The State-Trait Anxiety Inventory, Trait Version: Examination of a Method Factor

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Abstract: The factor structure and concurrent validity of the State-Trait Anxiety Inventory, Trait Version (STAI-T) were examined in two college student samples in Korea. We demonstrated method effects due to the inclusion of reverse-scored items. Confirmatory factor analyses supported the single factor model with method factor. This indicates that the Korean version of the STAI-T (K-STAI-T) can be contaminated by method effects and response patterns are different between non-reversed and reverse-scored items. Thus, the relevance of reverse-scored items in the K-STAI-T is questioned.

Key words: State-Trait Anxiety Inventory, Trait Version (STAI-T), Factor Structure.

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The State-Trait Anxiety Inventory, Trait Version (STAI-T; Spielberger, 1983; Spielberger, et al., 1970) is one of the most frequently and widely used self-report measures of individual differences in anxiety as a personality trait, appearing in over 3000 studies (Spielberger, 1983). The STAI-T is a 20-item inventory and each of the items is rated from 1 (not at all) to 4 (very much so). Thirteen items are worded in a way such that higher scores indicate more anxiety (e.g. 'feel tense'). The remaining seven items are negatively loaded and have to be reverse-scored to reduce the effects of acquiescence (e.g. 'am happy').

The STAI-T has been translated into several languages and its psychometric properties have been examined in various populations. However, there remains some debate concerning the factor structure of the STAI-T. In the development of the STAI-T, Spielberger et al. (1970) assumed that STAI-T was a unifactorial measure. However, some investigators have suggested that the two-factor solution (with the 13 non-reversed items loaded on the first factor and the 7 reverse-scored items on the second factor) produces better fit to the data than the unidimensional solution (Spielberger, 1983). Some researchers have demonstrated differences in the item mix of the factors (Bieling et al., 1998). Bieling et al. (1998) revealed a two-factor structure dissimilar to that found in previous investigations. They identified two lower order factors (in addition to a higher order, general factor): (1) depression factor and (2) anxiety factor.

Researchers have inconsistent opinions about whether reverse-scored items should be included in self-report questionnaires. Some researchers suggest a mixture of the same number of non-reversed and reverse-scored items. They proposed that inclusions of reverse-scored items would reduce response biases resulted from an agreement response tendency (Nunnally & Bernstein, 1994). Others insist that reverse-scored items should be excluded in that they might cause poor reliability and validity of scale

(Pilotte & Gable, 1990; Schriesheim et al., 1991). For example, Schriesheim et al. (1991) indicated that both a positive item and the opposite of the same negatively keyed item do not necessarily mean the same thing. They also pointed out that the inclusion of revere-scored items has caused unstable factor structure and a dimension of reverse-scored items.

Some researchers have studied the STAI-T factor structure in non-English speakers, and have showed differences in the number of the dimensions. The authors reported a 2-factor structure (factor 1 was composed of the non-reversed items and factor 2 consisted of the reverse-scored items) in factor analysis in Japanese (Hishinuma et al, 2000), Brazilian (Gorenstein & Andrade, 1996), Chinese (Shek, 1991) and Puerto Rican (Virella et al., 1994). These results were similar to that found in prior investigations of White-American populations. However, using a French sample, Caci et al. (2003) found a 3-factor solution: anxiety, depression, and well being.

Although many results concluded that the STAI-T has a 2-factor structure, "anxiety present" and "anxiety absent," a question still remain unresolved: The second factor consisting of seven reverse-scored items may not represent a conceptually distinct trait anxiety dimension but rather represent a different response pattern to reverse-scored items.

The aim of this study was to investigate the factor structure of the Korean version of the STAI-T (K-STAI-T) on Korean samples, and to determine the presence of method effects. The factorial structure was examined using exploratory factor analysis (EFA), and method effects were assessed by means of confirmatory factor analysis (CFA) according to the suggestion of Marsh (1996). Three models were compared based on the previous researches. The first model was a unifactorial model of the STAI-T originally hypothesized by Spielberger et al. (1970). The second model represents the structure proposed by Spielberger

(1983), and is composed of two correlated factors: standard and reverse-scored items. The final model is a method factor model with all 20 items reflecting a trait anxiety factor and the seven reverse-scored items as indicators of a method factor. Additionally, the relationships between each K-STAI-T factor and an external criterion such as anxiety and depression were examined.

