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Exploring the role of psychological inflexibility, rumination, perfectionism cognitions, cognitive defusion, and self-forgiveness in cognitive test anxiety

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Abstract
This study examined the roles of psychological inflexibility, rumination, perfectionism cognitions, cognitive defusion, and self-forgiveness in predicting cognitive test anxiety among a sample of 715 university students (351 females, 364 males). The Cognitive Test Anxiety Scale-Revised, Acceptance and Action Questionnaire-II, Ruminative Response Scale, Perfectionism Cognitions Inventory, Drexel Defusion Scale, State Self-Forgiveness Scale, and Demographic Information Form were used as data collection instruments. The results of Hierarchical Multiple Regression Analysis revealed that psychological inflexibility, rumination, perfectionism cognitions, and cognitive defusion were significant predictors of cognitive test anxiety, whereas self-forgiveness made no significant contribution to the model. The hypothesized model overall accounted for 31% of the variance in cognitive test anxiety scores, with psychological inflexibility explaining 23% of the variance in the first model, and the remaining variables accounting for an additional 8% of the variance. The strongest contribution to cognitive test anxiety was psychological inflexibility, followed by cognitive defusion, rumination and perfectionism cognitions. While psychological inflexibility, rumination, and perfectionism cognitions were found to correlate with cognitive test anxiety positively, cognitive defusion was negatively associated with cognitive test anxiety.

Keywords Cognitive test anxiety · Psychological inflexibility · Rumination · Perfectionism cognitions · Cognitive defusion · Self-forgiveness

Introduction

Academic anxiety is an inclusive construct that involves anxiety towards various academic activities in school settings. Its specific forms include anxiety towards math, computer usage, tests, and other types of performance evaluation. With the rise in the number and importance of tests/exams in today's competitive academic environment, the potential for test anxiety has also increased (Cizek and Burg 2006). According to a recent meta-analytic study that examined the findings of 238 studies from 1988 to 2017, test anxiety increased between 2010 and 2017 even though there was a decline in the first decade of the twenty-first century (von der Embse et al. 2018). Although students take their first examinations in early childhood, they experience more test anxiety as they get older and become more acutely aware of how academic success plays an important role in their future life (Zeidner 1998). Von der Embse et al. (2018) found that the relationship between test anxiety and performance was higher in middle school, decreased in high school, and showed an increase in college years, from which it can be understood that test anxiety affects students at all levels of education, including at college/university (Ergene 2003; Gibson 2014; Thomas et al. 2018). Putwain and Daly (2014) reported that approximately 15% of learners have high levels of test anxiety, and Thomas et al. (2018) indicated that 38% of university students have high, and 22% have a moderate level of test anxiety. Test-anxious college students are at risk of low academic achievement and dropout (Gerwing et al. 2015). They also experience excessive

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worry and depression, difficulty in making decisions, and have low self-confidence (Depreeuw 1984). Recognizing the association between such emotional difficulties, student retention and achievement, higher education institutions have begun placing more emphasis on meeting the needs of these students (Thomas and Cassady 2019).

Defined as "the set of phenomenological, physiological, and behavioral responses that accompany concern about possible negative consequences or failure on an exam or similar evaluative situation" (Zeidner 1998, p. 17), test anxiety is comprised of two components, worry and emotionality. The worry includes negative thoughts or cognitions about being unsuccessful in a test, and emotionality includes physiological symptoms as well as emotions (Liebert and Morris 1967). Sarason (1980) has described three different dimensions of test anxiety: cognitive, affective, and behavioral. More recently, Cassady (2004) found a strong negative correlation between worry and academic achievement; and Chapell et al. (2005) and Rana and Mahmood (2010) reported that the worry dimension makes a greater contribution to test anxiety than the emotionality dimension. This emphasis on worry prompted an increase in research into the cognitive aspects of test anxiety (Cassady and Johnson 2002; Rana and Mahmood 2010). Similarly, recent meta-analysis has supported the idea that the correlations between the worry component of test anxiety and performance were higher than between the affective/physiological component and performance (von der Embse et al. 2018).

