 1991; Smith et al., 2008), the effect of negative cognitions on the relationship between resilience and self-esteem with test anxiety is not fully known. We consider that test-related negative cognitions may have a confounding effect on the relationship between resilience and self-esteem with test anxiety. Therefore, the present study aims to develop a valid and reliable scale to assess test-related negative cognitions of adolescents and examine the mediating role of cognitions in the relationship between test anxiety and self-esteem and resilience. Since the research indicated that test anxiety varies according to

gender, grade level, and grade point average (Chapell et al., 2005; Everson et al., 1991; Hembree 1988; McDonald 2001; Putwain et al., 2014; Szafranski et al., 2012; von der Embse et al., 2018) test anxiety scores were adjusted according to these variables in the mediation analysis.

Based on all these, the following hypotheses were addressed:

Hypothesis 1: The Test-Related Negative Cognitions Scale (TRNCS) developed in the sample of [masked], is a valid and reliable measurement tool.

Hypothesis 2: a) Test-related negative cognitions would relate to test anxiety, b) test-related negative cognitions would mediate in the relationship between resilience and test anxiety, and c) test-related negative cognitions would mediate in the relationship between self-esteem and test anxiety.

Study I: Scale Development

Method

Ten steps in scale development and reporting described by Carpenter (2018) were followed in reporting this study. In this phase of the study, we examined the reliability and Exploratory Factor Analysis (EFA) results of the TRNCS. Specifically, the stability and internal consistency, as well as the underlying structure of the items comprising, were evaluated through EFA.

Participants and Procedure

Carpenter (2018) highlighted the importance of conducting individual interviews that focused on the specific goal of the scale that was developed to generate and validate dimensions and items. Therefore, we conducted interviews with high school students who struggle with test anxiety to identify potential factors and items for the initial item pool. A total of 62 negative thoughts were obtained during the interviews with the students who struggle with test anxiety and literature review. After the evaluation of field experts and the relevant literature, the item pool was reduced to 51 items based on the components of test anxiety assessed by Hodapp and Benson (1997). A pre-test was conducted with a sample of twenty-four high school students to evaluate the scale's feasibility and preliminary psychometric properties. Pre-tests were used to improve the design and wording of scale items. Researchers can identify and address potential issues such as ambiguous wording, leading questions, confusing phrasing, difficult language, skipped items, sensitive topics, and missing items by conducting pre-tests (Carpenter, 2018). Based on the feedback obtained from the high school students who participated in the study, the TRNCS was finalized after incorporating minor item changes. The final draft of the

TRNCS consisted of 51 items, each comprising a five-point Likert-type scale ranging from "1= *Never*" to "5= *Always*."

We included 475 students from various high schools in the city of [masked] in Study I. However, 31 students were excluded from the analysis due to a high percentage of missing data, careless responses, and outliers. Therefore, the final sample for the analysis consisted of 446 students, including 182 (40.80%) boys, 260 (58.20%) girls, and four (0.90%) students who did not specify their gender. The average age of the participants was 15.69 (*SD* = 2.03, *Range* = 13-19), and the participants' grade point average for the last semester was 84.80 (*SD* = 10.70).

Data Analysis

R version 4.2.2 (R Core Team, 2022) was used to clean and pre-process data and for preliminary analyses. The following R packages were utilized: careless for inattentive responding, dplyr for data cleaning, mice for missing data imputation, corrplot for correlations, psych for Factor analysis, oblique rotations, and reliability analysis, and nFactors for estimating the number of factors. In determining the number of factors, both goodness of fit indexes and parallel analysis were considered.

Results

Factor loadings, descriptive statistics, item-total correlations, and reliability are presented in Table I. After verifying the accuracy and completeness of the data and identifying any potential outliers, we assessed the additivity of the scale by examining the correlations between individual items. The range of correlation coefficients between items in the scale was .20-.71. To determine whether the data were normally distributed, we generated random data, fit a linear model to it, standardized the fitted values of the model, and plotted a histogram of the standardized fitted values. We concluded that the data were normally distributed based on the resulting histogram. Additionally, the data met the assumptions of sphericity, as demonstrated by the results of Bartlett's test (χ^2 = 16,708.73, *df* = 1,275, $p < .001$) and sampling adequacy, as demonstrated by the results of the Kaiser-Meyer-Olkin test (KMO = .96). An EFA was then conducted using maximum likelihood extraction, direct oblimin rotation, and 100 iterations to analyze the internal structure of the scale. Four factors with eigenvalues greater than 1 emerged in the first analysis, explaining 49.8% of the variance. The factor loadings of individual items were then evaluated, revealing that, except for 29 items, most items had weak loadings, and seven items had cross-loading or no loading. After removing items incompatible with the factor structure, a two-factor structure was obtained based on eigenvalues.

