The Beck Anxiety Inventory: Reexamination of Factor Structure and Psychometric Properties

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Several exploratory factor-analytic studies of the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988) have reported two, four, and five factors. This study evaluated the fit of four competing models to data provided by a sample of 350 undergraduates. Results of the initial confirmatory factor analyses (CFA) provided strong support for the fit of the four-factor oblique model. Next, we respecified the four-factor model as a single second-order BAI. Results showed that the second-order model also provided adequate fit to the data. Evidence also supported the psychometric indices of reliability and convergent validity. Finally, we examined the relation of the BAI to several demographic variables. Limitations of the study are discussed.

In 1988, Beck and his colleagues attempted to address the relatively high correlation between anxiety and depression problems in self-report measures by developing the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988). This 21-item scale was developed specifically to assess the severity of anxiety symptoms. Each BAI item is rated on a 4-point scale: 0 (*not at all*) to 3 (*severely, I could barely stand it*).

Norms and psychometric properties of the BAI were presented by Beck and co-workers in two studies. The data of the first study were provided by a subsample of 160 diagnostically mixed psychiatric outpatients. An iterated principal factor analysis was conducted using the Promax rotation method. The scree test was subsequently used to retain two factors: *somatic* (12 items) and *subjective anxiety and panic* (9 items). When we examined the reported item-factor loadings, we found that three of the 21 items loaded less than .35: Items 1 (factor loading = .24), 11 (factor loading = .32), and 18 (factor loading = .29). In the second study (see Beck & Steer, 1991) involving a sample of 367 outpatients, the authors performed principal components analysis with varimax rotation. Four factors were extracted: *subjective, neurophys-*

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iological, autonomic, and *panic.* Although, in both studies, the BAI factors showed adequate internal consistency reliability and satisfactory levels of convergent and discriminant validity, the data presented in support of factorial validity lead to the conclusion that the BAI is characterized by a two- and a four-factor dimension in clinical samples.

Other exploratory factor-analytic studies of the BAI in clinical and nonclinical populations have noted similar concerns over the factor structure and item-factor compositions of the BAI. In 1991, Borden, Peterson, and Jackson attempted to validate the factor structure of the BAI with a sample of 293 undergraduates. Five factors emerged from their exploratory principal-components analysis: subjective fear (8 items), somatic nervousness (5 items), neurophysiological (5 items), muscular/motoric (5 items), and respiration (3 items). Because of problems related to items loading on more than one factor, the authors reported 26 items for the five-factor BAI. Additionally, the authors did not report internal consistency estimates for the BAI or the five factors.

Recently, Steer, Rissmiller, Ranieri, and Beck (1993) administered a computer-assisted version of the BAI to an inpatient sample of 250 subjects. Principal factor analysis of the data resulted in the retention of two factors: somatic (14 items) and subjective (6 items). Several items defined by the somatic and subjective factors did not correspond to the item-factor dimensions originally observed by Beck et al. (1988). Also, one item (Item 16) loaded less than .35, and another item (Item 8) loaded on both factors. Similar findings have been noted in more recent studies of the factor structure of the BAI (see Creamer, Foran, & Bell, 1995; Steer, Kumar, Ranieri, & Beck, 1995).

To date, only one study has replicated the four-factor structure reported by Beck and Steer (1991). Osman, Barrios, Aukes, Osman, and Markway (1993) evaluated the adequacy of the two- and five-factor solutions of the BAI with a sample of 225 community-dwelling adults. Confirmatory factor analyses showed that both models were not satisfactory for use with their data. Subsequently, the authors used exploratory principal-components analyses with varimax rotation to extract four factors: subjective, neurophysiological, autonomic, and panic. However, the authors did not validate these findings in an independent sample of nonclinical adults. Lastly, we note that although Hewitt and Norton (1993) also observed that two and four factors could be extracted for the BAI using the eigenvalue greater than one criterion, the authors reported only the expected two factors. Interestingly, the authors concluded, "some items loaded moderately on both the cognitive and somatic factors, suggesting that they may not adequately reflect the two factors" (p. 411). Given the different factor solutions that have resulted from the use of exploratory factor analytic procedures, there is a need for confirmatory factor analytic studies to address the *structural* and *measurement* problems associated with the BAI (see Gorsuch, 1990; Snook & Gorsuch, 1989).

