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Factorial and Item-Level Invariance of an Emotional Intelligence Scale Across Groups of International Students

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Abstract
This study examined the factorial and item-level invariance of Wong and Law's emotional intelligence scale (WLEIS) in a sample of 375 international students in U.S. universities. Confirmatory factor analysis (CFA) and differential item functioning (DIF) analysis were employed at the test and item level, respectively. International students from three regions were of interest: Far East Asia, India, and Europe. A single group CFA was conducted, and the model was found to fit for each group. The factorial invariance between the groups was tested through three models with cumulative constraints. The results suggest that the WLEIS is a viable emotional intelligence measure when applied to this student population. Students from different cultures shared similar pattern of EI. The DIF analysis further revealed that 14 out of 16 items functioned similarly between Far East Asian students and Indian students, while all the items functioned similarly between Far East Asian and European students.

Keywords
international students, emotional intelligence, factorial invariance, differential item functioning

International student enrollment in the U.S. higher education increased by 8% to a high record of 671,616 in the 2008/2009 academic year (Bajka, 2009). According to the U.S. Department of Commerce, international students contribute US$17.8 billion to the U.S. economy through their expenditures on tuition and living expenses (Bajka, 2009). The growth of international students has led to increased attention in the literature on this student population; however, assessment instruments developed and validated for this group of students are rare (Yoon & Portman, 2004). International students are heterogeneous because of nationality and cultural backgrounds. Therefore, a psychometrically valid instrument for international students should take into consideration of the variances due to the cultural origins of these students.

1University of North Carolina at Charlotte, NC, USA

Corresponding Author:
Chuang Wang, Department of Educational Leadership, University of North Carolina at Charlotte, 9201 University City Boulevard, Charlotte, NC 28223, USA
Email: cwang15@uncc.edu
Recently, emotional intelligence (EI) has drawn great attention from researchers and practitioners across disciplines as EI has been suggested to be important to students’ academic achievement (Parker, Sumferfeldt, Hogan, & Majeski, 2004; Van der Zee, Thijs, & Schakel, 2002) and well-being (Fukuda et al., 2011; Martinez-Pons, 1997; Palmer, Donaldson, & Stough, 2002). The lack of a valid EI instrument for international students interferes with research on the relationships between EI and the social and emotional functioning of these students.

The purpose of this study was to examine the factorial and item-level invariance of Wong and Law’s EI scale (WLEIS; 2002) in a sample of international students in the U.S. universities. Specifically, we applied confirmatory factor analysis (CFA) to evaluate the variance-covariance matrix to test the equality of covariance structures across three international student groups: Far East Asian countries, India, and European countries. We also used Differential Item Functioning (DIF) analysis to test if each item functioned similarly across different groups. This study builds on our previous research that examined the factor structure of the scale on a large sample (n = 601) that included students from countries not included in the current study’s groupings of students (Ng, Wang, Zalaquett, & Bodenhorn, 2008). Although previous research provided some evidence of validity of WLEIS with various populations (Ng et al., 2008; Fukuda et al., 2011; Law, Wong, & Song, 2004; Wong & Law, 2002), few had attempted to examine the cross-cultural validity of this instrument (Sharma, Biswal, Deller, & Mandal, 2009). To the best of our knowledge, the current study is the first to evaluate the factorial invariance of the WLEIS across populations.

Emotional Intelligence and Academic Achievement

Salovey and Mayer (1990) were among the first to introduce a scientific conceptualization of EI and defined it as “the ability to monitor one’s own and other’s feelings and emotions, to discriminate among them and to use this information to guide both thinking and actions” (p. 189). EI is “a distinct (because it can be isolated in personality space), compound (because it is partially determined by several personality dimensions) construct that lies in the lower levels of personality hierarchies” (Petrides, Pita, & Kokkinaki, 2007, p. 283). Interest in this construct and its applications increased greatly after Goleman (1995) claimed that EI was more powerful than IQ in predicting one’s success. Mayer and Salovey (1997) refined their definition of EI and proposed four subconstructs: (a) perception, appraisal, and expression of emotions; (b) accessing and generating feelings to facilitate thinking; (c) understanding emotions; and (d) regulating emotions to promote personal growth. A great progress was made toward the operational definition of EI by Petrides and Furnham (2000) when they distinguished trait EI from ability EI. Petrides and Furnham coined the term trait EI to include self-perceived abilities to recognize, process, and utilize emotion-laden information and proposed to measure the construct through self-report questionnaires. These researchers agreed with Mayer and Salovey who proposed that ability EI represents the actual ability to recognize, process, and utilize emotion-laden information and is measured by maximal performance tests. The current study focuses on the WLESI, which is a trait EI measure. Compared to ability EI tests, trait EI measures are much more straightforward (Petrides, Frederickson, & Furnham, 2004).

