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Psychometric Analyses of the Test Anxiety Scale for Elementary Students (TAS-E) Scores among Singapore Primary School Students

Patricia A. Lowe · Rebecca P. Ang · Stephen W. Loke

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Abstract The psychometric properties of the Test Anxiety Scale for Elementary Students (TAS-E) scores were examined among Singapore primary school students. In Study 1, an exploratory factor analysis (EFA) was performed to determine the factor structure of the TAS-E in a sample of 540 Singapore students. In Study 2, a confirmatory factor analysis (CFA) was performed on the TAS-E scores in another sample of 540 Singapore students to determine whether the findings would support the factor structure reported in Study 1. The results of the EFA and Schmid-Leiman transformation in Study 1 and the CFA in Study 2 suggest that the TAS-E has four factors (Physiological Hyperarousal, Social Concerns, Task Irrelevant Behavior, and Worry) and a higher-order factor, the Total Test Anxiety factor. These findings are similar to the results reported in validation studies of the TAS-E scores with U.S. elementary students. In addition, the test score stability and convergent and discriminant validity of the TAS-E scores were examined in Study 3 among 1,080 Singapore primary school students. The results indicated that the TAS-E scores appear to have adequate test score stability over a 2-week test-retest period. Evidence supporting the convergent and discriminant validity of the TAS-E scores was also found. Implications of the findings of the three studies are discussed.

P. A. Lowe (✉) · S. W. Loke
University of Kansas,
634 JRP Hall, 1122W. Campus Rd.,
Lawrence, KS 66047, USA
e-mail: tlowe@ku.edu

S. W. Loke
e-mail: swloke@ku.edu

R. P. Ang
Division of Psychology, Nanyang Technological University,
14 Nanyang Drive,
Singapore 637332, Singapore
e-mail: rpang@ntu.edu.sg

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Test anxiety has been examined in different countries and cultures throughout the world (Bodas and Ollendick 2005; Zeidner 1998). Test anxiety is a prevalent and cross-cultural phenomenon (Seipp and Schwarzer 1996). Many researchers conceptualize test anxiety as a situation-specific form of trait anxiety (Spielberger et al. 1976; Spielberger and Vagg 1995) and it involves excessive worry, apprehension, and tension in reaction to test situations (Spielberger and Vagg 1995). Reported negative effects of test anxiety include poor test performance (Bodas and Ollendick 2005; Everson et al. 1991; Sharma and Rao 1983), poor classroom grades (Chapell et al. 2005; Sharma and Rao 1983), concentration difficulties (Bedell and Marlowe 1995), grade retention (Beidel and Turner 1988), school dropout (Tobias 1979), lower self-esteem, (Putwain 2007), and higher rates of psychopathology (Bodas and Ollendick 2005; King et al. 1995). A review of the international test anxiety literature reveals no published research conducted to date on test anxiety among Singapore primary school students.

Cultural Context and Test Anxiety

In the Singapore educational system, English is the language of instruction for all students (Li et al. 2008). Singapore students may attend kindergarten for 2 years, followed by 6 years of primary school. At the end of primary school, students are required to take a qualifying examination, the Primary School Leaving Examination (PSLE; Singapore Department of Statistics 2006). The results of the PSLE assist parents and their child in selecting an appropriate secondary school for their child to attend. Once students complete their secondary school experience, they take a

national examination, the Singapore-Cambridge GCE 'N' or 'O' Level examination. These examinations assess academic achievement and determine post-secondary educational options (Singapore Department of Statistics 2006). However, in recent years, Singapore has been moving towards an education system that is more flexible and diverse. For example, the Integrated Program combines secondary and junior college education without the intermediate GCE "O" Level examination (Singapore Ministry of Education 2010). Although some Singapore students have opted for this educational route, many students continue to participate in the traditional school experience and complete the national exam at the end of their secondary school experience (Singapore Department of Statistics 2006).

The Singapore educational system is highly competitive surrounding these national exams, and these exams play an important role in determining educational options, career pathways, and future careers for Singapore students (Ang et al. 2009; Ho and Yip 2003). Singapore students experience pressure to perform well on these national exams and to excel academically in their schools, as future careers and status in the Singapore society are determined in part by students' performance in the schools (Ho and Yip 2003).

Pressure on Asian students to perform well in school not only comes from the self, but it also comes from the family (Ang et al. 2009; Li et al. 2008). Performing well in school is a filial duty (Ang et al. 2009). Asian students are expected to achieve academically in school in order to please their parents (Ang et al. 2009; Salili et al. 2001; Wong et al. 2005). Students who excel in school are a source of pride to the Asian family and students who do not perform well in school bring shame and loss of face to their parents, family (Ang et al. 2009), and the entire community (Yeh and Huang 1996). Filial piety (i.e. respect for elders) is a core tenet of parent–child relationships in Confucian philosophy (Park and Chesla 2007) and Confucian philosophy is prevalent and firmly ingrained in the Singapore society (Ang et al. 2009; Graham et al. 2002; Li et al. 2008). Thus, these pressures on students produce stress (Ang et al. 2009) and may result in high levels of test anxiety, as culture-specific socialization practices and parental values have been speculated in the development of public self-consciousness and anxiety (Zeidner 1998). Schwarzer and Kim (1984) found evidence to support these claims among some Asian students.