Table I. Factor Loadings, Descriptive Statistics, Item-Total Correlations, and Reliability, Study I

Items	*M*	*SD*	Factor loadings	Item-Total correlations	Cronbach's alpha (α)
Catastrophizing failure					0.85
If I fail the test, it will be a total disaster.	3.39	1.26	0.83	0.81	
If I fail the test, all my hard work will be for nothing.	3.80	1.23	0.76	0.74	
If I fail the test, I will be ruined.	3.41		0.74	0.81	
Social consequences					0.88
If I fail the test, I will not be able to face my acquaintances.	2.57	1.46	0.69	0.80	
I will be disgraced if I do not pass the test.	2.74	1.53	0.91	0.87	
People will make fun of me if I do not pass the test.	2.31	1.48	0.80	0.79	
Distraction					0.86
What if I experience physical distress (headache, nausea, sweating, trembling, stomach-ache, etc.) during the test?	3.21	1.42	0.72	0.70	
During the test, there will be noises from outside, and I will be disturbed by these noises.	2.82	1.47	0.80	0.73	
I will not be able to focus on the questions in the test.	2.91	1.42	0.77	0.86	
I will not be able to concentrate on the test.	2.87	1.43	0.64	0.79	
Performance deficit					0.91
It is impossible to catch up with my competitors.	2.52	1.43	0.76	0.82	
No matter how hard I try, I will not succeed.	2.36	1.44	0.90	0.87	
I have just been lucky up until now; I will not be able to do it on the test.	2.29	1.43	0.76	0.77	
I will not even be able to do the questions I know in the test.	2.35	1.40	0.66	0.77	
I am not good enough to pass the test.	2.57	1.47	0.84	0.85	

Note. N = 446. Loadings are from EFA with maximum likelihood extraction and direct oblimin rotation

A parallel analysis with 51 items was conducted to identify the most appropriate set of items and factors. The new analysis resulted in an extraction of seven factors; the total variance explained was 55.6%. In this analysis, 19 items with loadings greater than .50 on 4 factors (with eigenvalues ranging from 1.02 to 19.21), with no cross-loading. The remaining factors were loaded with only two items, which were not deemed meaningful or defensible. Four factors with 19 items explained 63% of the variance. The reduced 19-item scale (loadings >.50) was re-evaluated by four field experts – two cognitive behavioral therapists and two test anxiety researchers and the items' content validity and four-dimensional structure were re-examined. A consensus was reached, and four items were identified as redundant or not close enough to the conceptual definition.

Reliability analysis using 51 items yielded a Cronbach's alpha (α) of .97. The first factor analysis identified two factors formed by 27 items with loadings greater than .50, with Cronbach's alphas (α) of .91 and .92, but the factor structure was

unclear. The Cronbach's alpha (α) values of the factors obtained through parallel analysis and formed by 15 items with factor loadings greater than .50 were found to be between .85 and .91. Goodness of fit indices were used to compare the two constructs. It was found that the 4-factor structure from parallel analysis (χ^2 (101) = 220.86, $p < .001$, CFI = .98, TLI = .96, RMSEA = .05, SRMR = .03) had better values and was more explainable and meaningful than the 2-factor structure based on eigenvalues (χ^2 (298) = 1467.71, $p < .001$, CFI = .86, TLI = .84, RMSEA = .09, SRMR = .05).

Discussion

Study I indicated that the TRNCS comprises four dimensions. Factor analysis allowed the identification of the most central items in the scale. The Cronbach's alpha (α) for the final 15 items, which comprised the performance deficit (5 items), social consequences (4 items), distraction (3 items), and catastrophizing failure (3 items) subscales, was found to be 0.92, indicating that these items demonstrated high levels of internal consistency. The Cronbach alpha (α) values of all sub-dimensions ranged between .81 and .92. These items explained 68% of the total variance, *M* = 2.40 (*SD* = 1.20) across all items.

Study II: Scale Validation and the Mediation Model

Method

At this step of the present study, the internal structure of the TRNCS was assessed by confirmatory factor analysis (CFA) using maximum likelihood estimation. Correlational analyses were then used to assess how strongly the scale was associated with similar concepts (i.e., test anxiety) for convergent validity. Correlational analyses were also used to compare the scale to other variables (i.e., self-esteem and resilience) for criterion validity. Additionally, reliability was calculated with different coefficients such as Cronbach alpha (α) and McDonald's omega (ω). Finally, we examined the mediating role of test-related negative cognitions in the associations between resilience, self-esteem, and test anxiety.

Participants and Procedure

Study II consisted of 466 high school students recruited from [masked]. The sample was 66.7% (*n* = 311) female and 33.3% (*n* = 155) male. The mean age of participants was 15.06 (*SD* = 1.35, *Range* = 13-19 years). Regarding the school year, the sample was 33.7% (*n* = 157) freshmen, 18.0% (*n* = 84) sophomores, 25.8% (*n* =

120) juniors, and 22.5% (*n* = 105) seniors. Finally, the grade point average of the participants was 81.10 (*SD*= 13.00, *Range*= 38-100).

