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Multi-Sample Confirmatory Factor Analysis of the Task and Ego Orientation in Sport Questionnaire

Likang Chi and Joan L. Duda

The Task and Ego Orientation in Sport Questionnaire (TEOSQ; Duda, 1989; Duda & Nicholls, 1992) was designed to assess individual differences in the proneness for task and ego involvement in athletic settings. The purpose of this study was to independently and simultaneously test the measurement model assumed to underlie the TEOSQ across intercollegiate athletes (n = 143), college students enrolled in skill classes (n = 270), high school athletes (n = 310), and junior high school sport participants (n = 234). Single-sample confirmatory factor analysis (CFA) was employed to establish and to evaluate the tenability of a baseline model in terms of each sample. A series of multi-sample CFAs were then conducted to test the invariance of the measurement and factor structure of the TEOSQ across the four groups. The measures of overall fit for the hypothetical two-factor structure of the TEOSQ were generally acceptable, albeit weaker in the case of the college students. Further, the results of the multi-sample CFA did not support the assumption for intergroup invariance of the TEOSQ. This finding indicated that the 13 items and structure of the TEOSQ were not equally valid across the present four samples.

Key words: confirmatory factor analysis, motivation, goal orientation, psychological assessment

Recent social cognitive theories of achievement motivation have proposed that goal perspectives play an integral role in predicting cognitions, affect, and behaviors in achievement settings (Ames & Archer, 1988; Dweck & Leggett, 1988; Nicholls, 1989). It has been suggested that there are two goal perspectives or criteria underlying subjective success; namely, task and ego involvement. In the former state, perceptions of ability are self-referenced and one's own perceived mastery is the focus of ability judgments. When task involved, subjective success is based on the experience of personal improvement, learning and insight, or mastering the demands of a task.

Ego involvement, on the other hand, implies that superiority over others is the goal. Perceptions of demonstrated ability entail the comparison of one's performance and exerted effort to the performance and exerted effort of referent others. When ego involved, learning and personal skill development are insufficient bases for the perception of high competence.

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Nicholls (1989) suggested that there are individual differences or dispositional proneness for these states of task and ego involvement (i.e., task and ego orientation). Drawing from the scales designed to assess task and ego orientation in the classroom (Nicholls, 1989), Duda and Nicholls (Duda, 1989; Duda & Nicholls, 1992) developed the Task and Ego Orientation in Sport Questionnaire (TEOSQ). With respect to previous studies, theoretically consistent relationships have been found between TEOSQ scores and (a) individuals' beliefs about the causes of sport success (Duda & White, 1992; Duda, Fox, Biddle, & Armstrong, 1992), (b) perceptions of the purposes of sport participation (Duda, 1989), (c) "sportsmanship" attitudes and views about aggressive sport acts (Duda, Olson, & Templin, 1991), and (d) intrinsic interest and enjoyment (Duda, Chi, Newton, Walling, & Catley, in press; Duda et al., 1992). Individual differences in task and ego orientation (as measured by the TEOSQ) have significantly predicted performance and task choice in the physical domain (Chi, 1993).

Previous studies examining the construct validity of the TEOSQ via exploratory factor analysis have revealed a stable two-factor solution representing a task and ego orientation across samples of youth sport (Duda et al., 1992), high school students (Duda, 1989; Duda et al., 1991), and college students enrolled in physical activity classes (Duda et al., in press). In addition, the internal reliability of the two TEOSQ scales have been found to be adequate.

In general, limited sport psychology research has been conducted to test hypothesized factor structures of commonly used measures (Gill & Deeter, 1988; McAuley, Duncan, & Tammen, 1989; Walling, Duda, & Chi, 1993; Weiss, Bredemeier, & Shewchuk, 1985). The tenability of the two-factor measurement model presumed to underlie the TEOSQ in particular has not been examined through confirmatory factor analysis (CFA). Further, to date, few studies in the field of sport psychology have examined the assumption of invariance in measurement models across different samples (Schutz, Eom, Smoll, & Smith, 1994). Specific to the TEOSQ, past work using this instrument to assess dispositional sport goal orientations among diverse groups has assumed such intergroup invariance. However, no attention has been given to test the generalizability of the two-factor structure of the TEOSQ across divergent samples. Therefore, the purpose of this study was to independently and simultaneously test the tenability of a hypothesized two-factor structure of the TEOSQ among intercollegiate athletes, college students, high school athletes, and junior high school sport participants using single-sample and multi-sample CFAs.