Moderate relationships between academic achievement and EI in college and high school students were reported in various countries (e.g., Elias, Bruene-Butler, Blum, & Schuyler, 1997; Parker et al., 2004; Petrides et al., 2004; Wong, Day, Maxwell, & Meara, 1995). Furthermore, Sternberg, Wagner, and Okagaki (1993) claimed that EI played a significant role during the transition from high school to college.

Emotional Intelligence and Culture

Parker et al. (2005) cautioned that the EI construct in different cultures might vary because culture can influence the experience and expression of emotions (Scollon, Diener, Oishi, &
Biswas-Diener, 2004). A meta-analysis of 190 cross-culture quantitative studies on emotions revealed that the size of cross-cultural differences reported in the literature might be overestimated although different patterns in emotions were noticed along the lines of the distinction between political systems of countries, individualism versus collectivism values, and religiosity (Van Hemert, Poortinga, & Van de Vijver, 2007).

The ability to recognize facial expressions is critical to appraise other’s emotions, but considerable differences exist across cultures (Parker et al., 2005). See Ekman (1993) for a review of cross-cultural research on facial expressions. European English native speakers and Himba natives in northern Namibia were found to have similar vocal signals corresponding to facial expressions for negative emotions but different vocal signals for positive emotions (Sauter, Eisner, Ekman, & Scott, 2010). Moreover, significant differences in emotion judgments and emotional expressions were noticed among college students with cultural backgrounds of White, African American, Hispanic, and Asian ethnicities (Matsumoto, 1993). Therefore, it is important to examine the validity of an EI instrument across cultures to see if the factor structure is the same and if differences exist in the general or subconstructs of EI. For example, Parker et al. (2005) conducted a study in Canada with 384 aboriginal children and adolescents and a matched sample of 384 nonaboriginal children and adolescents using Bar-On’s (1997) EI inventory (EQ-i). They reported that the factor structure of EQ-i was the same between two groups and that the aboriginal participants scored significantly lower on interpersonal, adaptability, and stress management dimensions of EI. Similarly, in a comparative study of 234 Iranian college students and 220 American college students, the factor structure of the EI measure was similar although differences existed in constructs: American students had more positive and optimistic ratings (Ghorbani, Bing, Watson, Davison, & Mack, 2002). The authors speculated that the differences were possibly due to the historical emphasis on the self and individualism in American culture.

Measurement of EI and the WLEIS Scale

Scholars developed a number of EI measures (e.g., Bar-On, 1997; Boyatzis, Goleman, & Hay/McBer, 1999; Dulewicz & Higgs, 2001; Jordan, Ashkanasy, Hartel, & Hooper, 2002; Martinez-Pons, 2000; Palmer & Stough, 2002; Petrides & Furnham, 2003; Salovey, Mayer, Goldman, Turvey, & Palfai, 1995; Sjoberg, 2001; Tapia, 2001). Tett, Fox, and Wang (2005) had conducted a comprehensive review of the psychometric properties of these instruments. The number of items in these instruments ranges from 16 to 789 with the median number of 66 items. The WLEIS was chosen as the focus of the current study because it is the shortest scale (16 items) as well as one of the scales that have shown a stable factor structure (Tett et al., 2005).

The WLEIS was developed and validated from three studies with graduate and undergraduate students in Hong Kong using Mayer and Salovey’s (1997) definition of EI (Wong & Law, 2002). Items were originally generated from 120 undergraduate and graduate students. After removing overlapping and unclear items, the authors narrowed down to 16 items with exploratory and confirmatory factor analysis. Wong and Law reported that the 16 items captured effectively the EI dimensions and that the WLEIS was a valid measure of EI.

After the publication of WLEIS, additional empirical studies (e.g., Law et al., 2004; Shi & Wang, 2007) had confirmed the four EI constructs: Self-emotion Appraisal (SEA), Others’ Emotion Appraisal (OEA), Use of Emotion (UOE), and Regulation of Emotion (ROE). Other than Ng et al. (2008) study that examined the factor structure of the WLEIS on a large sample of international students studying in the United States, no research has examined the factorial invariance of the measure across various groups of international students. Additional research is needed to understand more fully the psychometric properties of the WLEIS among international students. A valid EI instrument will facilitate EI research on international students and help to
further shed light on the relationships between EI and other psychosocial correlates important for the understanding of the needs and functioning of this student population.