The data were collected from [masked] in [masked] via Google Forms between November and December 2022. Students received a form for parental and informed consent. Depending on the respondents, filling out the screening tools took an average of twenty minutes. The research team meticulously followed the principle of confidentiality during data collection.

Measures

The *Test Anxiety Inventory (TAI),* developed by Spielberger (1980) and adapted into Turkish by Öner (1990), was used for the tests of convergent validity to measure test anxiety. Each item was rated on a scale from (1 = *never*, 4 = *always*). The scale has two sub-dimensions (worry and emotionality) and consists of 20 items. A high score on the scale indicated greater test-related anxiety. Some scale items are as follows: *"I feel safe and comfortable during the test"* and "*I can't help thinking about the consequences of failing during tests."* The adaptation of the scale into Turkish indicated that the reliability coefficient (Cronbach alpha [α]) was .87 and test-retest reliability was .80 for the scale. In this study, Cronbach alpha (α) coefficient was found to be .94.

The *Brief Resilience Scale (BRS)* and *Two-Dimensional Self-Esteem (TDSE)* were used for the tests of criterion validity. The BRS, developed by Smith et al. (2008) and adapted into Turkish by Doğan (2015), was used to measure the level of individual resilience. The BRS includes six items. Each item was rated on a scale from (1 = *strongly disagree*, 4 = *strongly agree*). Doğan (2015) stated that the one-dimensional structure of the Turkish BRS showed acceptable fit indices: χ^2(12.86/7) = 1.83, NFI = .99, NNFI = .99, CFI = .99, IFI = .99, RFI = .97, GFI = .99, AGFI = .96, RMSEA = .05, SRMR = .03. Some of the scale items are as follows: *"I tend to bounce back quickly after hard times*" and "*It does not take me long to recover from a stressful event*." We found the Cronbach alpha (α) coefficient of BRS .80, in this study.

The TDSE, developed by Tafarodi and Swan (2001) and adapted into Turkish by Doğan (2011), was used to measure the level of individual self-esteem. The CFA result showed that the scale's two-factor structure was confirmed as in its original form (Doğan, 2011). The Cronbach's alpha (α) coefficient was found to be .83 for "self-liking" and .74 for "self-competence.", in adaptation study. The test-retest reliability coefficient was also found to be .72 for both factors. Two-factor structure of the Turkish TDSE showed acceptable fit indices: χ^2 (258.93/98) = 2.64, NFI = .95, CFI = .97, IFI = .99, RFI = .94, GFI = .94, AGFI = .91, RMSEA = .05. Some of the scale items are as follows: *"I am highly effective at the things I do*" and "*I never doubt my personal worth*." In this study, Cronbach alpha (coefficient) was found to be .91.

Data Analysis

The internal structure of the TRNCS was assessed by CFA using maximum likelihood estimation in Mplus 8.8. Software (Muthén & Muthén, 1998; 2019). Model chi-square test (χ^2), Tucker-Lewis index (TLI), standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA), and comparative fit index (CFI) were used to evaluate model fit. In addition, the relationship of the TRNCS with test anxiety (convergent validity) and self-esteem and resilience (criterion validity) was calculated with the correlation coefficient in R version 4.2.2 (R Core Team, 2022). Reliability was also calculated with different coefficients, such as Cronbach alpha (α) and McDonald's omega (ω) in R version 4.2.2 (R Core Team, 2022). Finally, CFA and structural equation modeling (SEM) were conducted using Mplus 8.8 software (Muthén & Muthén, 1998; 2019) to examine the mediating role of test-related negative cognitions in the associations between resilience, self-esteem, and test anxiety. Weighted least squares estimation with a mean and variance-adjusted (WLSMV) chi-square was used, along with a polychoric covariance matrix and probit factor loadings (Lei & Shiverdecker, 2020) to test the individual CFAs of the variables of self-esteem, resilience, and test anxiety. The self-esteem measurement was treated as summed scores for two different subscales due to the results of the CFA, indicating low goodness of fit indexes for the scale. To test for mediation, the cross-products of the direct effects were calculated to obtain the indirect effects (Hayes, 2017). The Delta Method was used to estimate the standard errors of the indirect effects with 1000 nonparametric bootstrapped replications.

Results

The TRNCS Properties

The CFA revealed that the items were fitted to four factors, and the model showed perfect model fit with the 15-item TRNCS; WLSMV $\chi^2(86, N = 466) = 361.81$, $p < .001$, CFI = .98, TLI = .97, RMSEA = .08 (90% CI [.08, .09]), SRMR = .04. Standardized item loadings ranged from .59 to .94, and standardized item covariance residuals ranged from .11 to .65. The CFA is presented in Figure I.