Method

Subjects

Data reported in this study were from four different studies. The primary sources of data for each of the four samples are described as follows:

1. The intercollegiate athletes' data were part of a study that examined the relationship between goal orientations and beliefs about causes of success (Duda & White, 1992). Subjects were 143 intercollegiate skiers from the Northeast region of the United States. The average age of the subjects in this sample was 21.4 ± 1.3 years. All the subjects had previously competed in the National Collegiate Athletic Association National Ski Championships and had an average of 11.0 ± 9.1 years of skiing experience.

2. The college students' data were part of a study conducted by Chi (1993). The subjects were 270 undergraduate male ($n = 155$) and female ($n = 115$) students enrolled in physical activity classes, which included weight training, jogging, badminton, tennis, softball, and aerobics classes. The average age of this sample was 20.3 ± 1.8 years.

3. The high school athletes' data were part of a study that examined the relationship between goal orientations and the perceived purposes of sport (Duda, 1989). The subjects were 310 high school male ($n = 196$) and female ($n = 114$) interscholastic athletes from six high schools in a Midwestern community of the United States. They were enrolled in either the 11th or 12th grade at their respective schools and were participants in a variety of sports, including basketball, track and field, tennis, and softball. The average age of the athletes in this sample was 17.5 ± 0.9 years.

4. The junior high school sport participants' data were part of a study conducted by Walling, Duda, and Crawford (1992). The subjects were 234 junior high school male ($n = 125$) and female ($n = 109$) students, ranging from 12 to 15 years of age ($M = 13.6$, $SD = 1.3$), who were participants in either a regional state tournament or a tennis skills development camp in the Midwest region of the United States. The regional state tournament sports included bowling, track and field, soccer, swimming, volleyball, and wrestling.

Measures and Procedure

The TEOSQ was administered in a practice situation for the athletes or at the end of a physical activity skill class in the case of the college students. The 13-item TEOSQ employed in this study is shown in Table 1. When completing the instrument, the subjects were requested to think about a time when they felt most successful in either their favorite sport (college students) or the sport in which they were presently competing (intercollegiate skiers, high school athletes, and junior high school sport participants) and to indicate their degree of agreement with each of the TEOSQ items on a 5-point Likert-type scale (1 = *strongly disagree*, 5 = *strongly agree*).

Table 1. Items on the Task and Ego Orientation in Sport Questionnaire

I feel most successful in sport when...
1. I'm the only one who can do the play or skill. (Ego)
2. I learn a new skill and it makes me want to practice more. (Task)
3. I can do better than my friends. (Ego)
4. The others can't do as well as me. (Ego)
5. I learn something that is fun to do. (Task)
6. Others mess up and I don't. (Ego)
7. I learn a new skill by trying hard. (Task)
8. I work really hard. (Task)
9. I score the most points/goals/hits. (Ego)
10. Something I learn makes me want to go and practice more. (Task)
11. I'm the best. (Ego)
12. A skill I learn really feels right. (Task)
13. I do my very best. (Task)

Data Analysis

Because CFA is based on the assumption that the observed variables are multivariate normally distributed, the PRELIS program was used to examine the multivariate normality of the variables in each sample. Specifically, the skewness and kurtosis of each item was examined across the four groups. Mardia's (1985) test was also used to examine the multivariate normality. For the sample of intercollegiate skiers, college students, and high school athletes, no more than one or two items exhibited high skewness or kurtosis (a skewness or kurtosis value greater than 2 is considered high). In the case of the junior high school sport participants, three items reflected high skewness and/or kurtosis. Mardia's measure of multivariate kurtosis was 2.13, which suggested that the data marginally supported the assumed distribution of multivariate normality.

To conduct the multi-sample CFA across the four samples, a series of maximum likelihood CFAs were used (LISREL 8; Jöreskog & Sörbom, 1993). Data analysis included two stages: (a) the establishment and evaluation of a baseline model by conducting single-sample CFAs for each of the four groups and (b) the simultaneous testing of the invariance of the TEOSQ measurements and structures across the four groups.

One of the major concerns in conducting structural covariance modeling is the issue of what indexes should be used to assess the overall model fit. Historically, the chi-square statistic has been used to evaluate goodness of fit (Bollen & Long, 1992). A significant chi-square indicates that a proposed measurement model does not correspond to the data. However, there is a growing recognition of the inappropriateness of hypothesis testing because of the sensitivity to sample size and multivariate normality for chi-square statistics (Bollen & Long, 1992; Marsh, Balla, & McDonald, 1988).