Method

Procedure and Participants

Participants were recruited electronically to respond to an online survey developed to study the socioemotional functioning of international students attending American universities. E-mail invitations were dispatched to international student advisors in the 20 universities with the highest enrollment of international students and two other randomly selected universities in each state in the country. The advisors were requested to forward the research invitations to international students in their institutions. Participants were given the choice to enter into a sweepstakes to win one of 40 US$40 awards on submission of the survey. Names and contact information of those who entered the sweepstakes were collected. Otherwise, participation of the survey was anonymous.

Out of the 628 respondents, 387 were selected from countries that were either represented with a large number or could be grouped together based on geographic regions that shared common cultural backgrounds as recognized in the literature. Data screening revealed a few missing values in certain items with 12 respondents; but the pattern of missing items was completely random. As a result, the final sample consisted of 375 international undergraduate (n = 86) and graduate (n = 289) students. The complete sample of 628 was used in a previous study that focused on investigating the factorial validity of the WLEIS on international students (Ng et al., 2008). The students were placed into three groups:

1. The Far East Asian group (n = 169), used as the reference group, comprised students from Hong Kong, Taiwan, Japan, Korea, and mainland China. Confucian heritage culture is dominant in these Asian societies (Nguyen, Terlouw, & Pilot, 2006).
2. Students (n = 98) from 19 European countries were used as a comparison group.
3. Students from India (n = 108) were used as another comparison group. The Indian society is markedly different from Far East Asian countries because of the strong influence of Hinduism, instead of Confucianism.

An additional rationale for this grouping method was that our previous study suggested Indian students scored differently on the WLEIS than students from mainland China, Taiwan, Japan, and Korea, whereas significant differences were not noted between students from these four Confucian heritage societies (Ng et al., 2008).

Of the 373 students who identified their gender, 200 (54%) were females and 173 (46%) were males. The average age of these students was 26.31 (SD = 4.42). Both the median and mode of the length of staying in the United States were 2 years, and 83% of the participants had been in the United States for less than 4 years at the time of the study. These students were enrolled in universities across 28 states in the United States.

Instruments

WLEIS is a 16-item self-report measure designed to assess EI in four dimensions (SEA, OEA, UOE, and ROE). Items are rated on a 7-point Likert-type scale (1 = strongly disagree and 7 = strongly agree (Wong & Law, 2002). All items are positively keyed. A sample item from SEA (Items 1-4) is “I have a good sense of why I have certain feelings most of the time.” A sample
item from OEA (Items 5-8) is “I always know my friend’s emotions from their behavior.” “I always set goals for myself and then try my best to achieve them” and “I have good control of my own emotions” are items from UOE (Items 9-12) and ROE (Items 13-16) respectively.

Data Analytical Procedure

One-way analysis of variance (ANOVA) was first employed to examine differences in the mean self-report of EI across the three groups of students. Then, multivariate analysis of variance (MANOVA) was used to see if the groups differ on the combination of the four subconstructs of EI. Scheffe’s method was used for post hoc multiple comparisons. CFA was conducted to test the factorial invariance across the three groups with LISREL 8.8 (Jöreskog & Sörbom, 2006). Following our previous research (Ng et al., 2008), a two-level four-subconstruct measurement model (SEA, OEA, UOE, ROE) was chosen for the CFAs. The first level was EI, and the second level consisted of the four subconstructs. A single group CFA was first conducted for each group to assess the overall model fit using the \( \chi^2 \) statistic, Standardized Root Mean Square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), Nonnormed Fit Index (NNFI), and Comparative Fit Index (CFI). The 2-index presentation strategy (i.e., SRMR coupled with another index) suggested by Hu and Bentler (1999) was not used because they were based on very restrictive assumptions (Marsh, Hau, & Wen, 2004) and cautions to use this strategy was raised by Fan and Sivo (2005). Different levels of factorial invariance between the student groups were tested through the following three steps: (a) all parameters were freely estimated (Model 1, baseline model); (b) the factor loadings were constrained to be equal for each pair of the four dimensions of EI across the groups (Model 2); and (c) factor loadings and error variances were constrained to be equal for each pair of the four dimensions of EI across the groups (Model 3). Significant changes in \( \chi^2 \) and changes in CFI values of .01 or above were used to flag significant differences when testing the models (Cheung & Rensvold, 2002).