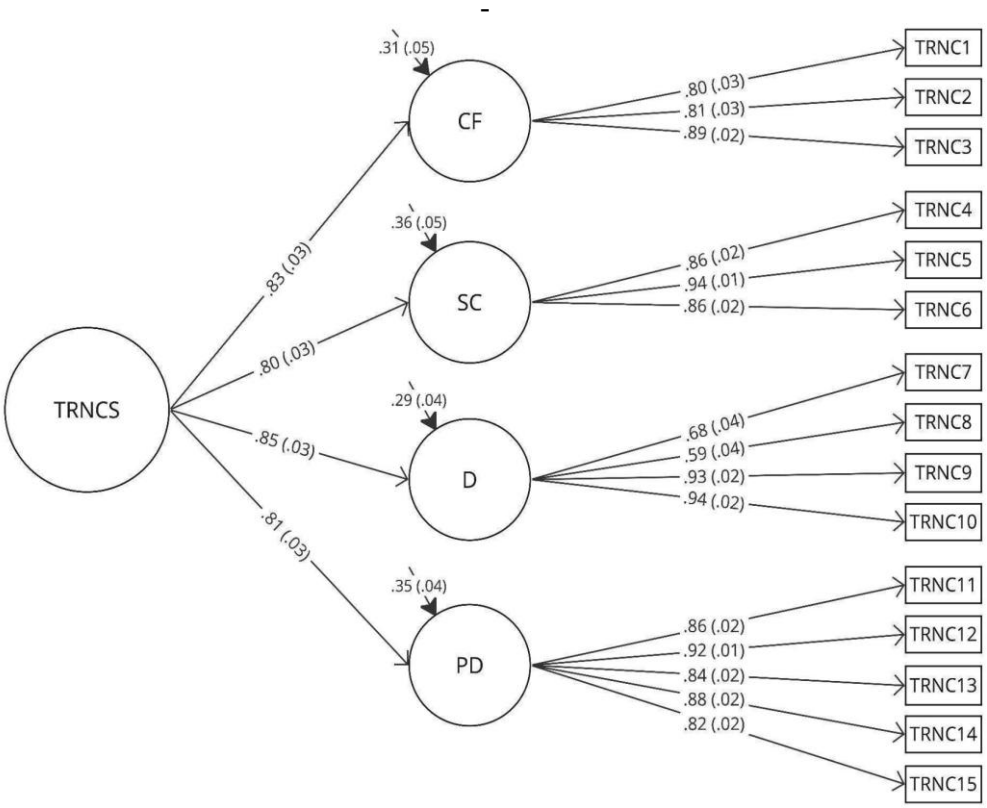

Figure I. Confirmatory Factor Analysis for Test-Related Negative Cognitions Scale

Note. TRNCS: Test related negative cognitions scale; CF: Catastrophizing failure; SC: Social consequences; D: Distraction; PD: Performance deficit.

Convergent and criterion validity results are presented in Table II. Related concepts for tests of convergent validity showed that the TRNCS total score was positively correlated with TAI total score (r = .762, p < .001). Sub-dimensions of the TRNCS, including performance deficits (r = .588, p < .001), social consequences (r = .460, p < .001), distraction (r = .693, p < .001), and catastrophizing failure (r = .605, p < .001), were positively correlated with the worry, a sub-dimension of the TAI. Moreover, significant positive relationships were found between TRNCS sub-dimensions and emotionality, another sub-dimension of the TAI (r = .672, .460, .675, .603, respectively, and p < .001 for all effect sizes).

Table II. Convergent and Criterion Validity Measures

Variables	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Performance deficits[a]	12.40	6.16												
2. Social consequences[a]	7.38	3.92	.535***											
3. Distraction[a]	11.90	4.57	.600***	.519***										
4. Catastrophizing failure[a]	9.46	3.58	.516***	.615***	.572***									
5. TRNCS Total	41.10	15.00	.858***	.788***	.825***	.787***								
6. Emotionality[b]	30.60	8.70	.672***	.460***	.675***	.603***	.747***							
7. Worry[b]	19.10	6.12	.588***	.460***	.693***	.605***	.719***	.832***						
8. TAI Total	49.70	14.20	.650***	.480***	.715***	.631***	.762***	.941***	.971***					
9. BRS	16.60	5.40	-.391***	-.351***	-.434***	-.415***	-.485***	-.424***	-.468***	-.470***				
10. Self-liking[c]	25.50	8.10	-.524***	-.404***	-.425***	-.389***	-.544***	-.444***	-.432***	-.455***	.455***			
11. Self-competence[c]	23.50	6.37	-.573***	-.379***	-.470***	-.403***	-.575***	-.478***	-.454***	-.484***	.470***	.742***		
12. TDSE Total	49.00	13.50	-.584***	-.421***	-.476***	-.423***	-.597***	-.491***	-.473***	-.501***	.494***	.949***	.916***	

Note. N= 466. TAI= Test Anxiety Inventory, TRNCS= Test Related Negative Cognitions Scale. BRS= Brief Resilience Scale, TDSE= Two Dimensional Self-Esteem Scale. [a] Subscale of the TRNCS, [b] Subscale of the TAI, [c] Subscale of the TDSE. ***$p < .001$.