Test Anxiety Construct

From an international perspective, the test anxiety construct is somewhat elusive (Zeidner 1998). Many researchers believe the test anxiety construct consists of multiple dimensions (Benson 1998; Friedman and Bendas-Jacob 1997; Zeidner 1998). However, many measures in current use do not capture the multidimensional nature of the test anxiety construct (Friedman and Bendas-Jacob 1997; Zeidner 1998). Moreover, the majority of the instruments in current use are relatively old. These instruments are more than 30 years old, with outdated items and old norms (Lowe et al. 2004). In addition, measures of test anxiety must account for developmental differences, as we cannot assume the construct of test anxiety is same throughout the lifespan (Wren and Benson 2004) and most test anxiety measures have been developed for adults (Anderson and Sauser 1995). Thus, new multidimensional measures need to be developed for specific age groups to account for any developmental differences in the test anxiety construct. Also, no known new multidimensional measure of test anxiety based on theory and current research in the field has been developed for students in grades 2 through 6 (Lowe et al. 2011). According to Sarason and colleagues (as cited in Hill 1972), test anxiety symptoms first appear in the early elementary school years, specifically in grade 2. Therefore, new multidimensional measures of test anxiety need to be developed to help identify test-anxious students in the early elementary school years. With early identification of test-anxious students, mental health experts may be able to intervene early and hopefully, reduce test anxiety and its negative effects.

Test Anxiety Scale for Elementary Students

The Test Anxiety Scale for Elementary Students (TAS-E) is a new multidimensional measure of test anxiety. The TAS-E consists of 30 items and includes a Total Test Anxiety scale and four test anxiety subscales (Physiological Hyperarousal, Social Concerns, Task Irrelevant Behaviors, and Worry). The TAS-E was developed for children in grades 2 through 6. Prior to the TAS-E, no new multidimensional measures of test anxiety had been developed to assess test anxiety among students in grades 2 through 6 (Lowe et al. 2011).

In the present studies, the TAS-E was validated using both exploratory (EFA) and confirmatory factor analyses (CFA) to assess the cross-cultural suitability of the TAS-E scores among Singapore primary school students. In addition, test score stability and convergent and discriminant validity of the TAS-E scores were examined.

Study 1

Method

The total sample of 1, 080 was split in half (odd-even split) and the responses of 50.0% of the students (n=540) were

used to conduct an EFA in Study 1. In Study 2, the responses of the other 50% of the students (n=540) were used to perform a CFA. In Study 3, test score stability and convergent and discriminant validity of the TAS-E scores were examined using the total Singapore sample (n=1,080).

Participants

The participants for Study 1 included 540 students, 245 (45.4%) males and 283 (53.4%) females, ages 9 to 13, in grades 4 through 5. Twelve (2.2%) students did not indicate their gender. The average age of the total sample was 10.37 years (SD=.61) and the mean grade level was 4.49 (SD=.50). The racial/ethnic composition of the sample consisted of 61.9% Chinese, 9.5% Indian, 26.1% Malay, .2% Eurasian, and 2.2% other.

Instrument

The TAS-E is a 30 item self-report measure of test anxiety developed for students in grades 2 through 6. The TAS-E consists of a Total Test Anxiety scale and four test anxiety (Physiological Hyperarousal, Social Concerns, Task Irrelevant Behavior, and Worry) subscales. The Physiological Hyperarousal subscale consists of 9 items (score range is 9–36, M=16.69, SD=5.95) and measures physical symptoms of test anxiety. The Social Concerns subscale includes 6 items (score range is 6–24, M=8.31, SD=2.74) and assesses concerns a student has about the perceptions of others if one fails a test. The Task Irrelevant Behavior subscale consists of 8 items (score range is 8–32, M=19.50, SD=6.17) and measures avoidant, fidgety, and restless behaviors associated with evaluative situations. The Worry subscale includes 7 items (score range is 7 – 28, M=17.49, SD=5.91) and measures worrisome thoughts associated with test situations. The Total Test Anxiety scale consists of 30 items (score range is 30–120, M=62.00, SD=16.51) and is a measure of overall debilitating test anxiety. The Total Test Anxiety score is obtained by summing the raw scores from the four test anxiety subscales. A higher Total Test Anxiety score suggests a higher level of test anxiety. Respondents rate their responses on a 4-point Likert scale, ranging from 1 (*never*) to 4 (*always*; Lowe et al. 2011).