In addition to CFAs, Differential Item Functioning (DIF) analysis was also used with an extension of the Cochran-Mantel-Haenszel chi-square approach (Mantel & Haenszel, 1959; Zwick, Donoghue, & Grima, 1993) to polytomous items to examine the measurement invariance at the item level. The Far East Asian student group served as the reference group. The Indian and European student groups served as the focal group (i.e., group of primary interest). Analyses were conducted separately for the Indian and European groups. If the results were not statistically significant (\( p > .05 \)), the focal and reference groups matched on an ability variable (e.g., total score) were similar in their item scores. If the results were statistically significant (\( p < .05 \)), the focal and reference groups would differ in their item scores. In addition to statistical significance, the standardized mean difference (SMD), a descriptive index (Dorans, Schmitt, & Bleistein, 1992; Zwick & Thayer, 1996) was obtained. The SMD is the difference between the unweighted item mean of the focal group and the weighted item mean of the reference group. An effect size (ES) estimate for the SMD is then obtained by dividing the SMD by the total group item standard deviation. The present study used the following polytomous DIF classification rule developed by the Educational Testing Service (ETS) and used in the National Assessment of Educational Progress (NAEP; as cited in Meyer, Huynh, & Seaman, 2004; Michalis, 2008).

\[
\begin{align*}
\text{Rule 1:} & \quad \text{If the chi-square is not significant, } p > .05, \text{ then classify the item as negligible DIF (AA). Otherwise, continue with the following rules.} \\
\text{Rule 2:} & \quad \text{If } |ES| \leq .17, \text{ then classify the item as negligible DIF (AA).} \\
\text{Rule 3:} & \quad \text{If } |ES| > .17 \text{ but } \leq .25, \text{ then classify the item as intermediate DIF (BB).} \\
\text{Rule 4:} & \quad \text{If } |ES| > .25, \text{ then classify the item as large DIF (CC).}
\end{align*}
\]
Items flagged as large or CC-level are recommended further review. A plus (+) sign of ES indicates that items were in favor of the focal group. A minus (–) sign of ES indicates that items are in favor of the reference group.

**Results**

**Mean Comparisons and Factor Structure**

Table 1 displays the raw score means and standard deviations by group and constructs.

Levene’s test of equality of error variances suggest that the assumption of homogeneity of variance held for ANOVA. Students from the reference group and the comparison groups scored significantly differently from each other on the total WLEIS score, $F(2, 372) = 5.94, p = .003$. The effect size was small: $\eta^2 = .03$. Post hoc multiple comparisons using Scheffe’s method revealed that Indian students had statistically higher mean WLEIS scores than both the reference group and the European group. The difference between the reference group and European group was not statistically significantly different from zero. The Box’ $M$ test of equality of covariance matrices yielded a $p$ value of .008, but the outcome was disregarded because this test was notoriously known to be sensitive and the robustness of significance tests was expected when the sample sizes were approximately equal (Tabachnick & Fidell, 2007). Levene’s test of equality of error variances yielded $p$ values of .29, .60, .17, and .38 for the four subconstructs, respectively. Pillai’s trace, the pooled effect variances, was used instead of Wilks’ lambda for multivariate statistical inference because of the advantage of Pillai’s criterion in terms of robustness when there was more than one degree of freedom for effect (Tabachnick & Fidell, 2007). The students were significantly different from each other on the combination of four EI constructs, $F(8, 740) = 2.69, p = .006$. The effect size was small: $\eta^2 = .03$. Tests of between-subjects effects revealed that the participants were significantly different from each other on ROE only, $F(2, 372) = 8.80, p < .001$. The effect size was also small: $\eta^2 = .05$. Post hoc multiple comparisons using Scheffe’s method suggested that Indian students had significantly higher mean ROE score than both the reference group and the European group, but the mean ROE scores for the reference group and the European group were not statistically significantly different from each other.

CFAs were conducted separately for each group to assess the fit of the data to the four-factor model. Results indicated that the two-level four-construct model was not rejected, suggesting that the model adequately represented the factorial structure of EI (NNFI = .96, CFI = .97, RMSEA = .07, and SRMR = .07 for the reference group; NNFI = .94, CFI = .95, RMSEA = .10, and SRMR = .09 for Indian students; and NNFI = .96, CFI = .97, RMSEA = .07, and SRMR = .09 for European students). In testing factorial invariance, Model 1 was used as the baseline model with which the more constrained models (i.e., Model 2 and Model 3) were compared.
The results of the invariance tests are presented in the top part of Table 2. In Model 1, all fit values showed good fit of the data, suggesting that the factorial pattern of WLEIS was similar across the three cultural groups. Students from the three groups appeared to have a similar pattern of the unstandardized factor loadings and error variances. In Model 2, the factor loadings were imposed to be equal across the groups. The CFI difference (ΔCFI) between Model 1 and Model 2 was equal to zero and the SRMR fit values stayed the same from Model 1 to Model 2, suggesting that factor loadings were invariant across the groups. When both the factor loadings and error variances were imposed to be equal across the groups (Model 3), the ΔCFI was equal to .01, and the SRMR value increased by .02, indicating that Model 3 is worse than Model 1 and Model 2. Pairwise comparisons showed that the model fit was not acceptable for the comparison between the Indian group and the European group. The increase of SRMR values from Model 2 to Model 3 suggested that Model 2 fit our data better than Model 3. In summary, there was a significant difference in the error variances across the groups, specifically between Indian and European students, but the factor loadings were the same across the three groups.