Related concepts for tests of criterion validity, which examined how test-related negative cognitions related to variables that were expected to be influenced by or influence test-related negative cognitions, also revealed that the TRNCS total score was negatively correlated with the BRS (r = -.485, p < .001). Additionally, all TRNCS sub-dimensions, including performance deficits (r = -.391, p < .001), social consequences (r = -.351, p < .001), distraction (r = -.434, p < .001), and catastrophizing (r = -.415, p < .001) were negatively correlated with the BRS. On the other hand, results indicated that TRNCS total score was negatively correlated with the TDSE total score (r = -.597, p < .001). Similarly, all TRNCS sub-dimensions, including performance deficits (r = -.524, p < .001), social consequences (r = -.404, p < .001), distraction (r = -.425, p < .001), and catastrophizing failure (r = -.389, p < .001) were negatively correlated with self-liking, a sub-dimension of the TDSE. Moreover, significant negative relationships were observed between these TRNCS sub-dimensions and self-competence, another sub-dimension of the TDSE (r = -.573, -.379, -.470, and -.403, respectively, p < .001for all effect sizes).

The reliabilities of the 15-item TRNCS with four factors revealed that the Cronbach's alpha (α) (performance deficits = .83; social consequences= .87; distraction = .81; catastrophizing = .91; and the TRNCS Total = .92), and McDonald's omega (ω) (performance deficits = .83; social consequences = .88; distraction = .83; catastrophizing = .91; and the TRNCS Total = .93) were highly acceptable (*Hypothesis 1*).

The Results of SEM

We conducted SEM analysis to examine the mediating role of test-related negative cognitions in the associations between resilience, self-esteem, and test anxiety. Based on the theory and relevant literature, the general trend in the hypotheses of this study is that test-related negative cognitions represent the cognition dimension from cognitive behavioral therapy (CBT), associated with test anxiety, and mediating relations between resilience, self-esteem, and test anxiety. Resilience and self-esteem are related to test-related negative cognitions, which in turn are believed to contribute to test anxiety, including worry and emotionality dimensions. Additionally, grade level, grade point average (GPA), and gender (being female) have been identified as factors that may increase the severity of test anxiety (von der Embse et al., 2018). This model aligns with the principles of cognitive-behavioral therapy, which suggest that psychological difficulties often stem from maladaptive thinking patterns. The research model for this study is presented in Figure II.

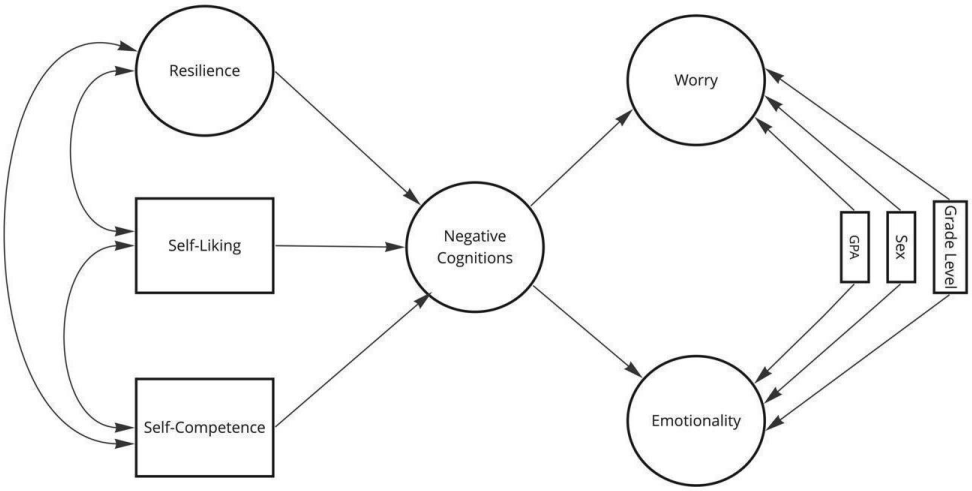

Figure II. Hypothesized Model for Psychological Contributors to Test Anxiety, Adjusting for Sex, GPA, and Grade Level

Note. Latent variables are represented by circles, while squares represent observed variables. Negative Cognitions = Test Related Negative Cognitions.