The χ^2/df ratio has also been employed as a fit index, where the recommendations for an "acceptable" ratio vary from 2.0–5.0 (Byrne, 1989). The goodness-of-fit index (GFI) represents the relative amount of variance and covariance in the observed indicators that is explained by the model. The Adjusted GFI (AGFI) differs from the GFI only in the fact that it adjusts the GFI for the degrees of freedom used to estimate free parameters (Jöreskog & Sörbom, 1989). Both the GFI and AGFI range from 0–1, and a value greater than .90 is considered to be acceptable. The root mean square residual (RMSR) is a measure of the average of the fitted residuals (comparing the model estimate of the correlation matrix with the observed sample correlation matrix). Values for the RMSR of less than .05 reflect a good fit. Values between .05 and .10 are considered acceptable (McAuley et al., 1989; Rupp & Segal, 1989).

One more index was used to evaluate the overall model fit; namely, the comparative fit index (CFI; Bentler, 1990). The CFI is relatively independent of sample size and unaffected by their sampling distribution. Generally, values of the CFI range from 0–1, where values greater than .90 provide evidence for an acceptable fit.

Tests of invariance of factor structures across the four groups involved (a) testing for the predicted equality of the covariance structure of the observed variables; (b) testing the predicted invariance of the two-factor pattern; (c) testing the predicted invariance of the factor pattern and factor loadings; (d) testing the predicted invariance of the factor pattern, factor loadings, and error terms; and (e) testing the predicted invariance of the factor pattern, factor loadings, error terms, and covariance structure of latent variables.

The hierarchical testing of the hypotheses of invariance of models among groups involved an assessment of the goodness of fit of different models. With the exception of the equality of covariance structure hypothesis, the testing of each of the hypotheses stated earlier entailed fitting the estimated matrix to the observed matrix twice; once with parameters constrained to be equal across the four groups and once allowing the parameters to be different. This provided two chi-square likelihood ratios (i.e., the difference between these chi-squares and the difference between the degrees of freedom). These statistics were used to accept or reject the hypotheses. Specifically, all invariance testing of the restrictive models was based on the differences of two chi-squares and two degrees of freedom. A significant chi-square indicated noninvariance (i.e., rejection of the hypothesis of invariance).

Results

Establishing Baseline Models

As a prerequisite to testing for factorial invariance, a single-group CFA was conducted for each sample to establish baseline models. The means, standard deviations, and the intercorrelations among the 13 TEOSQ items for the four groups are shown in Table 2.

Table 3 presents the sequential maximum likelihood estimates of the parameters of the measurement models by using correlation matrices. According to the goal perspective theory (Nicholls, 1989), task and ego orientation are assumed to be independent. Therefore, the model was tested for uncorrelated factors. In fitting the baseline model for each group, Byrne (1989) suggested a procedure focused on examining the modification indexes (MIs) for each specified model. The MI represents the estimated change in the chi-square statistic if the parameter is respecified from fixed to free. Examination of the MI for multiple covariance among error variances revealed high residuals due to the error covariance terms. Multiple covariance among error variances within the same factor often represent nonrandom measurement error due to a "testing effect" (e.g., the incorporation of parallel wordings). It also suggests the possible existence of additional common factors (Gerbing & Anderson, 1984). Specifying multiple covariance among error variances within the same factor to achieve a better fit model has been observed in previous research examining the psychometrics of psychological constructs (Byrne, 1989; Byrne & Shavelson, 1987). However, it is suggested that such parameter respecification should be grounded on theoretical and empirical justification (Gerbing & Anderson, 1984; Jöreskog & Sörbom, 1989).

As can be seen in Table 3, a baseline model for each group was achieved by correlating two pairs of within-factor error terms. With respect to the task orientation scale, the pair of items were "I learn a new skill and it makes me want to practice more" and "Something I learn makes me want to go and practice more." Both of these items reflected the emphasis on learning and practice, which is fundamental to a task orientation. For the ego orientation scale, the pair of items were "I score the most points/goals/hits" and "I'm the best." These two items captured the emphasis placed on social comparison-based outcomes among individuals high in ego orientation. Based on the criteria for acceptable fit in-

Table 2. Observed means, standard deviations, and intercorrelations for TEOSQ items by groups