The purposes of the present study were (a) provide nonclinical normative (means and standard deviations) data on the BAI items and total score, (b) evaluate the adequacy of fit for two previously replicated first-order BAI models, (c) validate a second-order BAI factor, using factors from the best-fitting model as first-order factors, and (d) examine evidence for convergent validity in this sample.

METHOD

Subjects

Participants were recruited from undergraduate psychology courses at a medium-sized Midwestern university. The sample was composed of 145 men (mean age = 20.95 years, SD = 3.52) and 205 women (mean age = 21.64 years, SD = 5.58). There was no significant difference between men and women in age, $t(348) = 1.31$, $p = .19$. The sample was predominantly

White (92.6%) and single, never married (87.7%). All participants gave their written consent to complete the study measures.

Measures and Procedure

Participants completed a brief background information questionnaire, the BAI, and the following three self-report measures.

State-Trait Anxiety Inventory. (STAI-Form Y; Spielberger, 1983). The STAI is a widely used instrument for assessing state anxiety (A-State, 20 items), and trait anxiety (A-Trait, 20 items). Responses on the A-State are rated on a 4-point scale: 1 (*not at all*) to 4 (*very much so*) to indicate current level of anxiety. The A-Trait uses a 4-point scale ranging from 1 (*almost never*) to 4 (*almost always*) to express general level of anxiety. Ten of the A-State items, and 9 of the A-Trait items are reverse-scored. A weighted raw score is obtained for each scale by summing the ratings for each scale. The STAI scales have good internal consistency reliabilities and satisfactory levels of construct, convergent, and discriminant validity. This measure was used to establish convergent validity for the BAI.

Cognition Checklist. (CCL; Beck, Brown, Steer, Eidelson, & Riskind, 1987). The CCL contains 26 items designed to measure the frequency of cognitive anxiety (CCL-A, 12 items) and depression (CCL-D, 14 items). Items are rated on a 5-point scale: 0 (*never*) to 4 (*always*). The CCL has satisfactory internal consistency reliability and concurrent validity in clinical and nonclinical populations.

Brief Symptom Inventory. (BSI; Derogatis, 1992). The BSI consists of 53 items designed to assess nine psychological symptom dimensions: somatization, obsessive-compulsive, interpersonal sensitivity, hostility, phobic anxiety, paranoid ideation, psychoticism, depression, and anxiety. Each item is rated on a 5-point scale, ranging from 0 (*not at all*) to 4 (*extremely*). The BSI also yields three global indices to indicate level of general psychological distress. Internal consistency estimates for the BSI subscales are adequate: range .71 to .85. Three BSI subscale scores were used in this study.

RESULTS

Preliminary Analyses

Table 1 presents the total sample means and standard deviations for each BAI item and total score. Analyses of gender differences on the BAI items showed a significant effect: Hotelling's $T^2 = .24$, $p < .001$. Women had higher scores than men on 8 of the 21 BAI items including: Items 4, 5, 9, 13, 17, 18, 19, and 20. Men had a higher score for Item 21 than women.

In addition, analyses of internal consistency reliability indicated that the BAI had adequate item-total score correlations and a high Cronbach alpha value of .90. Finally, Pearson product-moment correlational analyses were conducted to evaluate the relationships between demographic factors and the BAI total and subscale scores. No significant relationships with education, marital status, or age were obtained. Thus, these demographic variables were not controlled for in subsequent analyses.