According to Cassady and Johnson (2002), "cognitive test anxiety" includes all negative beliefs, cognitions and self-evaluative statements about tests occurring immediately before, during, or after the testing period. Individuals with high cognitive test anxiety experience high levels of worry in test-taking situations, have cognitions about their potential failure, or perceive the concept of evaluation as threatening, and thus earnestly compare their performance with those of others (Cassady 2004; Cassady and Finch 2015; Cassady and Johnson 2002). Among individuals with high test anxiety, worries and self-deprecatory internal dialog regarding failure have a negative impact on the cognitive functions and capacity used in performing the test (Hembree 1988). Individuals with high test anxiety also tend to retain in their long-term memories more worrying schemas, such as images and thoughts related to past experiences of failure, and as a result, they more easily evoke worry cognitions and perceive evaluative situations as more threatening (Putwain and Daly 2014). In view of these connections, examining other cognitive correlates of cognitive test anxiety is likely to contribute to research into the treatment of test anxiety.

Different approaches to treating test anxiety have been developed over the last 50 years in line with advances in research regarding the conceptualization of test anxiety. Initially the emphasis was on physiological and emotional components, but in time this moved towards cognitive behavioral and combined treatment approaches (Ergene 2003). During the last few decades, cognitive-behavioral approaches have evolved into 'third wave' intervention methods. As stated by Hayes and Hofmann (2017), "third wave methods have emphasized such issues as mindfulness, emotions, acceptance, the relationship, values, goals, and meta-cognition" (p. 163) and cover approaches such as dialectical behavior therapy (DBT), acceptance and commitment therapy (ACT), mindfulness-based cognitive therapy (MBCT), and many others. Acceptance and Commitment Therapy (ACT) offers new ways of engaging with problems by emphasizing the acceptance of situations rather than fighting against them, and by focusing on changing one's relationship with an event rather than changing the event itself (Hayes et al. 1999). In other words, rather than focusing on the management of anxiety by avoiding anxious feelings and examining possible solutions, ACT suggests focusing on a deep understanding of emotions and allowing cognitive processes to take the lead in dealing with events.

ACT, a successful approach to an adverse event, requires psychological flexibility which is defined as the experience of all emotions and behaviors with acceptance (Hayes and Smith 2005). ACT strives to achieve psychological flexibility by improving six specific processes: acceptance, cognitive defusion, self-as-context, committed action, attention to the present moment, and values (Hayes and Lillis 2012). ACT emphasizes values as the basis of meaning and direction in life, with individuals taking committed action based on these values. Moreover, individuals experience positive and negative emotions by considering everything as a step towards defined values, which they reach by paying attention to the present moment. The self-as-context process in psychological flexibility also involves separating actions from the self in such a way that the self is no longer part of the event (Hayes and Lillis 2012). Finally, cognitive defusion refers to putting a distance between one's thoughts and one's self by considering them as thoughts only; i.e., one's thoughts do not reflect one's characteristics (Hayes and Lillis 2012).

In general, anxiety is one of the most widely studied variables in ACT (Bluett et al. 2014; Sabourin 2013; Sharp 2012; Swain et al. 2013a). Other types of anxiety that affect university students such as social anxiety (Block and Wulfert 2000) and public-speaking anxiety (Block 2002) also have been examined from the ACT perspective. Swain et al. (2013a) have identified two studies that have investigated the effectiveness of ACT in academic matters related to anxiety; one of them is about math anxiety (Zettle 2003), and the other is related to test anxiety (Brown et al. 2011). The relationship between cognitive test anxiety (worry component of test anxiety) and psychological flexibility has not yet been investigated. Even though a negative correlation has been found between anxiety and psychological flexibility (Hayes et al. 2006), several

studies have shown that psychological flexibility plays the role of mediator (e.g., Ruiz 2012), especially between mindfulness skills and worry (Ruiz 2014). The worry aspect of test anxiety brings many other related cognitive factors to the surface. Extensive research about test anxiety has also shown it to be negatively associated with rumination, which is defined as overthinking past or unwanted events or feelings (Martin and Tesser 1996). In other words, overthinking about past performance increases test anxiety. Studies have shown that an increase in rumination results in higher levels of anxiety among university students (Dora 2012; Yu et al. 2015), and conversely, that students with high levels of test anxiety are more prone to ruminate about exams (Grant and Beck 2010).

