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A Cross-Cultural Assessment of School Connectedness: Testing Measurement Invariance With U.S. and Chile Adolescents

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Abstract

Positive associations between measures of school connectedness and behavioral and academic outcomes suggest that it is an important protective factor for adolescents in the United States. However, little is known about the meaning or measurement of academic connectedness outside the United States, and especially in South America where rapid economic and educational changes are underway. Using the Hemingway: Measure of Adolescent Connectedness measurement invariance analyses were conducted that compared Chile and United States samples. Results revealed that although all scales reflected factorial validity in both cultures, the connectedness to school, teachers, and self-in-the-future factors were noninvariant across groups, whereas the factors of connectedness to peers and self-in-the-present were invariance across groups. Consequently, all of these subscales can be used in both cultures, but comparing United States and Chile youth on three subscales may be ill advised.

Keywords

cross-cultural research, measurement invariance, school connectedness, factor analysis

A positive school climate and overall feeling of connectedness to peers, teachers, and parents, and especially school connectedness (collectively called academic connectedness here), have been linked to lower rates of substance use, delinquency, problem behavior, and gang membership (Catalano, Haggerty, Oesterle, Fleming, & Hawkings, 2004; Eisenburg, Neumark-Sztainer, & Perry, 2003; Karcher, 2002; Karcher & Finn, 2005; Resnick et al., 1997; Thomas & Smith, 2004). Past research also indicates that school culture, climate, and overall student success in the United

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States are intricately tied to the concept of connectedness (Catalano et al., 2004). These findings beg the question of whether the manifestation and importance of academic connectedness generally, and school connectedness more specifically, is unique to adolescents in the United States.

One hindrance to cross-cultural research is that, such investigations require the use of psychometrically sound instruments that possess measurement invariance across cultures (Meade & Bauer, 2007).[AQ: 2] The use of such measures would allow researchers to better understand the nature and impact of academic connectedness between populations by ensuring the constructs' equivalence. Moreover, measurement invariance is critical when utilizing inferential statistics (e.g., mean difference or correlation analyses) that compare two populations (Little, 2007) as these differences could manifest from cross-cultural differences or noninvariant measures.

Importance of Culture on Research

The present study attempts to set the stage for subsequent studies which compare academic connectedness in the United States and Chile. Such comparisons are imperative because culture influences psychological development, values, and behavior (Fontaine, Poortinga, Delbeke, & Shwartz, 2008) and therefore interpersonal relations. To understand the contribution of academic connectedness in other countries' educational systems, it is critical to explore cross-cultural manifestations of academic connectedness using theory-based models. Although much can be learned from studying academic connectedness in other cultural settings, efforts to develop and test theoretical models across cultures have been few. One reason for this dearth of research and theory is the lack of psychometrically sound instrumentation that is invariant across cultures.

Connectedness in Chile

Since the ending of a 17-year dictatorship in 1990, a number of national policies and initiatives have been implemented that affect adolescent Chileans, including education reform (Cox, 2004), compulsory secondary education (initiated in 2003), and the formation of a National Youth Institute in 1991. The education reforms efforts underway parallel changes recently proposed in the United States (Parry, 1997). Perhaps the United States could learn from Chile about the consequences of school reform on academic connectedness.

Yet little is known about academic connectedness for Chile adolescents. But engagement with family and school are important protective factors for Chile adolescents, particularly with respect to destructive behaviors, drug and alcohol use, and risky sexual behavior (Florenzano, 2002; Magaña & Meschi, 2002). Another study directly addressing adolescent connectedness in Chile (McWhirter & McWhirter, 2009) reports similarities between correlates of connectedness among youth in the United States and the Chile sample used in this study. As in the United States, Chile students reporting more antisocial and problem behaviors were less connected to their parents, teachers, and schools. Student reports of connectedness to teachers and schools were associated with higher parental monitoring, more positive family relationships, fewer attention problems, less alcohol use, and reduced depressive symptoms. Thus, academic connectedness may serve as a protective factor for Chile students as it does in the United States, and declines in connectedness following educational reforms may be instructive for those in the United States. However, current cross-cultural comparisons are ill advised given the absence of measurement invariance.