Confirmatory Analyses

The models evaluated are given in Table 2. Specifically, we tested two first-order models that have been previously *replicated* in the literature: (a) Beck et al.'s (1988) original two-factor

Table 1. *Means, Standard Deviations, and Corrected Item-Total Correlations*

Item Number	M	SD	*r*
1.	.35	.64	.39
2.	.91	.77	.42
3.	.38	.63	.52
4.	1.32	.84	.58
5.	1.23	.97	.56
6.	.59	.80	.50
7.	.96	.88	.58
8.	.48	.68	.63
9.	.37	.73	.56
10.	1.43	.81	.52
11.	.16	.53	.40
12.	.52	.74	.58
13.	.57	.74	.64
14.	.57	.88	.55
15.	.36	.70	.52
16.	.23	.61	.40
17.	.79	.79	.55
18.	.88	.88	.40
19.	.15	.43	.49
20.	.57	.74	.49
21.	.57	.76	.47
Total Score	13.41	8.96	
Alpha			.90

Note.—Items (mean) underlined differentiated between men and women.

oblique model, and (b) Beck and Steer's (1991) and Osman et al.'s (1993) four-factor oblique models. In addition, we evaluated the fit of a one-factor model, in which all 21 BAI items were represented by a common factor, and the null model. Finally, we respecified the "best-fitting" model as a second-order BAI model in our sample.

The fit of each model was evaluated using multiple criteria: the Bentler–Bonett Normed Fit Index (NFI, values .90 or greater), the Bentler–Bonett Nonnormed Fit Index (NNFI, values

Table 2. *Confirmatory Factor Analyses for the Beck Anxiety Inventory*

			Goodness-of-Fit Indices				
Model	x^2	df	NFI	NNFI	CFI	RMSR	rho
Null	6,996.75	210					
One-factor	964.09	188	.86	.87	.89	.04	.87
Two-factor Oblique	887.81	188	.87	.89	.89	.04	.88
Four-factor Oblique	656.44	179	.91	.92	.93	.03	.92
Second-order	656.73	180	.91	.92	.93	.03	.92

Note.—NFI = Normed Fit Index; NNFI = Nonnormed Fit Index; CFI = Comparative Fit Index; RMSR = Root mean squared residual.

.90 or greater), the Comparative Fit Index (CFI, values .90 or greater), and the Root mean squared residual (RMSR, values less than .10). Finally, we calculated the rho index to evaluate the relative simplicity of competing models (see Bentler, 1990; Bentler & Bonett, 1980).

All analyses were conducted using the EQS/Windows 5.0 program (Bentler, 1995). In view of the nonnormal data and response format on the BAI, covariance matrices were analyzed with the elliptical reweighted least squares estimation procedure (see Browne, 1984). Examination of Table 2 shows that the fit indices for the four-factor oblique model met all the preestablished practical criteria: NFI = .91, NNFI = .92, CFI = .93, RMSR = .04. This model also provided a better fit relative to the null model, rho = .92. All item loadings were statistically significant. The intercorrelations among the four factor scales ranged from .59 to .85. Although the chi-square statistic was significant ($p < .01$), the ratio of the chi-square to the degrees of freedom (value = 3.7) was less than 5, providing further evidence in support of the adequacy of the four-factor oblique model (see Wheaton, Muthen, Alwin, & Summers, 1977).

Finally, we respecified the four-factor oblique model as a single second-order factor of "general anxiety-severity" (see Figure 1). Results showed that this model fit the data very well. There was no statistically significant difference between the four-factor model and the second-order factor model. Furthermore, the rho statistic indicated that the second-order factor model was preferred to the null model. The first-order factors loaded significantly on the second-order factor (see Figure 1). These findings suggest that both the four-factor model and the second-order factor model were acceptable.

Correlational Analyses

Zero-order correlational analyses (see Table 3) showed support for convergent validity. The BAI total and subscale scores were moderately and significantly (Bonferroni's alpha: .05/5 = .01) correlated with other self-report anxiety scales (range, .35 to .69): the A-State, A-Trait, CCL-Anxiety, BSI-Anxiety, and BSI-Somatization subscales. However, after controlling statistically for the affective and cognitive symptoms of depression, the magnitudes of these correlations (although all remained significant) dropped markedly (range, .15 to .52). The highest correlations remained between the BSI-Anxiety subscale and the BAI total and subscale scores, and the BSI-Somatization subscale and the BAI total and subscale scores.