Another factor that may be positively associated with cognitive test anxiety is perfectionism cognitions. It is defined as having high standards in life (Flett et al. 1998); however, this desire to reach a perfect state in thoughts and behaviors strongly inhibits psychological well-being and represents a state of dissatisfaction with life (Hill et al. 2010). Research has indicated that college students with perfectionism based on the evaluations of others had higher test anxiety (Weiner and Carton 2012), and conversely, that university students with high levels of cognitive test anxiety had high levels of maladaptive perfectionism (Arana and Furlan 2016; Eum and Rice 2011). In other words, students who set very high standards for themselves or have perfectionism cognitions may end up suffering from test anxiety.

According to ACT, stressful situations can be tolerated through self-forgiveness and cognitive defusion as well as by taking committed action towards values (Hayes and Smith 2005; Zettle et al. 2009). Self-forgiveness is considered to be a partly cognitive process (Zettle et al. 2009) that relieves the self by providing a different perspective on events, including thoughts (Enright 1996). In other words, individuals capable of forgiving themselves have fewer anxiety-provoking thoughts. For this reason, the ability to forgive oneself for previous test failures may positively affect future exam performance. Although the amount of research examining the role of self-forgiveness in test anxiety is limited, some studies have stated that it has an effect on anxiety in general (Berry et al. 2001). Roberts and Sedley (2016) state that cognitive defusion is effective in dealing with anxiety because it allows thoughts to be separated from oneself and looked at from a broader perspective. By providing relief from being stuck within one's thoughts (Hayes and Lillis 2012), cognitive defusion can be used as a way of reducing test anxiety. In an experimental study, Brown et al. (2011) tested the use of cognitive defusion as a strategy for test-anxious students and they concluded that cognitive defusion was useful in group activities aimed at dealing with test anxiety.

Test anxiety and its related variables have been studied extensively; however, there is limited research regarding the contribution of cognitive factors to this type of anxiety (Berger 2012). Considering the lack of research about cognitive test anxiety and its related variables, this study used ACT as its theoretical framework while investigating the role of psychological flexibility, rumination, perfectionism cognitions, cognitive defusion, and self-forgiveness, in predicting cognitive test anxiety among university students.

Method

Design

This study was conducted using a cross-sectional correlation design in which correlations between dependent and independent variables were measured without manipulation.

Participants

The present study was conducted with 715 university students [351 (49.1%) females, 364 (50.9%) males; age range: 17–27 years; mean age: 18.57 ($SD = 1.02$)]. All students were enrolled in the English Language Preparatory School of a state university in Turkey that uses English as the medium of instruction. Students possessed varying levels of English-language proficiency (beginner, elementary, intermediate, upper-intermediate) and were required to pass an English Proficiency Exam in order to enter the freshmen class. As stated by von der Embse et al. (2018), evaluative exams create more test anxiety. This particular cohort was selected because they were under the pressure of preparing for such a demanding examination. Stratified sampling (Fraenkel and Wallen 2006) was used to reflect students' language proficiency levels (i.e., percentages of beginner, elementary, intermediate, and upper-intermediate students were identical to the accessible population), with a total of 1000 students asked to participate in the study. Of these, 715 completed the questionnaires, giving a return rate of 71.5%. The demographic characteristics (gender and language level) of the participants are presented in Table 1.

Table 1 Demographic Information of the Participants

Variables	*f*	%
Gender		
Female	351	49.1
Male	364	50.9
Language Level		
Beginner	150	21.0
Elementary	343	48.0
Intermediate	175	24.5
Upper-Intermediate	47	6.5

Measures

In addition to demographic information, data were collected using the following instruments:

Cognitive Test Anxiety Scale-Revised (CTAR)