Purpose of Study

This study tested for measurement invariance using the Hemingway Measure of Adolescent Connectedness, which is a multidimensional measure that has been translated into several languages

Table 1. Demographic Characteristics by Sample

Sample characteristics	US1 (*n* = 157)	US2 (*n* = 176)	US3 (*n* = 175)	Overall United States (*N* = 508)	Chile (*N*= 893)
Grade					
9th	19 (12.1)	39 (22.2)	50 (28.6)	106 (20.9)	279 (31.2)
10th	29 (18.5)	53 (30.1)	38 (21.7)	120 (23.6)	277 (31.0)
11th	26 (16.6)	47 (26.7)	47 (26.9)	120 (23.6)	180 (20.2)
12th	28 (17.8)	37 (21.0)	40 (22.9)	105 (20.7)	157 (17.6)
Missing	55 (35.0)	0 (0.0)	0 (0.0)	55 (10.8)	0 (0.0)
Gender					
Females	116 (73.9)	86 (49.1)	74 (43.8)	276 (54.3)	428 (47.9)
Males	41 (26.1)	89 (50.9)	95 (56.2)	225 (44.3)	465 (52.1)
Missing	0 (0.0)	1 (0.6)	6 (3.4)	7 (1.4)	
Ethnicity					
White	0 (0.0)	129 (76.8)	77 (58.8)	206 (40.6)	0 (0.0)
Hispanic	81 (89.0)	8 (4.8)	3 (2.3)	92 (18.1)	893 (100.0)
African American	4 (4.4)	9 (5.4)	0 (0.0)	13 (2.6)	0 (0.0)
Asian	4 (4.4)	11 (6.5)	0 (0.0)	15 (3.0)	0 (0.0)
Biracial	0 (0.0)	6 (3.6)	51 (38.9)	57 (11.2)	0 (0.0)
Other	2 (2.2)	5 (3.0)	0 (0.0)	7 (1.4)	0 (0.0)
Missing	66 (42.0)	8 (4.5)	44 (25.1)	118 (23.2)	0 (0.0)

Note: Each of the U.S. sample was presented separately given that the demographics were more heterogeneous, whereas the Chile samples were more homogenous and therefore presented as a single sample. Hispanic students in the Chile sample are defined as either an indigenous group or Mestizo.

and has positive psychometric properties within the United States. For this study, five of the subscales were employed (connectedness to school, teachers, peers, self-in-the-present, and self-in-the-future) to assess factorial validity, internal consistency, and measurement invariance across United States and Chile youth. Also tested was whether these five Hemingway subscales produced a second-order factor labeled Academic Connectedness.

Method

Sample

The United States samples ($n = 508$) were collected from three larger studies designed to improve or assess academic connectedness, whereas the Chile (n = 893) samples were part of a larger study on risk and protective factors among Chile adolescents. The overall U.S. sample was composed of diverse ethnicities (see Table 1), with a relatively equal gender distribution and number of students from 12th (23.2%), 11th (26.5%), 10th (26.5%), and 9th (23.4%) grades. These students were socioeconomically diverse, with data from two public and one private high school located in urban areas. Sample 1 (US1) comprised mainly of lower- to middle-class Hispanic students; Sample 2 (US2) of upper-class White students; and Sample 3 (US3) of all socioeconomic status backgrounds. The U.S. response rates were 77% (US1), 88% (US2), and 94% (US2). Data for US1 was part of intervention study with full parental consent, whereas data for US2 and US3 were collected by school administration as part of an annual schoolwide assessment using passive consent.

Three of the four Chile schools were identified by the Chile Ministry of Education as “Priority” or “High-risk” public high schools. These schools were located in a poor suburban “barrio”

(n = 205), a poor semiurban "barrio" on the outskirts of Santiago (n = 160), and a small urban community serving a large rural agricultural area within an hour of Santiago (n = 357). The fourth Chile school (n = 171) was a private Catholic school in a central urban location that was semisubsidized by the government and serves poor to working class youth. All students with parental consent and those who volunteers to participate in the study were administered the survey. Data were collected in intact classrooms and those without permission or who did not assent to participate engaged in school-related reading or homework. The student response rate ranged from 73% to 99% across the four schools with an average of 87%.