	TEOSQ items														
Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	*M*	*SD*
A															
1	1.00	.02	.44	.50	.15	.48	-.03	-.07	.31	-.02	.42	.12	.01	2.52	1.12
2	.06	1.00	.01	-.01	.32	-.05	.28	.34	-.02	.56	.00	.11	.15	4.12	.68
3	.43	-.02	1.00	.62	-.10	.45	-.09	-.10	.36	-.15	.41	.12	-.09	3.19	1.00
4	.36	.15	.57	1.00	-.20	.55	-.15	-.11	.46	-.07	.47	.12	-.15	2.97	1.03
5	-.02	.36	.08	-.03	1.00	-.22	.27	.25	-.11	.34	-.16	.23	.25	4.21	.65
6	.28	-.17	.38	.49	-.06	1.00	-.16	-.11	.46	-.07	.47	.12	-.15	2.57	1.04
7	.09	.28	.10	-.00	.37	-.04	1.00	.61	.05	.41	-.03	.20	.34	4.26	.73
8	-.05	.33	.01	-.05	.23	-.12	.49	1.00	.06	.43	.04	.20	.44	4.15	.08
9	.33	.05	.42	.33	.14	.36	.23	.13	1.00	.04	.63	.23	.06	3.36	1.07
10	-.06	.60	-.08	-.11	.38	-.23	.48	.50	.01	1.00	.01	.31	.34	4.08	.66
11	.30	-.01	.46	.34	.05	.42	.11	.08	.64	-.13	1.00	.25	.08	3.04	1.16
12	.18	.21	.09	.09	.27	.09	.56	.35	.39	.42	.29	1.00	.37	4.05	.71
13	-.21	.11	-.08	-.21	.16	-.14	.19	.33	.14	.22	.05	.23	1.00	4.04	.68
M	3.23	4.42	3.41	3.01	4.40	2.48	4.46	4.44	3.93	4.41	3.44	4.40	4.50		
SD	1.27	.63	1.02	1.12	.08	1.19	.69	.72	1.09	.69	1.35	.72	.79		
B															
1	1.00	-.02	.33	.35	-.04	.30	.12	.05	.36	.05	.31	.21	.16	2.58	1.31
2	-.08	1.00	-.20	-.26	.36	-.12	.37	.25	.01	.55	-.13	.25	.25	4.08	.97
3	.06	-.03	1.00	.61	-.24	.49	-.15	-.02	.51	-.16	.57	-.00	.05	2.74	1.27
4	.56	-.06	.66	1.00	-.32	.47	-.14	-.11	.39	-.20	.48	-.07	-.14	2.42	1.22
5	-.10	.29	-.02	-.10	1.00	-.25	.35	.18	-.17	.36	-.18	.21	.23	4.28	.89
6	.47	-.07	.49	.52	-.01	1.00	-.15	-.12	.44	-.16	.48	.07	-.09	2.23	1.25
7	.06	.07	.01	-.03	.11	-.06	1.00	.29	-.01	.36	-.01	.35	.33	4.45	.87
8	-.01	.26	.06	.01	.12	-.04	.15	1.00	.13	.32	.01	.19	.47	4.48	.81
9	.37	.01	.45	.44	.02	.50	.03	.00	1.00	-.03	.57	.18	.08	2.95	1.29
10	-.05	.42	.03	-.07	.31	-.07	.09	.45	-.00	1.00	-.14	.35	.15	4.07	.97
11	.49	-.02	.56	.55	.02	.51	.01	.09	.61	.10	1.00	.09	.07	2.52	1.41
12	.02	.33	.04	.07	.29	.09	.07	.34	.22	.42	.30	1.00	.35	4.04	.91
13	-.06	.20	-.07	-.07	.17	.20	.11	.52	.09	.40	.08	.37	1.00	4.61	.69
M	2.57	4.20	2.80	2.61	4.22	2.28	4.52	4.47	2.98	4.12	3.00	4.26	4.63		
SD	1.27	.77	1.17	1.15	.82	1.11	2.93	.72	1.16	.77	1.35	.72	.69		

Note. For those vairables under A, upper diagonal values are for intercollegiate skiers ($n = 143$) and lower diagonal values are for college students ($n = 270$). For those variables under B, upper diagonal values are for junior high school sport participants ($n = 234$) and lower diagonal values are for high school athletes ($n = 310$). TEOSQ = Task and Ego Orientation in Sport Questionnaire.

dexes, the baseline model of the two-factor structure were generally acceptable, albeit weaker in the case of college students. The baseline model for each sample is shown in Figure 1.