Finally, the BAI total and subscale scores correlated moderately and significantly with the CCL-Depression (range, .24 to .54) scale, and with the BSI-Depression (range, .34 to .56) subscale. The magnitudes of these correlations were lower than the magnitudes of the correlations between the BAI and related self-report measures of anxiety. Results are given in Table 3.

DISCUSSION

In general, the findings of the present study provide support for the four and second-order factor models of the BAI. Internal consistency estimates of the BAI were satisfactory. The results did not support the fit of the frequently extracted two-factor solution. In subsequent supplementary analyses (data not reported here) of several two-factor models reported in the literature (e.g., Creamer et al.'s 1995 two-factor solution) the goodness of fit indices were poor. We did not evaluate the fit of Borden et al.'s (1991) five-factor model identified previously for use with undergraduates because several items were noted to load on two or more factors. Further, we obtained low internal consistency indices for the reported factor scales. Also, in contrast to previous exploratory factor analytic investigations of the BAI, each BAI item loaded significantly on the specified factor. Finally, the finding in support of the second-order factor model suggests that a single score can be obtained using the BAI factor scores.

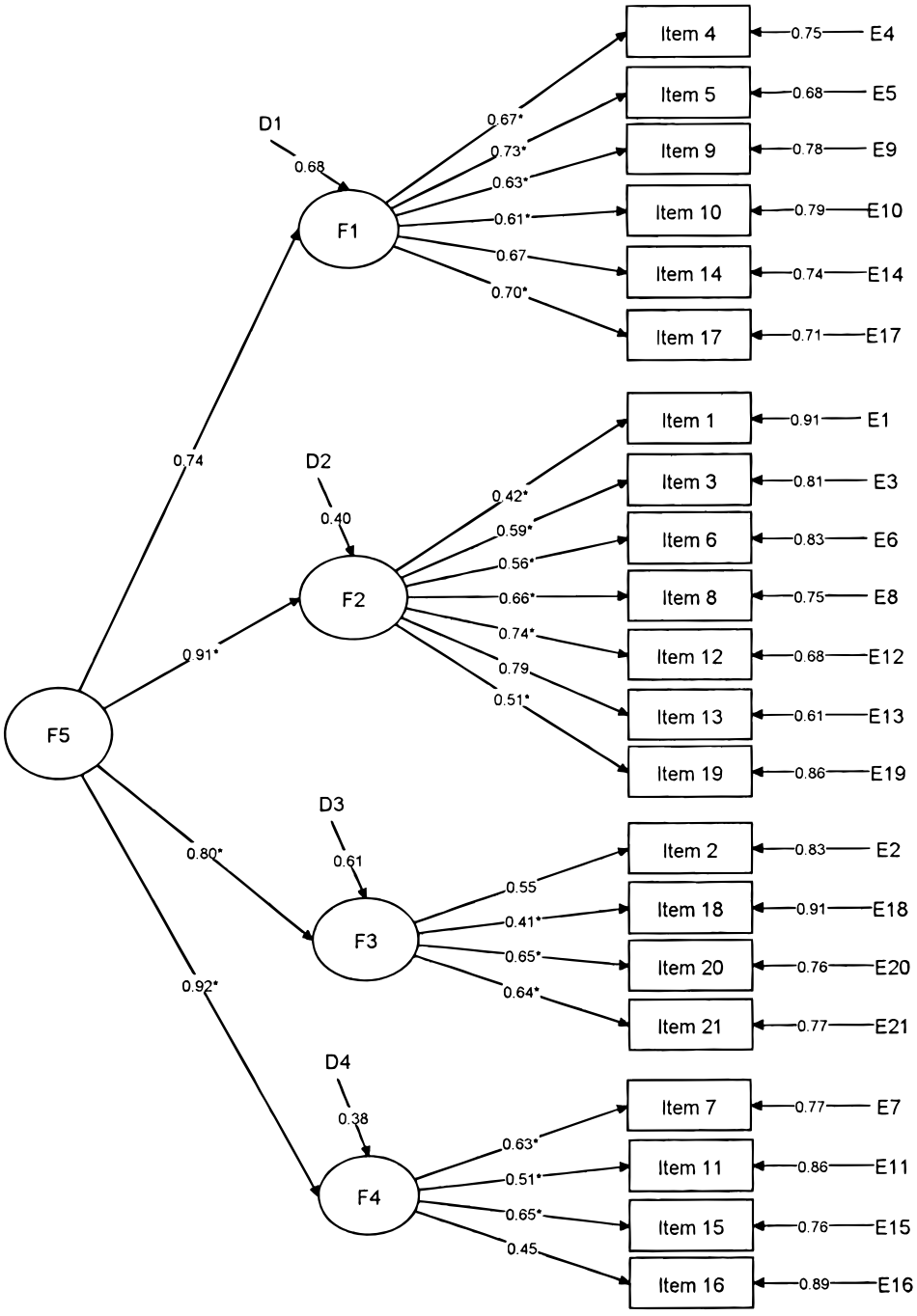

Figure 1. Second-order factor model.

In addition to establishing the factorial validity of the BAI, correlations were examined between the BAI and other measures of anxiety. Consistent with previous investigations (see Creamer et al., 1995; Fydrich, Dowdall, & Chambless, 1992), the BAI total and subscale scores correlated significantly with all related anxiety measures. Moreover, as noted by Creamer et al.

Table 3. *Correlational Analyses*

Measure	BAI Factor Scales				BAI Total Score
	Neuro-physiological	Subjective	Panic	Autonomic	