The Cognitive Test Anxiety Scale (CTAS) was developed by Cassady and Johnson (2002) and revised by Cassady and Finch (2015). The revised version of the CTAR has a uni-dimensional factor structure and comprises 25 items rated on a 4-point Likert-type scale ranging from 1 (not at all like me) to 4 (very much like me). Higher scores reflect high levels of cognitive test anxiety and total scores vary between 25 and 100. The scale indicated a high level of internal consistency (.91) (Cassady and Johnson 2002) and test-retest reliability (.94) (Cassady 2001). The CTAR was translated into Turkish and tested for validity and reliability on a sample of high school students by Bozkurt et al. (2017). The results of Exploratory Factor Analysis indicated a single-factor structure for the Turkish version of the scale (T-CTAR), with Items 22 and 24 omitted. The T-CTAR has 23 items and the scores range between 23 and 92. Similarly, the results of Confirmatory Factor Analysis (CFA) of the 23-item T-CTAR conducted within the framework of the present study indicated a uni-dimensional factor structure with acceptable fit indices [Satorra-Bentler χ^2 (224) = 1001.56, $p = .00$; $\chi^2/df\text{-}ratio = 4.47$; $NFI = .96$, $CFI = .97$, $RMSEA = .07$], and good internal consistency (.93) and test-retest reliability after a one-week interval (.93).

Perfectionism Cognitions Inventory (PCI)

Flett et al. (1998) developed the Perfectionism Cognitions Inventory (PCI) to measure the frequency of automatic thoughts related to perfectionism cognitions. With a uni-dimensional factor structure, the scale consists of 25 items scored on a 5-point Likert scale from 0 (never) to 4 (always). High scores point to high levels of perfectionistic thoughts, with a range from 0 to 100. Internal consistency and test-retest reliability were found to be .96 and .67, respectively. The scale was translated into Turkish by Aydın and Yerin Güneri (2018a), and the Turkish version of the scale (PCI-T) was tested on a sample of university students ($N = 418$), confirming its uni-dimensional factor structure. CFA results indicated an adequate model fit [Satorra-Bentler χ^2 (265) = 1285.96, $p = .00$; $\chi^2/df\text{-}ratio = 4.85$; $GFI = .89$, $CFI = .96$, $RMSEA = .07$, $SRMR = .06$]. The scale had high internal consistency (.94) and high test-retest reliability (.89) after a one-week interval.

Drexel Defusion Scale (DDS)

The Drexel Defusion Scale (DDS) was developed by Forman et al. (2012) in order to measure the ability to put a distance between thoughts and self. The DDS has one-factor structure and consists of 10 items based on different scenarios in which participants indicate their ability to maintain a state of defusion. Items, scored on a 6-point Likert scale ranging from 0 (not at all) to 5 (very much), give a total score ranging from 0 to 50. High scores indicate a good psychological distance from inner thoughts and feelings. The original DDS had a Cronbach's alpha of .83. The scale was translated into Turkish (DDS-T) by Aydın and Yerin Güneri (2018b), and tested with a sample of university students ($N = 1085$), which confirmed the uni-dimensional factor structure of the DDS-T and showed good fit indices [Satorra-Bentler χ^2 (33) = 53.49, $p = .00$; $\chi^2/df\text{-}ratio = 1.62$; $GFI = .97$, $CFI = .98$, $RMSEA = .04$], internal consistency (.80), and test-retest reliability (.81).

Ruminative Response Scale (RRS)

Nolen-Hoeksema and Morrow (1993) played a key role in developing the Ruminative Response Scale (RRS), which measures ruminative responses. The short version of the RRS was designed by Treynor et al. (2003) and includes 10 items loading onto two factors: 'Brooding' (5 items) and 'Reflection' (5 items). Higher levels of rumination can be detected with higher scores ranging from 10 to 40. The internal consistency of the short version of the RRS was calculated as .85 (Treynor et al. 2003). This version was translated into Turkish by Erdur-Baker and Bugay (2012), with CFA showing a good fit, and with a Cronbach's alpha of .85 (Erdur-Baker and Bugay 2012). When applied to the sample of university students in the current study, the Turkish version of the RRS was found to have a Cronbach's alpha level of .86.