Table 4 presents the standardized solution for the maximum likelihood estimates of the parameters of the baseline model for each group. Cronbach's (1951) alpha for the composite score of the task orientation scale ranged from .71–.77 among the four groups. In the case of the ego orientation scale, the observed reliability coefficients ranged from .80–.87. Thus, the two TEOSQ scales demonstrated acceptable internal consistency across samples.

Multi-Sample CFA

A series of multi-sample CFAs were conducted to simultaneously test the invariance of the factor structure of the TEOSQ baseline model across the four groups. It should be noted that even if the covariance matrices were found to be identical, it is possible that no factor analysis model (i.e., the hypothesized two-factor TEOSQ) may be found to model these matrices. Results from the simultaneous group model tests are summarized in Table 5. All the chi-square difference tests were significant. First, the hypothesis of invariant covariance matrices across the four groups was rejected, χ^2 (273, $N = 957$) = 833.43, $p < .001$. In other words, the covariance matrices were not identical among the four groups. Second, the hypothesis of an invariant two-factor pattern across the four groups was rejected, χ^2 (248, $N = 957$) = 722.14, $p < .001$. This result indicated that a two-factor pattern was not identical across the four groups. Because the sequential testing of multi-sample data is conditional, testing the invariance of the factor loadings would be based on the assumption that the factor patterns were invariant. Therefore, the hypothesis of invariant factor loadings across the four groups was also rejected. This finding suggested that the TEOSQ was not measuring the same underlying concepts and that the TEOSQ items were understood differently among the present samples of intercollegiate skiers, college students, high school athletes, and junior high school sport participants.

Table 3. Confirmatory factor analysis: Steps in model fitting for each group

Competing models	χ^2	*df*	χ^2/df	χ^2_{diff}	df_{diff}	RMSR	GFI	CFI
Intercollegiate skiers								
1. Basic two-factor model	156.56	64	2.45				.86	.84
2. Model with correlated error between Item 2 and Item 10 and error between Item 9 and Item 11	108.21	62	1.74	48.35*	2	.06	.90	.92
College students								
1. Basic two-factor model	350.67	64	5.48				.80	.74
2. Model with correlated error between Item 2 and Item 10 and error between Item 9 and Item 11	253.02	62	4.08	97.65*	2	.08	.89	.83
High school athletes								
1. Basic two-factor model	238.00	64	3.72				.89	.86
2. Model with correlated error between Item 2 and Item 10 and error between Item 9 and Item 11	195.50	62	3.15	42.50*	2	.07	.91	.89
Junior high school sport participants								
1. Basic two-factor model	192.75	64	3.01				.89	.85
2. Model with correlated error between Item 2 and Item 10 and error between Item 9 and Item 11	165.41	62	2.67	27.34*	2	.09	.90	.88

Note. RMSR = root mean square residual; GFI = goodness-of-fit index; CFI = Bentler's comparative fit index.
*$p < .001$.

Discussion

The use of linear structure relationships to test the invariance of the measurement and factor structure of theoretical constructs across multiple samples has hardly been considered in the field of sport psychology. The primary goal of this study was to examine the hypothesized measurement and factor structure of the TEOSQ within and across intercollegiate skiers, college students, high school athletes, and junior high school sport participants.

Drawing from the results of the CFA for each sample separately, support for a hypothetical two-factor structure was found across the four groups, albeit weaker in the sample of college students. This evidence stemmed from an examination of multiple fit indexes. For example, fit indexes observed for the four groups were within an acceptable range and certainly consonant with, if not superior to, values reported in previous tests of sport-related measurement models (e.g., Gill & Deeter, 1988; Walling et al., 1993).

The weakest support for the hypothesized two-factor structure emerged for the college students. From a methodological perspective, it is important to point out that the college students completed the TEOSQ with respect to their favorite sport activity. The other three groups responded to this questionnaire with reference to a specific sport in which they were participating in at the time of administration. Further, the men and women enrolled in college physical activity classes may have been diverse in their current and previous sport involvement. However, previous sport experience was not assessed. The remaining three groups, on the other hand, were comprised of athletic participants. This heterogeneity in the college student sample might have contributed to the poorer fit of the data with the hypothetical measurement model.