Items for the TAS-E were written to reflect the multiple dimensions (behavioral, physiological hyperarousal, social derogation, cognitive interference, and worry) of the test anxiety construct. The worry and emotionality (now called physiological hyperarousal; Joiner et al. 1999) components came from the work of Liebert and Morris (1967). Liebert and Morris believed that the test anxiety construct consisted of two components, a worry component and an emotionality component. The worry component is the concerns a student experiences about one's test performance and the emotionality component is the autonomic reactions a student experiences in an evaluative situation. The social concerns items were written based on the work of Friedman and Bendas-Jacob (1997). Friedman and Bendas-Jacob introduced the social derogation component in their three-dimensional (social derogation, tenseness, and cognitive obstruction) model of test anxiety. Social derogation is the worries of social belittlement a student expects from others when one fails a test. The cognitive interference component is based on the work of Wine (1971) and Friedman and Bendas-Jacob (1997). In Wine's (1971) cognitive-attentional model, task-irrelevant thoughts prevent a student from focusing on a test and lowers test performance. The cognitive interference component is similar to the cognitive obstruction component in Friedman and Bendas-Jacob's (1997) three dimensional model of test anxiety. However, Wren and Benson (2004) found evidence to suggest that unlike adults, children were less able to differentiate between the dimensions of cognitive interference and worry, which was also the case in the Lowe et al. (2011) study. Therefore, only a worry dimension is found on the TAS-E and this dimension includes several cognitive interference items. The last component, the behavioral component, was derived from the work of Nottelmann and Hill (1977); Sarason and Mandler (1952), and Wren and Benson (2004). Sarason and Mandler (1952) stated that the test-anxious student exhibits task-irrelevant (i.e. avoidance) behaviors in testing situations and Nottelmann and Hill (1977) and Wren and Benson (2004) indicated that there were certain off tasks behaviors, fidgety and restless behaviors, observed in the test-anxious student and these behaviors interfere and lower test performance.

Seventy items were written for the TAS-E to reflect the behavioral, physiological hyperarousal, social derogation, cognitive interference, and worry dimensions of the test anxiety construct. Rafferty et al. (1997) work also guided the item generation process. These authors suggest test anxiety symptoms may appear before, during, or after a test. After the items were written for the TAS-E, they were reviewed by two measurement experts, three elementary school teachers, and eight students in grades 2 through 6. Items reviewed were then revised to improve their clarity and readability. Twenty items were deleted from the TAS-E due to their redundancy (Lowe et al. 2011).

Lowe and colleagues (2011) administered the 50-item measure to a sample of 997 U.S. elementary school students. Of the 50 items administered to these students, 20 items were eventually dropped because these items had low item-total correlations, low factor loadings on all TAS-E factors, or high factor loadings on more than one TAS-E factor. The interpretability of the factors was also considered in the deletion of items from the TAS-E. The final TAS-E scale consisted of 30 items (Lowe et al. 2011).

Lowe and colleagues (2011) reported internal consistency reliability estimates of .80 to .93 for the TAS-E scale and subscale scores and test score stability coefficients of .83 to .91 over a 1- to 5-week test-retest interval for the TAS-E scores. Evidence supporting the construct validity of the TAS-E scores has been found (Lowe et al. 2011).

Procedures

Students were administered a packet of measures in large groups in their schools. The TAS-E and the other measures were administered in English, as English is the official language of instruction in all of the Singapore schools. Test administrators followed standardized procedures in the administration of the measures to the students according to the instructions printed in the manuals or at the top of the measures. Test administrators returned 2-weeks later to administer the TAS-E again along with some other measures.

Results

Sources of Validity Evidence

Evidence Based on Internal Structure Before the EFA was performed, the normality of the data was examined. Skewness values of the items ranged from −.50 to 3.69. Based on the skewness of the data, log transformations were performed (see Stevens 2009). Then two EFAs were conducted, one with the transformed item variables and the other with the non-transformed item variables. The purpose of performing two EFAs was to examine the similarity of the factor structure with transformed and non-transformed item variables. In addition, non-transformed item variables were used in the EFA performed with the U.S. data (Lowe et al. 2011).

The method of principal axis factoring was used to extract the factors in the EFAs. The factors were rotated using the promax procedure. The promax rotation procedure is an oblique technique and oblique rotation procedures are the most appropriate methods to use to rotate factors when the underlying factors are correlated with each other (Tabachnick and Fidell 2001). Research has shown the TAS-E factors to be correlated with each other in a U.S. sample (Lowe et al. 2011). The promax rotation procedure was chosen because it produces clinically useful solutions (Lowe and Reynolds 2000).

The number of factors to extract in the two factor analyses were determined by the decrements in the scree plot (Cattell 1966), results of parallel analysis (Horn 1965) and Velicer's (1976) minimum average partial (MAP) test, and the eigenvalues-greater-than-one rule (Kaiser 1960). The eigenvalues-greater-than-one rule tends to overestimate and at times underestimate the number of factors to extract, whereas the examination of the scree plot relies largely on the subjective judgment of the researcher to determine the number of factors to extract (Zwick and Velicer 1986). In contrast, Velicer's MAP test and parallel analysis are statistically-based factor extraction methods. According to many researchers, Velicer's MAP test and parallel analysis yield optimal solutions (O'Connor 2000; Zwick and Velicer 1986). In addition to these four factor extraction methods, the interpretability of the factor solutions was examined.

Inspection of the decrements in the scree plot, the results of parallel analysis and Velicer's MAP test, and the examination of the interpretability of the factor solutions suggested that four factors should be retained for both solutions. In contrast, the eigenvalues-greater-than one rule suggested that five factors should be retained for both solutions. Based on these results, the four-factor promax solutions were selected as the most appropriate solutions for the total sample. Examination of the four-factor promax solution for the transformed item variables and the non-transformed item variables yielded similar results and because they were similar and the four-factor promax solution for non-transformed item variables was reported in Lowe et al.'s (2011) study with a U.S. sample, the four-factor promax solution for the non-transformed items for the Singapore sample is presented in Table 1. Interfactor correlations for the non-transformed data ranged from .24 to .59 for the total sample.