Chile students were distributed relatively equally for gender, and across the four grade levels (see Table 1). Nationally, about 6% of Chileans are members of indigenous groups and the remainder identify as Mestizo (Martinez, Cumsille, & Thibaut, 2006), although these demographic data were not collected. Given the different social system, it is difficult to directly compare students' economic status. Nevertheless, average monthly household income (translated here to U.S. dollars) reported by participating parents was about US$760 per household, with the median income of US$666. Thus, the Chile students appeared to represent low- to lower-middle socioeconomic class while U.S. students generally represented more diverse socioeconomic statuses.

Measure

The Hemingway: Measure of Adolescent Connectedness (Karcher, 2003) is a 78-item self-report measure that assesses 15 subscales of adolescents' connectedness. For this study, five academically related connectedness subscales (School, Teacher, Peers, Self-in-the-Present, and Self-in-the-Future) were used. Each subscale included six items that were rated on a 5-point response scale from *not at all true* to *very true*, with one reverse-worded item per scale to lessen patterned responding. Karcher and Sass (2010) reported evidence of factorial validity, reliability, and cross-cultural invariance among U.S. youth.

The Connectedness to School factor measures the importance youth place on school and how actively they try to be successful in school (e.g., I get bored in school a lot). Connectedness to Teachers assesses effort made to get along with teachers and concerns about earning teachers' respect and trust (e.g., I do not get along with some of my teachers). Connectedness to Peers evaluates feelings about peers and about working with peers in class (e.g., I like working with my classmates). Self-in-the-Present evaluates feelings about current relationships, continuity in behavior across contexts, and an awareness of skills and interests that make them liked by others (e.g., "I can name 5 things that my friends like about me"). Self-in-the-Future explored behaviors and qualities that will help them in the future (e.g., "I will have a good future"). Note that different test length versions were used across samples, therefore students did not respond to items in an identical order. These minor differences were inadvertent and should have a trivial influence on the results.

Translation Procedures

The Hemingway Spanish version (Karcher, 2003) was translated from the Mexican-American to the Chile version of Spanish by a native Spanish speaker. This research assistant, a native of Peru, lived in Chile for 7 years prior to the onset of the study, completed a bachelor's degree in Chile, and was in the process of completing teacher training in Chile. First, the lead researchers discussed the meaning of each item with the research assistant to be sure that the intended meaning was clear. Next, they reviewed each item word-by-word and suggested minor vocabulary modifications to ensure language appropriateness for Chilean Spanish speakers. Slight modifications to be consistent with Chilean dialect of Spanish were implemented (e.g., rather than "escuela" the word *colegio* [generally a private K-8 or K-12 school] or *liceo* [high school] was used). The researchers also consulted with Chile researchers and educators on the intended meaning and optimal phrasing of each item. Finally, a Chile school guidance counselor also reviewed and approved each item with respect to clarity, meaning, and comprehension. The translation process ensured all items were linked to the English version, thus the translator considered both the English and Mexican-American versions. However, no formal back translation was conducted.

Missing Data

Missing data at the item level were treated using multiple imputations (MI) via the Expected Maximization (EM) algorithm and the Markov Chain Monte Carlo (MCMC) algorithm within LISREL. Default values were used, with the exception of increasing the number of draws from 200 to 500 to ensure stable and accurate results. MI, rather than full information maximum likelihood (FIML) estimation, was used because several fit indices are unavailable when executing FIML within LISREL given that the χ^2 statistic for independence models are unavailable in closed form. In any case, only 1.62% and 0.90% of the United States and Chile data were missing, respectively.