The CFA results for individual scales showed that sub-dimensions of test anxiety (i.e., worry and emotionality) measured by the TAI demonstrated good fit, $\chi^2(169, N = 466) = 505.07$, $p < .001$, CFI = .97, TLI = .97, RMSEA = .07 (90% CI [.06, .07]), SRMR = .04. Resilience that is measured by the BRS demonstrated adequate fit when the residual error variances of items 1 (*I tend to bounce back quickly after hard times*) and 3 (*It does not take me long to recover from a stressful event*) were correlated, as these items can be understood in the same way, especially in their Turkish translations, WLSMV $\chi^2 (8, N = 466) = 28.25$, $p < .001$, CFI = .96, TLI = .93, RMSEA = .07 (90% CI [.05, .10]), SRMR = .04. However, self-esteem did not show adequate fit WLSMV $\chi^2(100, N = 466) = 589.55$, $p < .001$, CFI = .82, TLI = .79, RMSEA = .10 (90% CI [.09-.11]). Therefore, two dimensions of self-esteem (i.e., self-liking and self-confidence) were treated as summed scores in SEM analysis.

The model shown in Figure II was tested and found to fit reasonably adequate based on most indices, $\chi^2 (971, N = 466) = 1977.88$, $p < .001$, CFI = .95, TLI = .95, RMSEA = .047 (90% CI [.04, .05]), SRMR = .09. Standardized parameter estimates with standard errors are presented in Figure III. It was found that both aspects of self-esteem, self-liking and self-confidence and resilience significantly predicted test-related negative cognitions when adjusting for sex, grade, and GPA. These results were in line with the hypotheses that lower self-esteem and resilience

would be associated with increased negative cognitions, significantly predicting higher levels of worry and emotionality in test anxiety (*Hypothesis 2*a). Additionally, the female sex was found to significantly predict higher levels of worry (β = -.26, *SE* = .04, *p* < .001) and emotionality (β = -.35, *SE* = .04, *p* < .001), while a higher GPA was significantly predicted lower levels of worry (β = -.19, *SE* = .05, *p* < .01). However, GPA did not significantly predict emotionality (β = -.04, *SE* = .05, *p* > .05). While a higher grade level was found to predict lower levels of worry significantly (β = -.09, *SE* = -.05, *p* < .05), it was found to predict emotionality insignificantly (β = .07, *SE* = .04, *p* > .05).

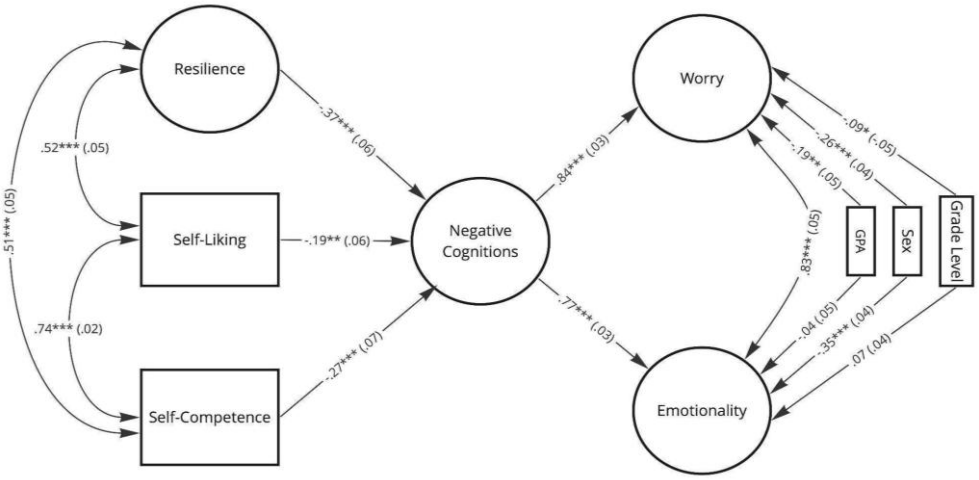

Figure III. SEM Model with Standardized Path Coefficients

Note. Circles represent latent variables, while squares represent observed variables. Negative Cognitions = Test Related Negative Cognitions, Sex was coded as female = 1, male = 2. Grade Level was coded as 1= freshman, 2 = sophomore, 3 = junior, 4 = senior. Factor loadings for the latent variables have been omitted for simplicity. However, they are available upon request to the first author. *p < .05, **p < .01, ***p < .001.