### Differential Item Functioning Analysis Results

Table 3 shows the effect size, p value, DIF classification results. For the group of Indian students, the majority of the items (13 items, 81%) displayed no DIF. Only three of the 16 items were found to function in a different manner for the reference group and Indian students. Specifically, both Item 10 “I always tell myself I am a competent person” and Item 15, “I can always calm down quickly when I am very angry” displayed BB-level (intermediate) DIF and favored Indian students, indicating that students in the reference group had a lower mean item score than Indian students. Item 1, “I have a good sense of why I have certain feelings most of the time” displayed CC-level (large) DIF and favored students in the reference group, indicating that Indian students had a lower mean item score than students in the reference group. As shown in Table 3, for the European students group, no DIF items were present, with all items classified as AA-level DIF, suggesting that students in the reference group and European students had a similar mean item score.

#### Table 2. Test of Invariance by Group and Model

<table>
<thead>
<tr>
<th>Model</th>
<th>df</th>
<th>$\chi^2$</th>
<th>Δdf</th>
<th>Δ$\chi^2$</th>
<th>CFI</th>
<th>ΔCFI</th>
<th>SRMR</th>
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Note: CFI = comparative fit index; SRMR = standardized root mean square residual.
*p < .05.
Discussions and Implications

Despite the reliability and validity of the WLEIS as a measure of EI provided by previous research (Tabachnick & Fidell, 2007), empirical studies on the invariance factorial structure between students of different cultural backgrounds were scarce. The current study sought to extend the current knowledge of the WLEIS by verifying the WLEIS factorial invariance across cultural groups among international students as well as examining the item response pattern of the measure among these student groups. Findings in this study are consistent with those of Parker et al. (2005) in that the factor structure of EI is similar between two different cultures although mean differences between groups exist.

With respect to mean differences, Indian students were noted to report higher levels of EI in general and ROE in particular when compared to students in the reference group from mainland China, Taiwan, Japan, and Korea and the European students. This result is also consistent with our earlier study (Ng et al., 2008). Although the factor structure of EI is the same across student groups, culture does have an impact on self-report of EI levels (Ghorbani et al., 2002). At the item level, Indian students reported significantly lower mean score on Item 1, “I have a good sense of why I have certain feelings most of the time”. Although there have been extensive literature about the cross-cultural studies of Asian, Australian, European, and American students with respect to EI (e.g., Ilangovan, Scroggins, & Rozell, 2007; Wang & Wang, 2010), very few studies have examined the subtle differences between Asian cultures (Ng et al., 2008). Asian students were usually believed to be influenced by collectivism culture and European and American students were believed to be influenced by the individualism culture (Hofstede, 2001). On the other hand, Indian students reported higher mean scores on Item 10, “I always tell myself I am a competent person” and Item 15, “I can always calm down quickly when I am very angry.” Different patterns of anger were noticed between Indian and Chinese when they were in an experimental study (Bishop & Robinson, 2000). It is important to note that these items came from different subscales of EI and no significant differences were noticed on the other three items within each of the subscales. Therefore, the results about group differences at the

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item-level are inconclusive. However, EI is likely to vary across cultures as it is influenced by one’s attitudes and beliefs within specific social contexts (Shipper, Kincaid, Rotondo, & Hoffman, 2003). We believe that the subtle differences between Asian cultures could be accountable for the differences noted at item levels in this study and call for more studies to examine differences between Asian countries.

Although this study is limited in that not all groups of international students in the United States were included and that the fit indices were not impressive for such a short scale, the findings of the study both enhance our understanding of the psychometric performance of the WLEIS and demonstrate that Far East Asian, Indian, and European students in the United States share the same pattern of EI as measured by the WLEIS. Based on the findings of factorial invariance and mean differences across students of a few cultural backgrounds (i.e., Far East Asian, Indian, and European) at item levels, it is recommended that while researchers now have empirical support to use the WLEIS with samples in these regions, they should be cautious to examine mean differences across these groups with respect to each of the EI dimensions.

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