State Self-Forgiveness Scale (SSFS)

Developed by Wohl et al. (2008), the State Self-Forgiveness Scale (SSFS) consists of two subscales - Self-Forgiving Feelings and Actions (SFFA) and Self-Forgiving Beliefs (SFB), with a total of 17 items rated on a 4-point Likert scale from 1 (not at all) to 4 (completely). A total score can be obtained from the scale ranging from 17 to 68 with high scores equaling high levels of self-forgiveness. Internal consistency (Cronbach's alpha) was calculated as .86 for SFFA and .91 for SFB. The SSFS was translated into Turkish and tested for validity and reliability on a sample of university students ($N = 455$) by Aydın and Yerin-Güneri (2017). The results yielded a two-factor structure for the Turkish version of the SSFS (SSFS-T); however, the factors differed from those of the original version, with items loading on "positive

perceptions of forgiveness" and "negative perceptions of forgiveness". Adequate fit indices were recorded, as follows: Satorra Bentler χ^2 (113) = 550.22, p = .00; χ^2/df- *ratio* = 4.86; *GFI* = .90, *CFI* = .97, *RMSEA* = .07. Cronbach alpha values for internal consistency obtained in the current study were .91 for the total scale, .87 for the "positive perceptions of forgiveness" sub-scale, and .89 for the "negative perceptions of forgiveness" subscale. The SSFS-T had a test-retest reliability of .79 after one week.

Acceptance and Action Questionnaire (AAQ-II)

Hayes et al. (2004) developed the Acceptance and Action Questionnaire (AAQ) to measure psychological inflexibility. The scale was revised as the AAQ-II (Bond et al. 2011) to include 7 items on a 7-point Likert scale ranging from 1 (never true) to 7 (always true). The AAQ-II has a uni-dimensional factor structure and scores ranging from 7 to 49. Higher scores reflect greater levels of psychological inflexibility. The AAQ-II was reported to have good internal consistency (Cronbach's alpha: .84; test-retest reliability: .81). The Turkish translation of the AAQ-II (Meunier et al. 2014) was also found to have good internal consistency (Cronbach's alpha: .88; test-retest reliability: .78). In the current study the internal consistency coefficient was found to be .90. (Because the AAQ-II provides a measure of psychological inflexibility rather than psychological flexibility, this study also reports scores for psychological inflexibility rather than flexibility.)

Procedure

This study received approval from the Human Subjects Ethics Committee of the university. Taking into consideration the proportion of students at each language level, 42 classes in the English Language Preparatory School were randomly selected. Then, for each study participant, an envelope was prepared that contained study measures in the following order: demographic information form, RRS, CTAR, AAQ-II, SSFS, PCI and DDS. A week before administration of the scale, the principal investigator informed instructors about the purpose of the study and the procedures that would be followed while administering the measures in the classrooms. All scales were applied by the course instructors on different days of the same week according to the convenience of the classroom schedule. A one-week-period which was not immediately after an exam or close to an approaching exam, was chosen so as not to get biased answers about test anxiety. After all the participants returned their written informed consents, the application of the instruments took approximately 20 minutes.

Data Analysis

Data were analyzed by Hierarchical Multiple Regression, with cognitive test anxiety as the dependent (outcome) variable, and psychological inflexibility, rumination, perfectionism cognitions, cognitive defusion, and self-forgiveness as the independent (predictor) variables. Descriptive statistics were presented for all variables. Statistical analysis was performed using the software program SPSS 23.

Results

Descriptive Statistics and Preliminary Analysis

Prior to the main analysis, descriptive statistics were obtained, and preliminary analysis was conducted, including identification of missing data and outliers as well as testing for normality, linearity, homoscedasticity, and multicollinearity (Berry 1993; Osborne and Waters 2002), including both the variance inflation factor (VIF) and tolerance values. In preliminary analysis, first the data set was checked for missing values. The data had 23 cases with missing values; three cases with only demographic information and three cases with no demographic information were removed from the study. For the total of 17 cases with one or more missing items in any scale, the listwise deletion method was used to exclude cases, in order to yield the least biased estimates considering the result of Little's MCAR test (Little 1992). The test indicated that data was completely missing at random. Also, univariate and multivariate outliers were checked via z scores, box plot and Mahalanobis distance. Four outliers exceeded the critical level. Therefore, two data files were created, one with and one without outliers. The model was tested on two data sets. As the model did not differ according to outliers, they were not excluded from the data set.