The multi-sample CFA reveals that the hypothetical two-factor structure of the TEOSQ is not identical across intercollegiate skiers, college students, high school athletes, and junior high school sport participants. In other words, it seems that the four groups did not hold an identical conceptualization of task and ego orientation. In explicating these results, it should be

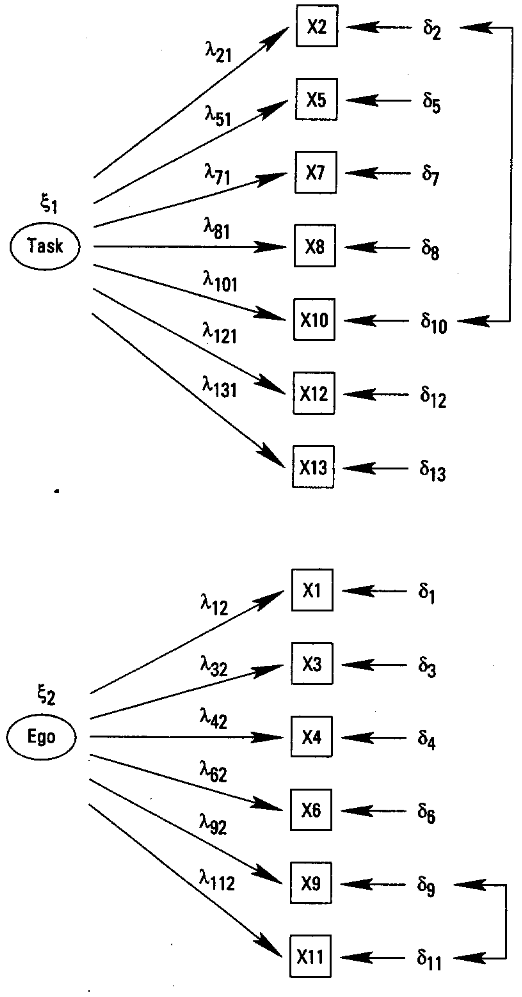

Figure 1. The measurement model for the 13-item Task and Ego Orientation in Sport Questionnaire.

Table 4. Standardized loadings for the maximum likelihood estimates of the parameters of the baseline model by groups

	Intercollegiate skiers	College students	High school athletes	Junior high school sport participants
Item	Loading	Loading	Loading	Loading
Task				
2	.53	.58	.50	.67
5	.45	.49	.38	.53
7	.68	.68	.17	.60
8	.73	.64	.64	.47
10	.69	.78	.72	.68
12	.37	.59	.60	.48
13	.54	.32	.61	.45
Ego				
1	.62	.52	.70	.67
3	.68	.72	.79	.79
4	.79	.65	.78	.71
6	.71	.59	.67	.65
9	.63	.67	.64	.67
11	.68	.70	.75	.74

pointed out that these analyses were not carried out separately for males and females because information on subjects' gender was not available from these secondary analyses. It is suggested that future studies examine possible gender differences in the tenability of the TEOSQ measurement model.

In conjunction with multi-sample CFA, structure equation modeling provides an approach to testing differences in factor means. As shown in Table 2, the mean score for each item varies among the four groups. In subsequent research, it would be interesting to compare the factor mean structure of the TEOSQ across participation groups that differ in theoretically meaningful ways; for example, comparing different groups varying in gender, age, and competitive level.

In terms of the conceptually based factor structure of the TEOSQ across the four groups, the present findings indicate that the assumption of intergroup invariance of the measurement and factor structure cannot be accepted. These results indicate that the 13-item TEOSQ is unequally valid for the present samples of intercollegiate skiers, college students, high school athletes, and junior high school sport participants.

Future studies using the TEOSQ should first confirm its factor structure on the specific sample employed before proceeding to test major research hypotheses. Moreover, identifying the sources of variability from different groups in response to this psychological measure should lead to further psychometric refinement of this measure of dispositional sport goal orientations. Finally, it is recommended that both single-group and multi-sample CFAs be employed to examine the psychometric properties of other established or recently developed sport psychology assessments.

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Table 5. Simultaneous tests for the invariance of the Task and Ego Orientation in Sport Questionnaire

Competing models	χ^2	*df*	χ^2_{diff}	df_{diff}	GFI	CFI
1. Model with covariance structure of the observed variables invariant across groups	833.43	273	--	--	.89	.85
2. Model with two-factor pattern invariant across groups	722.14	248	111.19*	25	.90	.88
3. Model with factor pattern and factor loadings invariant across groups	--	--	--	--	--	--

Note. Step 3 was not conducted due to lack of invariance found at Step 2. GFI = goodness-of-fit index; CFI = Bentler's comparative fit index.
*$p < .001$.

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Authors' Notes

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