Examination of the four-factor solution for Singapore students indicated that it was similar to the four-factor solution for a sample of U.S. students in Lowe et al.'s (2011) study. Factors I, II, III, and IV are the Worry, Social Concerns, Physiological Hyperarousal, and Task Irrelevant Behavior factors, respectively. These factors are the same factors found on the TAS-E in Lowe et al.'s (2011) study with a U.S. sample. For the Singapore sample, the items were most salient on the same factors in comparison to the sample of U.S. students, with one exception. Item 22, which assesses concentration difficulties (i.e. my mind goes blank when I take a test), moved from Factor I (Worry) to Factor III (Physiological Hyperarousal). This difference is relatively trivial.

In a previous study with a U.S. sample, a higher-order factor, the TAS-E Total Test Anxiety factor, was found (Lowe et al. 2011). Therefore, the Schmid-Leiman (1957) transformation was performed to determine the presence of a higher-order factor for the Singapore sample. The results of the analysis indicated the first-order factors accounted for 42.20% of the extracted variance and the general factor accounted for 57.80% of the extracted variance. These results support the presence of a higher-order factor, the Total Test Anxiety factor, for the Singapore sample.

Table 1 Factor pattern coefficients for the four-factor promax solution and the standardized factor coefficients for the Test Anxiety Scale for Elementary Students (TAS-E)

	Factor pattern coefficients				Standardized factor coefficients
Item No.	I	II	III	IV	
12	**.78**	.06	.10	.01	.76
27	**.77**	.03	.09	.01	.73
25	**.74**	.03	.01	.06	.71
10	**.72**	.04	.04	.03	.73
20	**.64**	.01	.03	.12	.73
17	**.46**	.03	.13	.14	.56
15	.05	**.85**	.01	.08	.67
21	.01	**.82**	.07	.03	.78
3	.12	**.69**	.09	.06	.58
29	.14	**.64**	.03	.04	.64
6	.12	**.62**	.09	.04	.60
23	.11	**.53**	.06	.07	.61
30	.09	.07	**.78**	.09	.53
14	.03	.07	**.67**	.09	.66
13	.02	.04	**.52**	.04	.62
1	.04	.07	**.50**	.05	.56
24	.37	.11	**.49**	.07	.52
9	.39	.05	**.46**	.10	.50
4	.06	.00	**.44**	.05	.58
19	.05	.16	**.44**	.16	.58
7	.16	.26	**.44**	.06	.50
22	.13	.09	**.27**	.21	.52
8	.04	.04	.25	**.67**	.46
11	.04	.04	.05	**.60**	.59
18	.12	.00	.13	**.56**	.57
28	.14	.01	.11	**.56**	.55
26	.13	.09	.12	**.53**	.63
5	.12	.03	.04	**.46**	.58
16	.13	.09	.10	**.42**	.44
2	.20	.07	.04	**.38**	**.51**
Trace	3.43	3.11	2.87	2.42	
Post-rotation Variance	28.99	26.29	12.38	20.46	

Highest factor pattern coefficients are in bold font. Factor I = Worry, Factor II = Social Concerns, Factor III = Physiological Hyperarousal, and Factor IV = Task Irrelevant Behavior

Internal consistency reliability estimates were computed for the TAS-E scale and subscale scores for the Singapore sample. Coefficient alphas for the TAS-E scores ranged from .75 to .90 (Physiological Hyperarousal=.83, Social Concerns=.81, Task Irrelevant Behavior=.75, Worry=.85, and Total Test Anxiety=.90). These reliability estimates appear adequate for research purposes (Henson 2001).

Study 2

Method

Participants

The participants in Study 2 included 540 Singapore primary students, 251 (46.5%) males and 285 (52.8%) females, ages 9 to 13, in grades 4 through 5. Four students (.7%) did not indicate their gender. The average age of the students was 10.37 years (*SD*=.62) and the mean grade level was 4.49 (SD=.50). The racial/ethnic composition of the sample consisted of 68.9% Chinese, 27.2% Malay, 5.9% Indian, .7% Eurasian, and 1.3% other. Five individuals (.9%) did not indicate their racial/ethnic background.

Instruments

The measure used in the present study was the TAS-E. The TAS-E is described in detail in Study 1.

Procedures

The same administration and data collection procedures were followed in Study 2 as were followed in Study 1.

Results

Sources of Validity Evidence

Evidence Based on Internal Structure Coefficient alphas were computed to assess the internal consistency reliability of the TAS-E scores for the Singapore sample. Internal consistency reliability estimates ranged from .76 to .90 (Physiological Hyperarousal=.82, Social Concerns=.81, Task Irrelevant Behavior=.76, Worry=.85, and Total Test Anxiety=.90). These reliability estimates appear adequate for research purposes (Henson 2001).