Statistical Analysis Procedures

Model estimation. Data analyses were conducted with LISREL 8.80 (Jöreskog & Sörbom, 2000)**[AQ: 3]** using the covariance matrix and a maximum likelihood estimation procedure. When evaluating the confirmatory factor analysis (CFA) models several unstandardized factor loadings (i.e., reference indicators) were fixed at 1.0 (denoted in Figure 1 by gray lines) to identify the model and set the factor's metric. These reference indicators were not selected arbitrarily, but instead numerous invariance models were tested to select the items (or first-order factor when testing the second-order factors) that were "most invariant" across the two cultural groups.

Invariance analyses. Although various approaches have been proposed to test for invariance, this study followed the procedures of Byrne and Stewart (2006) for comparing the first- and second-order factor solutions. If the unstandardized factor loadings and intercepts are invariant, the latent factor means across the cultural groups can justifiably be compared. Testing latent factor mean equality should not be conducted if the unit of measurement (i.e., unstandardized factor loadings) and scale origin (i.e., intercepts) differ between groups. Second-order latent factor means should only be compared after establishing first- and second-order factor loading invariance and both item and first-order factor intercept invariance (see Byrne & Stewart, 2006; Chen, Sousa, & West, 2005).

To better understand the invariance results, a brief description of the unstandardized parameter estimates is provided. An invariant unstandardized factor loading indicates parallel regression slopes between the item and first-order factor (or the first-order factor and second-order factor). This implies that the item responses increase by the same number of units as the first-order factor for each cultural group. Item intercept invariance occurs when the cultural groups have the same observed score (i.e., item response) when the factor score is zero. Factors (first- and second-order) with invariant unstandardized factor loadings and intercepts will have identical regression equations, thus factor scores are created in an identical fashion across groups. First-order factor disturbances and item residuals were also tested, although these components do not require invariance to statistically evaluate (e.g., means, correlations, etc.) the cultural groups.

Overall model fit criteria. The statistics employed to evaluate model fit for each cultural group were the minimum fit function χ^2, Comparative Fit Index (CFI), Root Mean Square Error of