Measures of Anxiety					
A-State					
Zero-order r	.40**	.55**	.35**	.37**	.53**
Partial r	.22**	.38**	.22**	.20**	.34**
A-trait					
Zero-order r	.42**	.61**	.37**	.42**	.58**
Partial r	.15**	.30**	.21**	.19**	.28**
CCL-Anxiety					
Zero-order r	.40**	.50**	.36**	.36**	.51**
Partial r	.21**	.19**	.26**	.18**	.27**
BSI-Anxiety					
Zero-order r	.52**	.68**	.47**	.50**	.69**
Partial r	.34**	.52**	.35**	.33**	.52**
BSI-Somatization					
Zero-order r	.60**	.41**	.46**	.57**	.62**
Partial r	.48**	.19**	.35**	.45**	.47**
Measures of Depression					
CCL-Depression					
Zero-order r	.33*	.54*	.24*	.31*	.48*
BSI-Depression					
Zero-order r	.45*	.55*	.34*	.42*	.56*

Note.—BAI = Beck Anxiety Inventory; CCL = Cognition Checklist; BSI = Brief Symptom Inventory.
**$p < .01$ (Bonfrrroni-adjusted level of significance). *$p < .05$.

(1995), the BAI correlated higher with the A-Trait scale than with the A-State scale. However, when we controlled statistically for the symptoms of depression, the BAI correlated higher with the A-State scale. Thus, the present study suggests that the BAI may be more closely related to the A-State scale than to the A-Trait scale.

This study also suggests that men and women may experience anxiety somewhat differently. Women reported higher levels of anxiety symptoms, as assessed with the BAI.

This study has specific problems that limit the generalizability of the findings. Our sample consisted primarily of nonclinical undergraduates. Also, the stability of responses on the BAI was not established. Finally, only self-report measures were used in establishing validity for the BAI. Despite these limitations, the present study is the first to extend investigation of the factorial validity of the BAI beyond the primary factors. In addition, our data argue strongly for the BAI being used as a measure of state anxiety. In general, the results support the use of the BAI in our college sample.

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