Confirmatory factor analysis of the responses of the students on the TAS-E was then performed to determine whether the findings would support the factor structure reported in Study 1. Mplus, Version 6 (Muthén and Muthén 1998–2010) was used to perform the confirmatory factor analysis. Because the analysis indicated that the data violated the multivariate normality assumption, parameters were estimated using robust maximum likelihood (MLM). The four-factor model with a higher-order factor reported in the analysis of Study 1 was compared to a one-factor model and a four-factor model. Two modification index values greater than 20 were identified. These two modification indices indicated two correlated measurement errors between Items 9 and 24 and Items 3 and 15. Model respecification should not be made unless the respecifica-

tion makes statistical and substantive sense (Brown 2006; Byrne 1994). Model respecification made statistical and substantive sense in this study because of the large modification index values and the magnitude of the expected parameter change (EPC) values noted for the two error covariances. Also, the two error covariances represented correlated errors among items on the same subscales on the same measure. As a result, the one-factor model, four-factor model and four-factor model with a higher-order factor were respecified with these two parameters freely estimated. Goodness of fit was evaluated using the chi-square fit statistic (χ^2), standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA), and the comparative fit index (CFI). CFI values of .90 and .93 indicate acceptable and good model fit, respectively (Byrne 1994). A RMSEA value of less than .06 and a SRMR value of less than .08 indicate good model fit (Hu and Bentler 1999).

The fit indices for the unmodified and modified one-factor model, four-factor model, and four-factor model with a higher-order factor are presented in Table 2. For the modified four- factor model with a higher-order factor, the chi-square fit index was significant. However, chi-square fit indexes are dependent on sample size (Byrne 1994) and the sample size in the present study was moderate to relatively large. The CFI, RMSEA, and SRMR values were .93, .04, and .06, respectively, for the modified four-factor model with a higher-order factor. The results indicate that the modified four-factor model with a higher-order factor represent a good fit to the data. In comparison to the modified one-factor model, the fit indices for the modified four-factor model with a higher-order factor were superior overall to the fit indices for the modified one-factor model. None of the fit indices for the modified one-factor model suggested an acceptable or good fit. In contrast, the fit indices for the modified four-factor model with a higher-order factor and the modified four-factor model were similar. However, the fit indices suggest that the modified four-factor model with a higher-order factor is more parsimonious than the modified four-factor model and the four-factor model with a higher-order factor appears justifiable on theoretical grounds. The standardized factor coefficients for the modified four-factor model with a higher-order factor are presented in Table 1. Standardized second-order factor coefficients ranged from .55 to .97.

Table 2 Fit indices from the confirmatory factor analyses of the Test Anxiety Scale for Elementary Students (TAS-E) scores

Model	χ^2	df	CFI	RMSEA	SRMR
1 factor (unmodified)	1708.48*	405	.63	.08	.09
1 factor (modified)	1533.79*	403	.68	.07	.09
4 factor (unmodified)	767.18*	399	.90	.04	.06
4 factor (modified)	661.63*	397	.93	.04	.06
4 factor with a higher-order factor (unmodified)	772.92*	401	.90	.04	.06
4 factor with a higher-order factor (modified)	664.84*	399	.93	.04	.06

χ^2 Chi Square; *CFI* Comparative Fit Index; *RMSEA* Root Mean Square Error of Approximation; *SRMR* Standardized Root Mean Square Residual

*$p<.0001$

Study 3

In Study 3, the convergent and discriminant validity of the TAS-E scores were examined. We expected high correlations between the TAS-E scores and the Academic Expectations Stress Inventory (AESI; Ang and Huan 2006) and the Revised Children's Manifest Anxiety Scale-Second Edition (RCMAS-2; Reynolds and Richmond 2008a) anxiety scores and low correlations between the TAS-E scores and the RCMAS-2 Defensiveness scores. We also expected the TAS-E scores to have high correlations with the scores of a similar dimension on the RCMAS-2.

Method

Participants

The participants for Study 3 consisted of 1,080 students, 496 (45.9%) males and 568 (52.6%) females, ages 9 to 13, in grades 4 through 5. Sixteen students (1.5%) did not indicate their gender. The average age of the students was 10.37 years (*SD*=.62) and the mean grade level was 4.49 (*SD*=.50). The racial/ethnic composition of the sample included 65.2% Chinese, 24.1% Malay, 7.7% Indian, .5% Eurasian, and 1.8% other. Nine individuals (.8%) did not indicate their race/ethnicity.

Instrument

The measures used in the present study included the AESI, RCMAS-2, and the TAS-E. A description of the TAS-E appears in Study 1. Brief descriptions of the AESI and the RCMAS-2 follow.

The Academic Expectations Stress Inventory (AESI) The AESI is a 9-item self-report measure used to assess academic stress in students. The AESI consists of a Total scale and two subscales (Expectations of Self and Expectations of Parents/Teachers). The Expectations of Self subscale assesses academic stress arising from the expectations of self and the Expectations of Parents/Teachers

subscale measures academic stress arising from the expectations of others. Students rate their responses on the AESI on a 5-point Likert scale, ranging from 1 (*Never true*) to 5 (*Almost always true;* Ang and Huan 2006). Ang and Huan reported internal consistency reliability estimates of .84 to .89 and test score stability coefficients of .77 to .85 over a 2-week test-retest interval for the AESI scores. Evidence supporting the construct validity of the AESI scores has been found (Ang and Huan 2006; Ang et al. 2007; Ang et al. 2009).