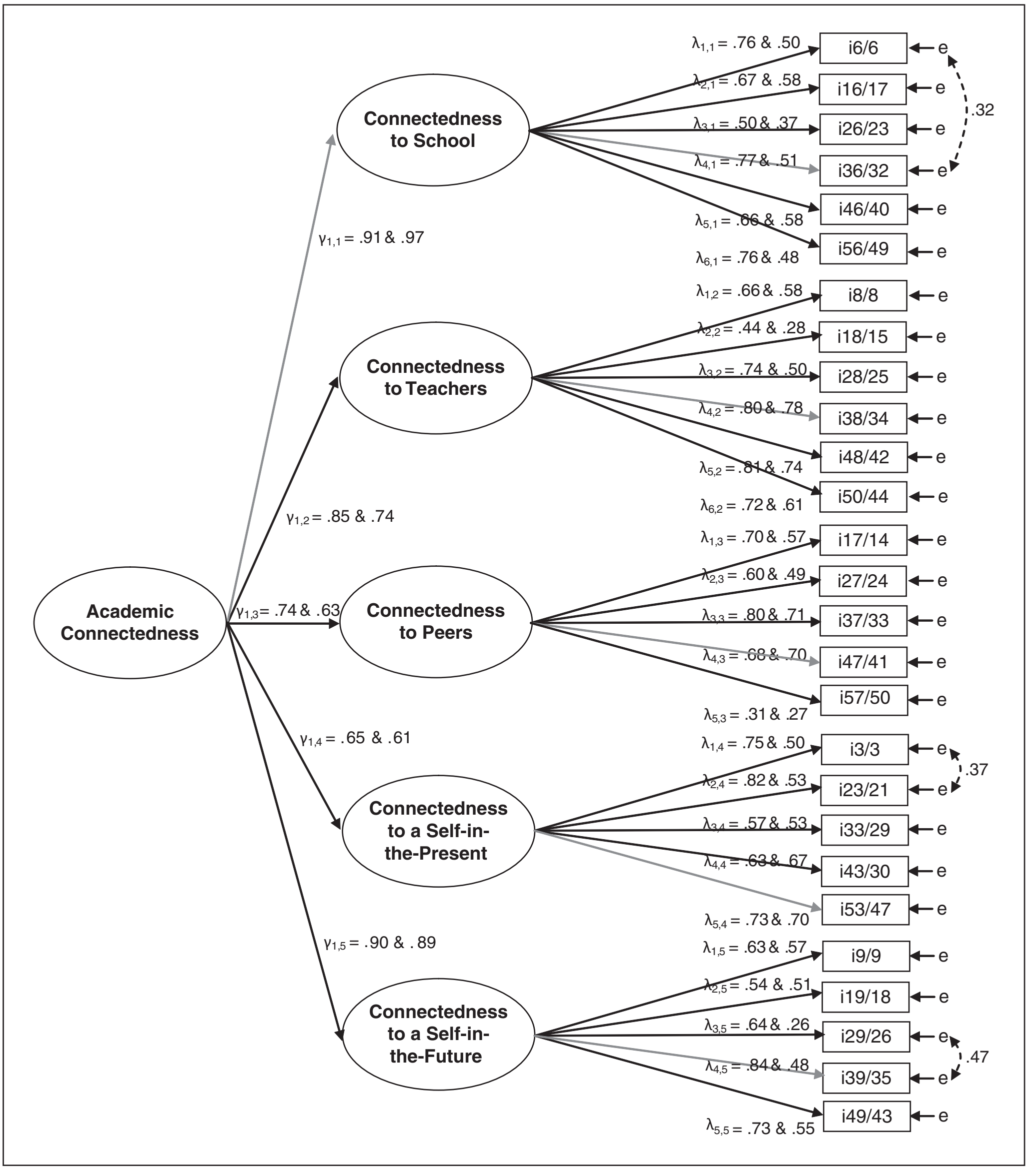

Figure 1. [AQ: 4]
Note: The first- and second-order standardized factor loadings are represented by λ and γ, respectively, and the first parameter estimate always refers to the U.S. sample. The noninvariant model parameters are provided in Table 3 and the correlated residuals (dashed lines) only correspond to the Chilean sample

Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Descriptions of these model fit statistics can be obtained from Hu and Bentler (1999), who defined CFI statistics greater than .90 as an "adequate" model fit and values greater than .95 as a "good" model fit. They also signify fit indexes for RMSEA and SRMR values less than .06 and .08, respectively, as "good" and values between .08 and .10 as "mediocre," respectively.

Invariance model fit criteria. The problems associated with evaluating model fit for invariance models are well documented (see Chen et al., 2005). Although a $\Delta\chi^2$ test allows a statistical comparison between nested models, this test presents several statistical problems (Chen, 2007;

Marsh & Hocevar, 1985). Like the χ^2, the $\Delta\chi^2$ statistic is sensitive to departures from multivariate normality and with complex models and/or large samples, the $\Delta\chi^2$ statistic is nearly always large and statistically significant. Consequently, the results were interpreted from a statistical ($\Delta\chi^2$) and practical (ΔCFI, ΔRMSEA, and ΔSRMR) model fit perspective. Following Chen's (2007) recommendations for practical significance, acceptable invariance model fit was based on the following criteria: ΔCFI ≤ .01, ΔRMSEA ≤ .015, and ΔSRMR ≤ .03 for tests of factor loading invariance and ΔCFI ≤ .01, ΔRMSEA ≤ .015, and ΔSRMR ≤ .01 for tests of intercept and residual invariance.