Finally, the mediation effects of negative cognitions between self-esteem dimensions and resilience on test anxiety dimensions were statistically significant, see in Figure III. First, in accordance with *Hypothesis 2*b, negative cognitions mediated the relationships between resilience and both worry (β = -.31, *SE* = .05, *p* < .001) and emotionality (β = -.28, *SE* = .05, *p* < .001) dimensions of test anxiety. Additionally, as predicted in *Hypothesis 2*c, negative cognitions mediated the relationships between self-competence and both worry (β = -.22, *SE* = .06, *p* < .001) and emotionality (β = -.21, *SE* = 0.05, *p* < .005) dimensions of test anxiety. Similarly, the relationship between self-liking and both the worry (β = -.16, *SE* = .05, *p* < .001) and emotionality (β = -.15, *SE* = .05, *p* < .005) dimensions of test anxiety was mediated by negative cognitions.

Discussion

The results of Study II showed that TRNC is a valid and reliable scale to assess negative cognitions related to testing, and it consists of four subscales: Performance deficit, social consequences, distraction, and catastrophizing failure. The performance deficit sub-scale consisted of students' cognitions indicating that they did not believe themselves to be sufficiently competent or skilled to complete the exam successfully. These thoughts may have reflected a lack of confidence in their academic abilities or a perception that they could not achieve the desired outcome. The social consequences sub-scale consists of thoughts that excessively anticipate adverse reactions and attitudes from the environment if students' test results are unsatisfactory. These cognitions may involve overestimating the negative consequences of not achieving the desired outcome. The cognitions comprising the distraction sub-scale are beliefs that students will be unable to control their anxiety or maintain focus during the exam. These thoughts may involve a perception of an inability to manage anxiety or concentrate effectively during the test-taking situation. Finally, the catastrophizing failure sub-scale consists of cognitions that pertain to the perceived negative impact on one's life if the desired outcome is not achieved on the test. These cognitions may involve exaggerating the negative consequences of not achieving the desired result.

According to the cognitive model, anxiety is characterized by an inaccurate assessment of one's personal coping resources, leading to a misperception of one's ability to handle a perceived threat. This model suggests that anxiety involves overestimating the threat and underestimating one's capacity to cope with it (Clark & Beck, 2011). In this study, we considered self-esteem and resilience as psychological resources and test anxiety as an outcome and tested whether negative cognitions significantly affect these relationships. The results of Study II indicated that lower self-esteem and resilience would be associated with increased test-related negative cognitions, significantly predicting higher levels of worry and emotionality in test anxiety. Moreover, students' negative cognitions about testing play a significant mediating role between their self-esteem, resilience, and their levels of test anxiety.

General Discussion

The purpose of the present study was to develop the TRNCS to measure students' negative cognitions related to testing and examine whether these cognitions significantly influence the relationship between test anxiety, self-esteem, and resilience. The study's results showed that the TRNCS is a valid and reliable tool for measuring students' test-related negative cognitions, confirming *Hypothesis 1*.

Additionally, the findings revealed that students' test-related negative cognitions predict test anxiety (*Hypothesis 2*a) with resilience and self-esteem being significant predictors of these cognitions. Finally, it was observed that test-related negative cognitions play a significant mediating role in the relationships between resilience (*Hypothesis 2*b), self-esteem (*Hypothesis 2*c), and test anxiety levels, even after adjusting for sex, GPA, and grade level.

However, it is noteworthy to recognise that within the broader context of the literature, there are studies suggesting that fear plays a potential positive role in enhancing motivation to a certain extent (Cassady & Johnson, 2002; Howard, 2020; Kader, 2016; Putwain, 2009). Although our study focused on the negative effects of test anxiety, it is important to recognise the nuanced interaction between anxiety and motivation.

This study's primary and significant finding is that a valid and reliable scale capable of measuring test-related negative cognitions has been developed. There was a need for the development of a scale to identify maladaptive negative cognitions related to testing, specifically for professionals and researchers focusing on test anxiety and applying CBT as a treatment approach. Professionals can use this measurement tool to evaluate the process and effectiveness of CBT interventions (e.g., before and after cognitive restructuring). By actively examining and challenging negative thoughts, individuals can learn to replace them with more adaptive and healthy thoughts that may help to reduce anxiety and improve overall well-being (Beck, 2021; Clark & Beck, 2011). This study's results align with the findings of Zeidner (1998), who reported that negative thoughts related to the test may be as self-doubt about one's performance abilities, preoccupation with self-deprecating thoughts, and making negative self-statements. However, this study found that individuals who struggle with test anxiety may develop negative beliefs about themselves and others, the future, and the test itself. In other words, the content of negative cognitions may change in individuals with test anxiety, similar to the cognitive triad included in the CBT's theoretical explanation of depression (Beck, 2021), and test-related negative cognitions are also included. Therefore, the scale developed in this study can facilitate the identification of the areas in which students develop negative cognitions, as well as the specific content of these cognitions, which can guide the development of interventions and provide clinicians with a useful tool for identifying these negative thoughts.