*The Revised Children's Manifest Anxiety Scale-Second Edition (RCMAS-2)*The RCMAS-2 is a 49 item self-report measure of general anxiety. The RCMAS-2 consists of a Total Anxiety scale, three anxiety subscales (Physiological Anxiety, Social Anxiety, and Worry), and a Defensiveness scale. The Total Anxiety scale scores assess general or trait anxiety. The Physiological Anxiety subscale scores measure an individual's physiological responses associated with general anxiety and the Social Anxiety subscale scores assess a person's anxiety in social and performance situations. The Worry subscale scores assess an individual's general fear, nervousness, and oversensitivity to environmental pressures. The Defensive scale scores measures a student's inaccurate view of the self or unwillingness to admit to typical imperfections. Raters respond to the items on the RCMAS-2 using a yes/no format (Reynolds and Richmond 2008b).

Reynolds and Richmond (2008b) reported internal consistency reliability estimates of .79 to .92 and Lowe et al. (2011) reported test score stability coefficients of .80 to .86 over a 1- to 5-week test-retest interval for the RCMAS-2 scores. Evidence supporting the construct validity of the RCMAS-2 scores has been found (Reynolds and Richmond 2008b).

Procedures

The same procedures were followed in Study 3 as were followed in Studies 1 and 2 in the administration of the measures and data collection.

Sources of Validity Evidence

Evidence Based on the Internal Structure Internal consistency reliability estimates were computed for the AESI, the RCMAS-2, and the TAS-E scores for the total sample. For the TAS-E scores, coefficient alphas ranged from .76 to .90 (Physiological Hyperarousal=.83, Social Concerns=.83, Task Irrelevant Behavior=.76, Worry=.86, and Total Test Anxiety=.90) for the first testing session and from .82 to .92 (Physiological Hyperarousal=.86, Social Concerns=.86, Task Irrelevant Behavior=.82, Worry=.90, and Total Test Anxiety=.92) for the second testing session. The internal consistency reliability estimates for the AESI Total scores was .90. Coefficient alphas of .81 and .83 were found for the AESI Expectations of Self and Expectations of Parents/Teachers subscale scores, respectively. The internal consistency reliability estimates for the RCMAS-2 scores ranged from .76 to .92 (Physiological Anxiety=.76, Social Anxiety=.81, Worry=.88, Total Anxiety=.92, and Defensiveness=.77). These reliability estimates are adequate for research purposes (Henson 2001).

Test score stability of the TAS-E scores was also examined over a 2-week test-retest interval. A test score stability coefficient of .77 was found for the TAS-E Total Test Anxiety scale scores. The test score stability coefficients for the four test anxiety subscale scores ranged from .70 to .77 (Physiological Hyperarousal=.77, Social Concerns=.71, Task Irrelevant Behavior=.70, and Worry=.71). These test score stability coefficients appear adequate for research purposes (Henson 2001; Nunnally and Bernstein 1994).

Evidence Based on the External Relations Correlations between the TAS-E scores and scores of measures external to the test were calculated. These validity coefficients are presented in Table 3. Examination of the validity coefficients indicated that the TAS-E scores correlated highest with scores of scales and subscales assessing similar constructs and correlated lowest with scores of scales assessing dissimilar constructs. The TAS-E Total Test Anxiety scale scores correlated the highest with the scores of the AESI and the RCMAS-2 Total Anxiety scale. Validity coefficients of .63 to .67, which represent large effect sizes according to Cohen (1988), were found between the scores of the TAS-E Total Test Anxiety scale and the scores of the AESI and the RCMAS-2 Total Anxiety scale. The AESI scores and the RCMAS-2 Total Anxiety scores accounted for 39.69% to 44.89% of the variance in the TAS-E Total Test Anxiety scores. Correlation coefficients of .28 to .66, which represent small to large effect sizes according to Cohen (1988), were reported between the TAS-E subscale scores and the AESI scores and the RCMAS-2 anxiety scores. Significant correlations were noted between the TAS-E subscale scores and the scores of similar dimensions on the RCMAS-2. These findings provide support for the convergent validity of the TAS-E scores. In contrast, validity coefficients of −.19 to −.02, which represent negligible to small effect sizes according to Cohen (1988), were noted between the TAS-E scores and the RCMAS-2 Defensiveness scores. These findings provide support for the discriminant validity of the TAS-E scores.

Discussion

Overall, the results of the present studies provide support for the four-factor structure with a higher-order factor for

Table 3 Correlations between the Test Anxiety Scale for Elementary Students (TAS-E) scores and the scores of the Academic Expectation Stress Inventory (AESI) and the Revised Children's Manifest Anxiety Scale-Second Edition (RCMAS-2) for the total sample (n=403)

	TAS-E				
Scale/subscale	Total Test anxiety	Physiological hyperarousal	Social concerns	Task irrelevant behavior	Worry
AESI					
Total	.67**	.52**	.34**	.32**	.66**
Expectations of parents/teachers	.63**	.50**	.34**	.32**	.61**
Expectations of self	.63**	.48**	.29**	.28**	.64**
RCMAS-2					
Total anxiety	.63**	.54**	.44**	.38**	.52**
Physiological anxiety	.55**	.52**	.34**	.43**	.40**
Social anxiety	.54**	.42**	.43**	.27**	.44**
Worry	.58**	.48**	.38**	.32**	.51**
Defensiveness	−.07*	−.02	−.06	−.19**	−.07*

*p<.05, **p<.01

the TAS-E scores among Singapore primary students in grades 4 through 5. These findings are similar to Lowe et al.'s (2011) results reported with a sample of U.S. students in grades 2 through 6. All of the items on the TAS-E were most salient on the same four factors in the current Singapore sample and a U.S. sample, with one exception. These findings provide support for the construct validity of the TAS-E scores among Singapore students in grades 4 through 5.