Results

Factorial Validity

Before conducting tests of invariance, we assessed the factorial validity across United States and Chile samples as it is unknown whether the same factor structure exists across cultures. The estimation method for testing factorial validity and invariance is identical, with the only difference is that the standardized solutions, rather than unstandardized, is evaluated. The proposed model for the U.S. sample revealed a good model fit, $\chi^2(df = 400) = 1320.16$, $p < .0001$, CFI = .960, RMSEA = .071, SRMR = .062, with all the standardized factor loading estimated larger than .30. The one exception was item 55, which possessed a very small estimated standardized factor loading ($\lambda_{US55} = .03$). For the Chile (C) sample, the model fit was noticeably worse, $\chi^2(df = 400) = 2158.68$, $p < .0001$, CFI = 0.889, RMSEA = 0.074, SRMR = 0.069, with five estimated standardized factor loadings smaller than .30 indicating that certain items were noninvariant and contributed a different weight to the factor score. To increase factorial validity for the Chile sample, three items with low factor loadings (i.e., $\lambda_{C7} = .16$, $\lambda_{C12} = .03$, and $\lambda_{C48} = -.17$) were removed, and then the models were retested. Also note, removing λ_{C48} eliminated the single poor U.S. item (i.e., λ_{US55}).

The final 27-item model produced a good fit for the U.S. sample (see Table 2) but mediocre to good fit for the Chile sample, $\chi^2(df = 319) = 1929.65$, $p < .0001$, CFI = 0.900, RMSEA = 0.079, SRMR = 0.069. The modification indices revealed that correlating three residuals (see Figure 1) significantly improved the overall fit (see Table 2). These modifications provided a CFI statistic more comparable to the U.S. sample and produced a better configural model. Overall, the fit statistics and estimated standardized factor loadings provided good evidence of factorial validity for both cultural groups. However standardized factor loadings were consistently smaller for Chiles and the correlated residuals suggested some items shared common variance unrelated to the common factor.

Internal Consistency Reliability

As expected from the CFA (i.e., smaller estimated standardized factor loadings), coefficient alphas were consistently smaller for Chile (C) than the United States (US) sample using the 27-item connectedness scale: School ($\alpha_{US} = .84$ & $\alpha_C = .69$), Teachers ($\alpha_{US} = .83$ & $\alpha_C = .74$), Peers ($\alpha_{US} = .72$ & $\alpha_C = .64$), Self-in-the-Present ($\alpha_{US} = .83$ & $\alpha_C = .75$), and Self-in-the-Future ($\alpha_{US} = .80$ & $\alpha_C = .62$). Thus some of these were adequate but not strong ($\alpha > .70$) for the Chile sample.

Invariance Tests Across Cultures Based on the ΔRMSEA, ΔSRMR, and ΔCFI

Given acceptable model fit statistics for both groups, we tested the configural model (see Table 2), which revealed a good baseline to test the more restrictive invariance models. The first two

Table 2. Model Fit Statistics Across the United States and Chilean Samples

	χ^2	df	$\Delta\chi^2$	Δdf	RMSEA	ΔRMSEA	SRMR	ΔSRMR	CFI	ΔCFI
United States	1130.73	319			.074		.062		.963	
Chile	1360.08	316			.065		.064		.933	
Model 1: Configural	2490.81	635			.068		.064		.951	
Model 2: First-order factor loadings	2635.61	657	*144.79	22	.069	.001	.071	.007	.948	−.003
Model 3: Second-order factor loadings	2641.68	661	6.07	4	.069	.000	.072	.001	.948	.000
Model 4: Item intercepts	3659.92	683	*1018.25	22	.085	.016	.077	.005	.921	−.026
Model 5: First-order factor intercepts	3886.62	688	*226.69	5	.087	.002	.073	−.004	.915	−.006
Model 6: First-order factor disturbances	3928.26	693	*41.64	5	.087	.000	.074	.002	.914	−.001
Model 7: Item residual	4887.71	720	*959.46	27	.092	.004	.082	.008	.890	−.025

Note: $\Delta\chi^2$ values marked with an * were statistically significant for the invariance models after the Bonferroni adjustment (.05/*df*).

invariance models tested equality of first- and second-order unstandardized factor loadings across cultural groups (Models 2 and 3). Practical model fit indices revealed the ΔRMSEA, ΔSRMR, and ΔCFI were always less than .01, thus the first- and second-order factor loadings (or regression slopes) were equivalent across cultural groups (see Table 2). The first-order factor intercepts appeared invariant, although evidence of item intercept invariance was not obtained (see Model 4). In summary, the first-order factors were noninvariant because of the item intercepts, and thus the invariance of the second-order factor (Academic Connectedness) was not interpreted. Although of limited interest, the first-order factor disturbances and residuals were also investigated (see Table 2).