No violations of the necessary assumptions of hierarchical multiple regression analysis were observed. Descriptive

Table 2 Descriptive Statistics of Variables

	Score Range	Min.	Max.	M	SD
Cognitive Test Anxiety	23–92	23	92	45.74	11.95
Psychological Inflexibility	7–49	7	49	21.10	9.62
Rumination	10–40	10	38	21.20	5.53
Perfectionism Cognitions	0–100	0	96	55.36	10.62
Cognitive Defusion	0–50	0	47	24.85	8.14
Self-forgiveness	17–68	17	68	48.77	9.60

Measurements for variables: Cognitive Test Anxiety - T-CTAR; Psychological Inflexibility - Turkish version of AAQ-II; Rumination - Turkish version of RRS; Perfectionism Cognitions - PCI-T; Cognitive Defusion - DDS-T; Self-Forgiveness - SSFS-T

Table 3 Bivariate Correlations

	Cognitive Test Anxiety	Rumination	Psychological Inflexibility	Self-forgiveness	Perfectionism Cognitions	Cognitive Defusion
Cognitive Test Anxiety	–					
Rumination	.43**	–				
Psychological Inflexibility	.48**	.60**	–			
Self-forgiveness	−.31**	−.36**	−.42**	–		
Perfectionism Cognitions	.31**	.33**	.34**	−.21**	–	
Cognitive Defusion	−.37**	−.37**	−.47**	.33**	−.04	–

**$p < .01$

statistics for the outcome and predictor variables (mean, min., max., SD) are given in Table 2. Bivariate correlations ranged between −.21 and .60 are presented in Table 3, indicating no violation of multicollinearity. Psychological inflexibility, rumination, and perfectionism cognitions were found to positively correlate with cognitive test anxiety, whereas self-forgiveness and cognitive defusion were shown to negatively correlate with cognitive test anxiety. The highest correlations were observed between psychological inflexibility and rumination ($r = .60$, $p < .05$), and between psychological inflexibility and cognitive test anxiety ($r = .48$, $p < .05$). In contrast, the lowest correlation was between perfectionism cognitions and self-forgiveness ($r = -.21$, $p < .05$). Also, no correlation was found between perfectionism cognitions and cognitive defusion.

The descriptive results showed that the mean score of cognitive test anxiety level for beginner students was 47.11 (SD = 12.44), for elementary students 47.64 (SD = 12.35), for intermediate students 40.71 (SD = 9.80), and finally for upper-intermediate students 46.17 (SD = 9.43). That is, intermediate level students had relatively the lowest mean of cognitive test anxiety scores compared to other language levels. In terms of gender, female students had higher cognitive test anxiety mean scores (M = 48.78, SD = 12.09) than male students (M = 42.80, SD = 11.06) at all language levels. Specifically, the mean cognitive test anxiety scores of the beginner, elementary, intermediate and upper-intermediate level for females were 47.87 (SD = 1.25), 51.76 (SD = .86), 42.95 (SD = 1.30), and 48.65 (SD = 2.34) respectively. The mean cognitive test anxiety scores of the beginner, elementary, intermediate and upper-intermediate level for males were 46.20 (SD = 1.35), 43.49 (SD = .86), 39.04 (SD = 1.12), and 43.79 (SD = 2.29), respectively.

Results of Hierarchical Multiple Regression Analysis

Hierarchical multiple regression analysis was conducted to determine how much of the overall variance in cognitive test anxiety was explained by the predictor variables. Predictor variables were introduced into the model in two blocks, with psychological inflexibility entered as a confounding variable in the first step, and the remaining variables (rumination, perfectionism cognitions, cognitive defusion, self-forgiveness) entered into the regression model as a second step. The findings of regression analysis are presented in terms of the effect size (adjusted R^2) of the overall regression model, the associated significance test value (p), and the individual contribution of each predictor (β).