The results of the present studies also provide support for the reliability of the TAS-E scores among Singapore primary school students in grades 4 through 5. The internal consistency reliability estimates across studies and the test score stability coefficients of the TAS-E scores appear adequate for research purposes (Henson 2001). These reliability estimates reported suggest that the items on the various TAS-E subscales are relatively homogeneous and demonstrate satisfactory consistency over a range of at least 2 weeks.

In addition, the findings provide support for the convergent and discriminant validity of the TAS-E scores. Small to large effect sizes were found between the TAS-E scores and the scores of the AESI and the RCMAS-2 anxiety scale and subscales. The scores of these measures assess similar constructs. The AESI scores measure academic stress in children and adolescents, and stress and anxiety are reported to be related constructs (Putwain 2007). Putwain states that anxiety is one potential psychological outcome of stress. Other potential psychological outcomes of stress include negative affect, perceived self-efficacy, and self-esteem. Test anxiety is viewed as an academic stress outcome or reaction to tests (Putwain 2007). Therefore, measures of academic stress and test anxiety should correlate significantly with each other. The TAS-E scores also correlated significantly with the RCMAS-2 anxiety scores. Test anxiety is reported to be significantly correlated with measures of general anxiety and with symptoms of different types of anxiety disorders, including generalized and social anxiety disorders (Beidel and Turner 1988; Hembree 1988). Hembree has stated that test anxiety is a common problem found among children and adolescents with anxiety disorders. Moreover, Barlow (2004) and Moses and Barlow (2006) have reported common core symptoms (i.e. hyperarousal and apprehension) among children and adolescents with test anxiety and most types of anxiety disorders. Therefore, these two constructs should and do correlate significantly with each other.

In contrast, negative and negligible to small effect sizes were found between the TAS-E scores and the scores of the RCMAS-2 Defensiveness scale. The TAS-E and the RCMAS-2 Defensiveness scores measure different constructs. Thus, these findings provide evidence to support the discriminant validity of the TAS-E scores.

The findings from the present study also suggest that the TAS-E has the potential to identify test-anxious students in primary schools or at least in grades 4 through 5 in Singapore schools. Early detection of high levels of test anxiety is needed, so mental health professionals can intervene early and reduce test anxiety. Researchers (Ang et al. 2009; Graham et al. 2002; Li et al. 2008) have suggested that the prevalence of anxiety, including test anxiety, can be attributed to the permeation of Confucian philosophy in Singapore's society. Achievement of academic success brings honor to the family and allows children to show filial piety to their parents (Ang et al. 2009; Salili et al. 2001). With student effort being highly valued in Asian societies, children are ingrained from an early age that academic success is attributed to hard work (Lee 1996). Stevenson et al. (1990) found mothers of Chinese children estimated that their children spent four times the amount of time on homework than American children. In addition to

the belief that effort and hard work lead to academic success, Stankov (2010) proposed that Confucian Asians may be less forgiving than Europeans. For example, Confucian Asians are less likely to disagree with statements encouraging toughness than Europeans and because of this unforgiving nature,Confucian Asians are more likely to experience high levels of anxiety and stress. Recent studies have shown that Confucian Asian students are more anxious and self-doubting than European students (Lee 2009; Wilkins 2004). However, Singapore students are not just pressured to achieve academically by their parents. In interdependent cultures like Singapore, children also experience societal demands to perform well in school (Woo et al. 2004). Teachers and other members of the Singapore society assume some responsibility in the development and education of children. As a result, children are pressured to not only satisfy their academic goals, but also to meet the academic goals set by their parents, teachers, and society (Stevenson et al. 1990).

The possibility that Confucian Asians may be less forgiving than Europeans and the belief that effort and hard work lead to academic success (Watkins and Biggs 2001) highlight the importance and the need to address test anxiety among Singapore students. However, in interdependent cultures like Singapore, seeking psychological and psychiatric services from mental health centers is still stigmatizing. Seeking these services can be seen as shameful to both the individual and the family (Ang et al. 2009). To prevent a "loss of face", parents may refrain from bringing their children to mental health centers to be evaluated. Consequently, these children do not receive the mental health services needed to improve their psychological well-being and success in school. To ameliorate the current situation, schools have been suggested as an important setting where mental health services can be provided to children and these services in the schools are viewed as less stigmatizing (Burns et al. 1995; Fung et al. 2011). Thus, families are more amenable to their children receiving mental health services and support from professionals in the schools. As a result, school-based mental health services have been recommended, not only in Singapore (Fung et al. 2011) but in other countries, such as the U.S. (Fox et al. 2008; Weems et al. 2009). Researchers have supported school-based prevention and intervention efforts to reduce anxiety (Fox et al. 2008; Weems et al. 2009) and test anxiety (Weems et al. 2009) in U.S. schools.