Invariance Tests Across Cultures From a Traditional (or Statistical) Perspective

To increase our understanding of model invariance misfit, additional analyses following the protocol of Byrne and Stewart (2006) were conducted to identify those parameter estimates with a statistically significant $\Delta\chi^2$. Following the sequence of invariance models tested above (i.e., starting with Model 2 and ending with Model 5), the parameter estimates with the largest modification index was identified and then relaxed (i.e., not set as invariant across groups) until no $\Delta\chi^2$ were statistically significant for each invariance model.

Analyses revealed that 5 of the 27 total first-order unstandardized factor loadings were noninvariant across cultural groups (see Table 3). The School and Teacher factors occupied two noninvariant items, each with one on the Self-in-the-Future factor. The largest $\Delta\chi^2$ statistics were for items "I want to be respected by my teachers" (Item 28/25) and "Doing well in school will help me in the future" (Item 19/18). The other three items, although statistically significant, reflected much smaller differences. As expected based on the practical model fit statistics, there were few statistically significant differences on the second-order factors.

There were many more item intercept differences. As seen in Table 3, item intercepts of greatest concern were 50/44 ("I usually like my teachers"), 26/23 ("I get bored in school"), and 56/49 ("Doing well in school is important to me"). For Item 50/44, the U.S. students' possessed a higher intercept than the Chile sample, whereas Chileans displayed a higher intercepts for the two school connectedness items (i.e., 26/23 & 56/49). In all, three of the five school connectedness item intercepts were noninvariant across the cultural groups and four of the five Self-in-the-Future items intercepts were not invariant. Overall, on average, Chileans had most of the of higher item intercepts (7 out of 11, see Table 3); of course, higher item intercepts do not necessarily imply higher factor scores as the loadings and intercepts must be interpreted in tandem.

Supplemental U.S. Invariance Analyses

Recall that the U.S. samples were heterogeneous (see Table 1), thus variation within these samples could have artificially influenced the invariance results across the United States and Chile samples. To partially eliminate confounding effects created by heterogeneity, invariance analyses were conducted between these samples. CFAs across the three independent U.S. samples revealed a good model fit using the 27-item version, along with an acceptable configural model fit (see Table 4). Most importantly, the first-order factor loadings (Model 2) and item intercepts (Model 4) were invariant from both a statistical and practical perspective. This means that the first-order factor loading and item intercept differences between the United States and Chile samples were not due to heterogeneity of the U.S. sample.

An investigation of the second-order results revealed invariant second-order factor loadings, but noninvariant first-order factor intercepts from a statistical perspective. However, invariance

Table 3. Noninvariant Items Based on the $\Delta\chi^2$ for the First- and Second-Order Factors

Parameter	Item/factor	Unstandardized estimates			$\Delta\chi^2$
		United States	Chile	Diff	
First-order factor loading	28/25	0.93	0.60	0.33	29.97
	19/18	0.49	0.89	–0.40	29.06
	46/40	0.95	1.14	–0.19	14.07
	18/15	0.60	0.55	0.05	12.52
	16/17	1.04	1.28	–0.24	11.49
Second-order factor loading	Teacher	0.80	0.99	–0.19	12.29
Item intercept	50/44	0.35	–0.41	0.76	249.02
	26/23	–0.24	0.91	–1.15	165.92
	56/49	0.78	1.55	–0.77	157.21
	49/43	0.55	1.15	–0.60	75.69
	9/9	1.77	2.12	–0.35	68.80
	33/37	0.91	1.31	–0.40	50.93
	28/25	0.41	2.08	–1.67	50.09
	6/6	–0.05	0.30	–0.35	37.37
	29/26	0.73	0.34	0.39	28.25
	19/18	2.62	1.42	1.20	23.88
	17/14	–0.78	–1.12	0.34	18.50
First-order intercept	School	3.81	3.11	0.70	41.03
	Self-in-the-present	3.89	3.53	0.36	63.43
	Peers	3.76	3.37	0.39	40.53
	Teacher	4.01	3.65	0.36	29.81
	Self-in-the-future	3.77	2.99	0.78	45.45

Note: Diff represents the difference between unstandardized parameter estimates (i.e., factor loadings or intercepts). All parameter estimates were significantly different from each other after a Bonferroni adjustment (.05/*df*) based on the $\Delta\chi^2$ with 1 *df*. The first and second item number corresponds to the English and Chilean items, respectively.

was obtained from a practical standpoint. These results were of less interest given the noninvariance between United States and Chile students.