Study 1

The aim of the study 1 was to examine the factor structure and psychometric properties of the K-STAI-T in a Korean college student sample.

Methods

Participants

A total of 260 undergraduate students at a University in Seoul participated in the study. The total sample consisted of 195 females and 65 males (Mean age = 22.09 years, *SD* = 3.56). No information is available on the clinical history of the sample.

Measures

The Korean version of the State-Trait Anxiety Inventory, Trait Version (K-STAI-T)

The STAI-T (Spielberger, 1983) is a 20-item questionnaire that assesses individual differences in anxiety as a personality trait. Each of the items is rated from 'not at all' (coded as 1) to 'very much so' (coded as 4). After reverse-scoring seven items, a total score is computed by summation (i.e. range of scores 20 to 80 with higher scores reflecting higher levels of trait anxiety). The internal consistency coefficient of K-STAI-T is .88 (Lim et al., 2005).

Procedure

Informed consent was fulfilled in advance, and then participants filled out the STAI-T in a classroom situation, during class time. Researchers were available to answer individual questions.

Data analyses

Prior to analysis, the distributions of all variables were examined and several of the indicators showed signs of a significant departure from normality using the Kolomogorov-Smirnov test (e.g., for the K-STAI-T item 3, skewness = 1.16 and kurtosis = .93). Due to the nonnormality of some indicators, the latent variable analyses were conducted using robust maximum likelihood (MLM) in Mplus 2.02 (Muthén and Muthén, 2002).

Assessment of model fit

The Root Mean Square Error of Approximation (RMSEA) and the Root Mean Square Residual (RMR) were selected as primary indices, based on the fact that each type of incremental fit index used in this study is based on a different rationale and describes somewhat different aspects of fit (see e.g., Maruyama, 1998). Based on published guidelines, an acceptable model fit was defined as: RMSEA (≤.08) and RMR (≤.05) (Thompson, 2000).

Results and Discussion

Reliability and item-level analyses

The mean K-STAI-T total score was 45.79 (SD = 7.13). K-STAI-T total scores for women (M = 46.15, SD = 6.18) were not higher than those for men ($M = 44.71$, $SD = 9.38$) (T-test, $P = 0.251$). This is higher than the mean score obtained by Plehn and Peterson (2002) and McWilliams and Cox (2001) for European American college students ($M = 39.63$, $SD = 9.27$; $M = 41.4$, $SD = 10.6$), but it is comparable to the mean obtained by Iwata and Higuchi (2000) for Japanese college students. These phenomena were explained by the fact that Asian students tended to inhibit positive ('anxiety absent') emotion, resulting in higher STAI-T scores (Iwata & Higuchi, 2000). Internal consistency tests gave a Cronbach alpha of 0.75 for the total scale, with an alpha of 0.88 (13 standard items) and 0.87 (7 reverse-scored items).

Exploratory Factor Analysis

Given that no published study at the time of this writing has reported a factor analysis on the K-STAI-T in Korea, we tested the structure of our data using EFA. As STAI-T subscales are generally moderately correlated, an oblique (promax) rotation was used. The number of factors to retain was evaluated using (1) Kaiser's (1961) eigenvalue>1 factor extraction rule, (2) the scree test (Cattell, 1966), (3) model fit indices (Muthén & Muthén, 2002) and (4) the parallel analysis (Longman et al., 1989). In addition, we utilized Thurstone's (1947) criteria, which include (a) a minimum number of items with salient loadings (≥0.30) on more than one factor, (b) a minimum number of items that do not have salient loadings on any factor, and (c) each factor is well-defined (i.e., has three or more salient loadings per factor).

Three factors possessed eigenvalues greater than one (7.49, 2.31, 1.28). According to the scree test, we estimated that one and two factors were necessary to explain the data, but the one-factor model was not sufficient to explain the data (Table 1). An acceptable model fit was found for a two-factor solution ($x^2(151) = 266.393$, RMSEA $= 0.054$, RMR $= 0.050$). In addition, Thurstone's criteria and the parallel analysis showed that the two-factor solution had the best simple structure.