Results of the hierarchical regression analysis indicated that psychological inflexibility was a significant predictor of cognitive test anxiety in the first step, [$\Delta R^2 = .23$, ΔF (1, 713) = 218.52, $p < .05$]. When rumination, perfectionism cognitions, cognitive defusion and self-forgiveness were entered into the model in the second step, the results indicated that the model was significant [$\Delta R^2 = .08$, ΔF (4, 709) = 19.45, $p < .05$]. Overall, the predictor variables entered into the model accounted for 31% of the total variance in cognitive test anxiety scores, with psychological inflexibility explaining 23% of the variance, as seen in the first model; and the remaining variables accounting for an additional 8% of the variance as shown in Table 4.

Beta values were checked to determine the degree to which each of the predictor variables contributed to the model. Results showed that, except for self-forgiveness, all the predictor variables made significant individual contributions to the outcome. In other words, psychological inflexibility, rumination, perfectionism cognitions, and cognitive defusion made statistically significant contributions to cognitive test anxiety, whereas self-forgiveness made no contribution to cognitive test anxiety. Beta scores indicated that the strongest contribution to cognitive test anxiety came from psychological inflexibility ($\beta = .23$, $p < .05$), followed by cognitive defusion ($\beta = -.17$, $p < .05$), rumination ($\beta = .16$, $p < .05$) and perfectionism cognitions ($\beta = .16$, $p < .05$), which made similar contributions. Self-forgiveness was not found to make a significant contribution to the model ($p > .05$). Partial variances of psychological inflexibility, cognitive defusion, perfectionism cognitions, and rumination were 4%, 3%, 3%, and 2%, respectively.

Table 4 Results of Hierarchical Multiple Regression Analysis Predicting Cognitive Test Anxiety

Predictors	B	SE	β	T	sr^2	ΔR^2	ΔF
Model 1						.23*	218.52
Psychological Inflexibility	.28	.05	.23	5.21*	.04		
Model 2						.08*	19.45
Rumination	.35	.09	.16	3.96*	.02		
Perfectionism Cognitions	.09	.02	.16	4.58*	.03		
Cognitive Defusion	−.25	.06	−.17	−4.72*	.03		
Self-forgiveness	−.08	.04	−.07	−1.86	.00		

*$p < .05$

Discussion

The present study examined the role of psychological inflexibility, rumination, perfectionism cognitions, cognitive defusion, and self-forgiveness in predicting cognitive test anxiety among university students. Beta values representing the unique contribution of each variable showed psychological inflexibility, rumination, perfectionism cognitions, and cognitive defusion to be significant predictors of cognitive test anxiety. Whereas psychological inflexibility, rumination, and perfectionism cognitions were positively associated with cognitive test anxiety, cognitive defusion was negatively associated with cognitive test anxiety. Self-forgiveness was not found to be significantly correlated with cognitive test anxiety.

Of the predictor variables examined, psychological inflexibility made the largest contribution to the model in the current study. The finding that psychological inflexibility predicted cognitive test anxiety is in line with ACT theory that suggests increasing psychological flexibility can be a favorable way of dealing with the problem of test anxiety (Brown et al. 2011). The literature has frequently reported on the negative association between anxiety and psychological flexibility (Bluett et al. 2014; Sabourin 2013; Sharp 2012; Swain et al. 2013a, b), with anxiety shown to prevent individuals from being psychologically flexible. Orsillo and Roemer (2011) proposed using mindful strategies to change one's relationship with test anxiety. In other words, if test anxiety could be viewed as a sign of the importance attached to an exam, in line with one's values, then it might no longer represent an obstacle to success. Sohrabi et al. (2013) concluded that mindfulness strategies are useful in decreasing test anxiety. Thus, from the findings of the current study, it might implied that increasing psychological flexibility by use of mindfulness-based techniques can also help university students in managing their cognitive test anxiety.

The findings of the present study indicating a positive correlation between rumination and cognitive test anxiety is in line with existing literature (Yu et al. 2015). It can be inferred that increased rumination would lead to greater increases in cognitive test anxiety. As Flett et al. (2016) mentioned, the present study found a strong correlation between worry and rumination, which supports the view that cognitive test anxiety has a significant relationship with rumination. Rumination is also regarded as a key factor in psychological inflexibility among anxious students, who experience less psychological flexibility because their state of mind is focused far from the present moment (Hayes et al. 2012).