Weems et al. (2009) conducted a successful school-based test anxiety screening and intervention program for underserved students, 94 ninth-grade ethnic minority students, in a New Orleans public charter school. These students were exposed to Hurricane Katrina and its aftermath. Thirty of these students had elevated levels of test anxiety. Relaxation training combined with gradual exposure to test anxiety—provoking stimuli resulted in lower test anxiety levels, higher academic performance, and fewer post-traumatic stress symptoms. Thus, these results indicated that the use of test anxiety strategies, specifically behavioral strategies, reduced other anxiety problems in addition to test anxiety. These findings support the work of Barlow (2002); Watson (2005), and Weems (2008) who suggest that there are certain core features of anxiety (i.e. hyperarousal and apprehension) and treatment of these core features will not only reduce test anxiety, but other types of anxiety problems experienced by students. Weems and colleagues (Weems et al. 2010) also conducted a subsequent study with 212 fourth through eighth-grade students who were also exposed to Hurricane Katrina and its aftermath and were screened for distress, post-traumatic symptoms and test anxiety. Weems et al. found evidence to the support the linkages of test anxiety and other anxiety problems.

In Singapore, the National Mental Health Policy and Blueprint was instituted by the Ministry of Health to develop a comprehensive national strategy in the prevention and treatment of mental illness. One of the aims of this blueprint is for schools to serve as the primary setting where mental health prevention and intervention services can be provided (Fung et al. 2011). School counselors will play an important role in this process. By 2011, all schools are expected to have community health teams, with the school counselor as the key member to disseminate information and train school staff in the early identification of children who experience emotional issues (Fung et al. 2011). With pressures to perform well in school being of utmost concern to most Singaporean youth (Israelowitz and Ong 1990), test anxiety is one area that schools should focus on with this underserved population. School counselors in Singapore schools can assess students for test anxiety using the TAS-E and based on the results from the TAS-E, they can develop and implement appropriate intervention strategies to reduce test anxiety and possibly other types of anxieties among Singapore students.

Several limitations are associated with the present studies. Students volunteered to participate in the current studies. Therefore, samples of convenience were used in the present studies. The use of samples of convenience introduces a validity threat and may limit the generalizability of the findings of studies. However, the total sample used in the present studies is fairly representative of the gender and diversity of the Singapore population, although males and students of Chinese descent were slightly underrepresented and students of Malay descent were slightly overrepresented in the present studies. The current ethnic composition of the Singapore population consists of 74.2% Chinese, 13.4% Malays, 9.2% Indians, and 3.2% other, and males make up approximately 51% of the

population in the 5–9 and 10–14 age groups (Singapore Department of Statistics 2009). Replication of the present studies with a larger proportion of students of Chinese descent and males yielding similar results would provide support for the findings reported in the present studies. A second limitation of the studies is the restriction based on grade level. The TAS-E was developed for students in grades 2 through 6 and in the present study only students in grades 4 through 5 were included due to logistics. However, the findings of the present study do provide support for the construct validity of the TAS-E scores among Singapore students in grades 4 through 5. In future studies with the TAS-E, Singapore students in grades 2 through 6 should be included to determine whether the factor structure is similar to the factor structure reported in the present study and in the study with U.S. students in grades 2 through 6. Another limitation is the exclusive use of self-report. Self report provides information on the perceptions of the individual who completes the measure. The exclusive use of self report introduces error variance due to response bias (Merrell 2008). Other methods of assessment, such as teacher and parent rating scales and clinical interviews, should be used in future studies with the TAS-E in order to obtain the perceptions of significant others in a student's life regarding the nature and level of test anxiety experienced by that individual. The inclusion of other assessment techniques in future studies would reduce error variance due to response bias.

Continued research on the examination of the psychometric properties of the TAS-E scores is needed. Additional studies need to be conducted on the convergent and discriminant validity as well as the predictive validity of the TAS-E scores among Singapore elementary students. Data collection in pursuit of evidence in support of the validity of the scores of new and existing measures is needed and is a never-ending process. Examination of group differences among Singapore students also needs to be explored in future studies with the TAS-E. Studies of Singapore students from different ethnic backgrounds, age groups, genders, socioeconomic status, exceptionalities, and levels of test anxiety need to be conducted.

Overall, the findings of the present studies contribute to the international literature on test anxiety as no known published studies on test anxiety have been conducted to date among Singapore primary school students. The results of the present studies provide evidence to support the construct validity of the TAS-E scores among Singapore students in grades 4 through 5. Although additional research needs to be conducted with the measure, the present studies suggest that the TAS-E is a new, promising multidimensional measure of test anxiety that has the potential to be used with Singapore primary schools to identify those students who experience high levels of test anxiety. New multidimensional measures of test anxiety based on the most recent conceptualizations of the test anxiety construct that take developmental differences into consideration are needed to assist mental health experts who work in the schools to identify test-anxious students, so appropriate and effective interventions may be developed and implemented to address their anxiety in testing situations.

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