Table 1. Goodness-of-fit indices for K-STAI-T models: Exploratory Factor Analysis

Model	x^2	df	RMSEA	RMR
Students sample (N=260)				
One factor	750.256	170	.115	.116
Two factor	266.393	151	.054	.050

* RMSEA=root mean square error of approximation; RMR=root mean square residual

Table 2 shows the rotated factor loadings for this two-factor solution. The two-factor solution had: (a) a small number of hyperplane items (zero items with no salient loading on any factor); (b) a relatively small number of complex items (1 item with salient loadings on more than one factor); and (c) a relatively high number of salient loadings per factor (i.e., factor Ⅰ had 13 and factor Ⅱ had 7). Taking salient loadings as those ≥.30, factor Ⅰ pertains to 'anxiety present'; factor Ⅱ pertains to 'anxiety absent'. These findings generally replicated those reported by Spielberger (1983).

However, although these EFA examinations produced two-factor structure consisting of reverse-scored and non-reversed items, this method is not used to elucidate the nature of these results. In contrast, CFA can be a suitable technique for dealing with these issues (Marsh, 1996). Thus, the aim of the second study was to re-exam the factor structure of the K-STAI-T using the CFA technique.

Table 2. Promax Rotated Loadings (2 factor model: students sample)

Item	Factor Ⅰ	Factor Ⅱ
17. Unimportant thoughts bother	.840	−.119
18. Take disappointments keenly	.837	−.048
9. Worry too much	.830	−.131
20. Tension or turmoil	.705	.029
11. Take things hard	.598	.031
3. Crying	.545	.094
8. Difficulties piling up	.510	.071
5. Can't make up mind	.498	.114
14. Avoid crises or difficulty	.444	−.097
15. Feel blue	.439	.317
12. Lack self-confidence	.424	.100
2. Tired quickly	.367	.066
4. Happy as others	.364	.137
16. Content	−.023	.904
10. Happy	−.026	.875
6. Feel rested	−.003	.848
13. Feel secure	.071	.805
1. Feel pleasant	.002	.788
7. Calm, cool, and collected	.060	.470
19. Steady person	−.026	.337

Study 2

The aims of study 2 were (1) to test the relative strengths of the one-factor solution with a method effect over two-factor solution and (2) to examine the properties of the K-STAI-T.

Methods

Measures

The Korean version of the State-Trait Anxiety Inventory, Trait Version (K-STAI-T)

This scale is identical to the one used in study1.

The Korean version of the Beck Depression Inventory (K-BDI)

Beck Depression Inventory (BDI; Beck and Steer, 1984) is a 21-item self-report instrument that measures the frequency of depressive symptoms over a 1-week period. Each symptom is rated on a four-point scale ranging from 0 to 3. The K-BDI has demonstrated good psychometric properties (Lee & Song, 1991).

The Korean version of the Beck Anxiety Inventory (K-BAI)

Beck Anxiety Inventory (BAI; Beck et al., 1988) consists of 21 items which assess and evaluate common symptoms of clinical anxiety over a 1-week period. Each symptom is rated on a four-point scale ranging from 0 to 3. We administered a Korean version of the BAI (Kwon, 1992), which has shown good psychometric properties. The internal consistency coefficient of K-BAI is .93 (Kwon, 1992), with test-retest reliability at $r = .84$ (Kwon, 1992).

Participants

A total of 253 college students recruited from introductory psychology courses at a University in Seoul participated in the study. The participants were between 20 to 32 years of age, and 73% of them were female (Mean age = 22.88 years, $SD = 1.99$). No data are available on the clinical history of these students.

Procedure

This procedure is identical to the one used in study 1.