That the results show that perfectionism cognitions are positively associated with cognitive test anxiety is also in line with the literature (Eum and Rice 2011). Weiner and Carton (2012) showed that individuals with perfectionistic ideas towards themselves had high levels of negative concerns regarding the possibility of failing a test, which can be regarded as maladaptive. The literature states that maladaptive perfectionism reduces students' academic success as a result of the increased importance they attach to exams, and their higher levels of test anxiety. In a study of anxiety conducted with a population of Iranian high school students, Abdollahi and Abu Talib (2015) similarly found a negative association between anxiety and adaptive perfectionism and a positive association between anxiety and maladaptive perfectionism (Stoeber et al. 2009). Perfectionism cognitions that are intensively focused outside the self, such as 'I have to get top grades, be the best in the classroom, so everyone will be proud of me' can decrease self-confidence because they prevent individuals from observing themselves. Students with perfectionism cognitions may therefore experience high levels of cognitive test anxiety, as their perfectionism stories cause them to attach excessive importance to exams.

Anxious thoughts can lead to cognitive test anxiety due to a failure to differentiate between thoughts and self, whereas defusion makes it possible to take an 'outsider's' perspective. Students who are able to put a distance between their thoughts and themselves, and thus treat anxiety-inducing thoughts as nothing more than 'mere thoughts', experience less anxiety. The finding of the present study, that cognitive defusion was a significant predictor of cognitive test anxiety, is in line with Hayes et al. (2012), who stated that cognitive defusion alleviates students' anxious thoughts by allowing them to categorize them as 'only thoughts'.

Last but not least, the literature demonstrates a close relationship between self-forgiveness and anxiety (Berry et al.

2001; Ross et al. 2007), and Zettle et al. (2009) have noted the importance of studying the role of self-forgiveness in test anxiety. Contrary to expectations, the present study found no significant relationship between self-forgiveness and cognitive test anxiety. Self-forgiveness as a construct comprises both emotional and cognitive processes, and the lack of any significant predictive role of self-forgiveness in the model could be due to the construct 'cognitive test anxiety' including only negative cognitions or self-statements, not emotions. Additionally, in line with Enright (1996), it is likely that college students find self-forgiveness a more difficult process than forgiving others or forgiving events.

Notwithstanding the above, test anxiety is a common problem throughout the world, and the test anxiety literature has indicated cognitive test anxiety as an obstacle that hinders academic performance (e.g. Cassady 2004). Following Brown et al.'s (2011) suggestion that test anxiety needs to be examined from an ACT perspective in various cultural contexts, the current study investigated the relationship between set of ACT based cognitive variables and cognitive test anxiety as an important contribution to the test anxiety literature. The fact that the present study found psychological inflexibility to make the highest contribution to cognitive test anxiety was a striking result, suggesting that these two variables should be examined in greater detail. The significant negative correlation between cognitive defusion and cognitive test anxiety suggests that cognitive defusion can be helpful in dealing with cognitive test anxiety. In fact, as Roberts and Sedley (2016) suggested, cognitive defusion could be used as one of the most critical strategies for dealing with anxiety. Increasing psychological flexibility by, for example, focusing on values, and decreasing rumination and perfectionism cognitions could also help university students in dealing with cognitive test anxiety.

This study had a number of limitations that need to be taken into consideration when interpreting the results. First, this study was conducted with students from the English Language Preparatory School of a state university in Turkey and is not generalizable to a broader population. For better generalizability, further studies should be conducted with students at different educational levels, educational programs and universities. Secondly, the cognitive predictors investigated in this study (psychological inflexibility, rumination, perfectionism cognitions and cognitive defusion) were selected based on a theory-driven perspective that supports the role of psychological flexibility in reducing cognitive test anxiety; however, the variance explained by the model could be improved through the inclusion of other cognitive variables. Finally, the findings of the current study have some implications for use in university counseling centers. Prevention strategies based on ACT and increasing psychological flexibility could be given a priority in dealing with cognitive test anxiety; and for students with cognitive test anxiety, ACT-based group counseling could be provided to foster acceptance and value-based living as well as to decrease perfectionism cognitions and rumination.

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Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest. This is to acknowledge no financial interest or benefit that has arisen from the direct applications of our research.

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