The results of SEM, the second aim of this study, showed that self-esteem indirectly affects test anxiety through test-related negative cognitions. In other words, self-esteem is indirectly related to test anxiety, and negative cognitions mediate or influence the relationship. It may be the case that individuals with lower self-esteem have more negative cognitions, leading to higher test anxiety levels. Moreover, individuals with high self-competence tend to place significant value on achieving their goals, making the reduction of test-related negative cognitions–a sign of progress towards desired outcomes–more effective. Likewise, those with a strong

sense of self-liking tend to exhibit fewer test-related negative cognitions. Hiçdurmaz et al. (2017) also found that self-esteem significantly predicted negative automatic thoughts and mental health symptoms among university students. Given the established between heightened levels of negative cognitions about tests or exams and increased test anxiety (Maloney et al., 2014), it is reasonable to posit that individuals' levels of self-competence and self-liking may mitigate test anxiety levels through their impact on test-related negative cognitions. Xie et al. (2019) similarly discovered direct and indirect effects of self-esteem on math anxiety among young men. Based on our study's findings, interventions aimed at reducing test-related negative cognitions while enhancing self-competence and self-liking could effectively alleviate test anxiety. However, since our study adopted a relational model, further research employing a causal model is warranted to establish definitive conclusions.

Another result of the SEM revealed that resilience indirectly affected test anxiety through test-related negative cognitions. In other words, even if students have high levels of resilience, which is conceptualized as the ability to withstand and recover from stress or distress (Luthar et al., 2000), if they have less negative cognitions about taking the test, and as a result they more less experience test anxiety. In this context, Mak et al. (2011) reported a significant association between resilience and positive cognitions about the self, the world, and the future. Specifically, individuals with higher levels of resilience had significantly more positive cognitions about self-competence for the test and reported significantly higher levels of life satisfaction and lower levels of depression. Students' past experiences in academic settings and the challenges they have encountered are crucial in building resilience. As a result, the more resilient students are, the better equipped they will be to manage their anxiety when faced with a new academic challenge (Trigueros et al., 2020; Jamshidi et al., 2018), because they have less test-related negative cognitions. In this context, it is suggested that the negative impact of test-related negative cognitions on test anxiety can be reduced through interventions working with improving resilience.

In addition to the influence of test-related negative cognitions on test anxiety, the effect of gender and GPA should not be ignored. Our study found that both gender and GPA (particularly GPA) are significant variables affecting test anxiety, which is in line with previous research (von der Embse et al., 2018; Zamir et al., 2021). The impact of GPA on students' test anxiety may be due to the fact that high school grade point averages are given extra weight in university entrance exams in [masked]. Further investigation is recommended to determine the reasons for the higher levels of test anxiety among female students and to develop potential interventions.

In conclusion, the results of this study highlight the utility of the TRNCS as a tool for assessing negative cognitions of students struggling with test anxiety. By identifying and addressing negative cognitions, students can learn to cope with test

anxiety more adaptively and positively, which may contribute to improved academic performance and overall functioning. The results of the SEM analysis suggest that low levels of self-esteem and resilience, as psychological resources, negatively affect test anxiety through test-related negative cognitions. Based on the CBT model's understanding of the mutual influence of these variables, it is recommended to identify children at risk by using various measurement tools, to provide services through school psychological counseling and guidance units, and to intervene in negative cognitions by conducting studies to increase self-esteem to reduce test anxiety effectively. Overall, this study adds to the growing body of research on the role of negative cognitions in test anxiety and the potential for CBT-based interventions to address these cognitions and alleviate anxiety.

Although the current study provides important information on test-related negative cognitions, a few limitations should be considered when interpreting the results. The sample of this study was taken from a metropolitan city, which may not be representative of the population, especially from rural areas. As a result, it is possible that the results of this study may not generalize to other regions or countries. Also, there may have been limitations in reporting cognitions because the cognitions that emerged during the test could not be measured during test-taking, and participants may have yet to remember the cognitions in their initial state due to the time factor. Moreover, the use of self-report scales to measure the variables may have introduced bias and may not accurately reflect the true cognitions or behaviors of the students. Finally, the current study employed a cross-sectional design that captures a snapshot of variables at a specific point in time. While this approach provides valuable insights into the relationships between variables, it may limit our ability to establish causality and trace developmental patterns. Future research endeavours could consider using longitudinal studies. Additionally, it is important to note that this study didn't utilize data based on test performance. Overall, these limitations should be considered when considering the implications of the study's findings.

Authors' Notes

Ethical Approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Two studies also received ethical approval from the Non-interventional Clinical Researches Ethics Board, Hacettepe University (13/01/2022; Application No: 16969557-64) and Ethics Board of Ministry of National Education in Türkiye (08/03/2022; Application No: E-59090411).

Competing Interests: All authors declare no conflict of interest.

Informed Consent: Online informed consent was obtained from all participants and their parents.

Data Availability: The corresponding author can provide the dataset analyzed for this study upon request.

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