Assessment of model fit

Model fit was based on the following fit indices: the Tucker–Lewis Index (TLI) (Tucker and Lewis, 1973), the Comparative Fit Index (CFI) (Bentler, 1990), and the Root Mean Square Error of Approximation (RMSEA) (Steiger, 1990). The following recommended criteria were used to determine acceptable fit of the models to the data: TLI ($\geq$.90), CFI ($\geq$.90), and RMSEA ($\leq$.08). Additionally, to determine the internal consistency reliability of the K-STAI-T total scale and subscales, we used Cronbach's alpha and examined item-total correlations, with criterion of alpha at or above .70, and item-total correlations exceeding the minimum acceptable value of .30 (Nunnally & Bernstein, 1994). Finally, to explore the relationship between the K-STAI-T and the remaining measures, we used Spearman ρ correlations. Given the number of correlations, P values were set at .01 to control for experiment-wise error (the Bonferroni adjustment was utilized, so an initial α of .05 was divided by the number of measures or .05/5).

Results and Discussion

Confirmatory Factor Analysis

The analyses examined a unifactorial model without method factor, a unifactorial model with method factor, and 2-factor model of the STAI-T, which was proposed by Spielberger (1983). The unifactorial model with method effects included an error theory to demonstrate the method effect from the seven reverse-scored items. The 2-factor model consisted of 'anxiety present' (the 13 non-reversed items), and 'anxiety absent' (the seven reverse-scored items) (Spielberger, 1983). The first analysis demonstrated a poor fit of the one-factor model to the data. The second analysis revealed a good fit of the alternative method factor model to the data. In the final analysis, the 2-factor solution yielded good fit indices (Table 3). However, the 2-factor model needs explanation for the clinical, empirical, or conceptual value of 'anxiety absent' factor with respect to the interpretability of this solution.

Table 3. Goodness-of-fit indices for K-STAI-T models : Confirmatory Factor Analysis

Model	x^2	df	TLI	CFI	RMSEA
Students sample (N=253)					
One factor without method effects	597.239	170	.705	.736	.100
One factor with method effects	300.127	163	.901	.915	.058
Two factor	308.660	169	.903	.914	.057

* TLI=Tucker-Lewis index; CFI=comparative fit index; RMSEA=root mean square error of approximation

Reliability and item-level analyses

The mean scores of items, the standard deviation and the corrected item-total correlation, i.e. the correlation of each item with the sum of the remaining items are shown in Table 4. The mean K-STAI-T total score was 44.78 (SD=9.40). K-STAI-T total scores for women (M=45.63, SD=9.41) were higher than those for men (M=42.47, SD=9.03) (T-test, $P<0.05$). The K-STAI-T was shown to have an adequate internal consistency, with Cronbach alpha of 0.89 for the entire scale, with an alpha of 0.86 (13 non-reversed items) and 0.84 (7 reverse-scored items). Based on the criterion of greater than .30 as a sound corrected item-total correlation (Nunnally & Bernstein, 1994), all items except item 19 are in a suitable range (range = .34–.63). However, the item-total correlation in the case of item 19 did not meet the criterion (.21).

Table 4. Mean, standard deviation, correlation of each K-STAI-T item with the sum of the other items and internal consistency if the item is deleted

Items	Mean	S.D.	Corrected item-total correlation	Alpha if item deleted
1.	2.39	.63	.59	.88
2.	2.41	.85	.43	.88
3.	1.66	.72	.48	.88
4.	2.79	.98	.34	.89
5.	2.01	.86	.54	.88
6.	2.59	.79	.57	.88
7.	2.51	.78	.34	.89
8.	1.70	.79	.41	.88
9.	2.38	.92	.52	.88
10.	2.22	.71	.57	.88
11.	1.94	.83	.60	.88
12.	2.19	.95	.58	.88
13.	2.46	.78	.62	.88
14.	2.43	.89	.36	.89
15.	1.88	.80	.63	.88
16.	2.51	.71	.56	.88
17.	2.30	.89	.63	.88
18.	2.25	.96	.56	.88
19.	2.15	.82	.21	.89
20.	2.00	.90	.56	.88

Concurrent validity

Since none of the measures were normally distributed based on the Kolomogorov–Smirnov test, Spearman's correlations were calculated to examine the relationship between the K-STAI-T and the concurrent validity measures (Table 5). The K-STAI-T had significant positive correlations with both measures of anxiety and depression. Moderate correlations between the K-STAI-T and the K-BDI and K-BAI presented evidence for convergent validity.

The strength of the correlation between the standard item scores and the K-STAI-T total was significantly higher than the correlation between the reversed-item scores and the K-STAI-T total. The correlation between the standard item scores and the reverse-scored item scores was 0.47. In addition, the correlations between the non-reversed item scores and the K-BAI were stronger than the correlations between the reverse-scored item scores and the K-BAI.

Table 5. Zero-correlations between the factors of the K-STAI-T, the K-BAI, and the K-BDI (N=253)*

	K-STAI-T score	Non-reversed items score	Reverse-scored items score	K-BAI
Non-reversed items score	.93			
Reverse-scored items score	.75	.47		
K-BAI	.49	.53	.28	
K-BDI	.69	.63	.55	.57

* All correlations are significant at the .001 level (two-tailed)
K-STAI-T=Korean version of the State-Trait Anxiety Inventory, Trait version;
K-BAI=Korean version of the Beck Anxiety Inventory;
K-BDI=Korean version of the Beck Depression Inventory

General Discussion

The aim of the current study was to examine the factor structure of the K-STAI-T, demonstrate method effects likely to be due to the presence of reverse-scored items, and present properties of the K-STAI-T.

The results of the current study can be summarized as follows. (a) The Cronbach alpha was high, indicating the internal reliability of the K-STAI-T is satisfactory. This finding is reported consistently in the literature. (b) The EFA provided support for two-factor solution rather than one-factor solution. Consistent with previous reports on other samples, all reverse-scored items were shown to contribute to the second factor. (c) The CFA supported both the single factor model with method factor and the two-factor model. Since the results of this study show that both solutions were a good fit, a necessary question to ask is whether the reverse-scored item factor should be regarded as substantial and meaningful or if they should be interpreted as method artifacts. There are several reasons to regard the reverse-scored item factor as a method factor. First, the reverse-scored items contributed less to the total score than the non-reversed items. For example, the full K-STAI-T demonstrated a higher part–whole correlation with non-reversed items than with reverse-scored items. Second, by item-total correlation analyses, there was one problematic item in reverse-scored ones. Third, the correlations between the reverse-scored item scores and the K-BAI were weaker than the correlations between the non-reversed item scores and the K-BAI. These findings question the relevance of the inclusion of the reverse-scored items of the K-STAI-T. However, it may be premature to choose any model as the ideal one, since another factor analysis (with larger and more diverse samples) might spotlight different items as weak or inappropriate. (d) As expected, moderate correlations between the K-STAI-T and the K-BAI and K-BDI provided strong evidence for convergent validity. These results are consistent with a previous study (Bieling et al., 1998) which had demonstrated that the STAI-T correlated moderately with the BDI ($r = 0.72$) and the BAI ($r = 0.42$).

Researchers worried about measurement error originated from the reverse-scored items may choose a 13-item version of the K-STAI-T consisting of only the non-reversed ones. The results of the current study indicate that this abbreviated version could be an adequate measure of trait anxiety. Although removal of the reverse-scored items from the original K-STAI-T may not be found useful for participants showing an affirmative response bias, these reverse-scored items may contribute for checking for the presence of such a bias. Moreover, comparisons with other studies cannot be made with a 13-item version of the K-STAI-T.

The present study has two important limitations. First, the present study included only college students. Therefore, we should be cautious about generalizing these findings to other populations, and more researches with other age and clinical groups are needed. Second, only self-reporting data was included in this study, and thus relationships between variables may have been inflated by questionnaire-specific method variance.

The K-STAI-T appears to be a sound measure for assessing trait anxiety, although it might benefit from further refinement. The K-STAI-T consisted of highly internally consistent and psychometrically adequate items. The CFA supported a single factor model. However, the inclusion of reverse-scored items in K-STAI-T may distort factor-analytic solutions by resulting in the appearance of artificial factors consisting of these items. In sum, we suggest that the psychometric properties of the K-STAI-T could be improved by dropping reverse-scored items.

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