Discussion

This study assessed whether researchers and evaluators can justify cross-cultural comparisons on subscales of academic connectedness, such as school connectedness, using the Hemingway measure of academic connectedness. Analyses revealed that three of the five factors were noninvariant from a statistical perceptive. Therefore, some differences, whether due to culture, measurement, intra-sample variation, or response style, probably exist between the United States and Chile. One could argue that the Teacher factor is reasonably invariant from a practical perspective, but the connectedness to school and self-in-the-future factors are not. The connectedness to Peers and Self-in-the-Present subscales, which do appear invariant across cultural groups, are therefore the most appropriate scales for making cross-cultural mean comparisons. To be sure, future researcher should conduct invariance analyses as well to ensure statistical comparisons are appropriate. Future research is also necessary to better understand whether these differences are due to dissimilar educational systems, translation errors, cultural variation, socioeconomic status, or other factors.

Despite the potential noninvariance of three subscales, the factorial validity is promising, which indicates that all five subscales are appropriate for use with Chile samples (even though the estimated

Table 4. Model Fit Statistics Across the United States

	χ^2	*df*	$\Delta\chi^2$	Δdf	RMSEA	ΔRMSEA	SRMR	ΔSRMR	CFI	ΔCFI
Sample1	701.47	319			.083		.081		.945	
Sample2	790.44	319			.096		.093		.923	
Sample3	558.54	319			.065		.077		.950	
Model 1: Configural	2282.36	957			.092		.093		.931	
Model 2: First-order factor loadings	2332.32	1001	49.96	44	.090	–.002	.092	–.002	.931	.000
Model 3: Second-order factor loadings	2339.51	1009	7.19	8	.090	.000	.092	.000	.931	.000
Model 4: Item intercepts	2357.02	1053	17.51	44	.087	–.003	.098	.006	.927	–.004
Model 5: First-order factor intercepts	2477.53	1061	*120.51	8	.089	.002	.088	–.010	.921	–.006
Model 6: First-order factor disturbances	2502.62	1071	*25.09	10	.089	.000	.088	.000	.920	–.001
Model 7: Item residual	2821.47	1125	*318.86	54	.093	.003	.100	.011	.905	–.015

Note: $\Delta\chi^2$ values marked with an * were statistically significant for the invariance models after the Bonferroni adjustment (.05/*df*).

standardized factor loadings and the internal consistency estimates are weaker than the U.S. sample). These findings are somewhat to be expected given the Hemingway was developed and validated for use within the United States, and may not consider connectedness components deemed important in other countries. Consequently, future research should identify components that better captures important academic connectedness components in Chile.

Three items were removed that did not significantly correlate to the common factors for Chile students. This suggests that these items were also likely noninvariant ("My classmates often bother me," "There is not much that is unique or special about me," & "What I do now will not affect my future," although this last item is not used in the standard scoring in the United States either). Given that several bilingual experts confirmed the face validity of the translation from English and Mexican American to Chilean, these differences are probably due to cultural, socio-economic differences, or other reasons. Interestingly, these are three of the five negatively worded items, which have also been problematic with U.S. samples (Karcher & Sass, 2010). It may suggest that Chileans are even less comfortable with such negatively worded items (or engage more in patterned responding) than U.S. students. This is consistent with research in the United States in which the item intercepts for ethnic minority and majority youth also differed on several negatively worded items.

Overall, fewer first-order factor loadings (18.5%) were noninvariant than item intercepts (40.7%). Fortunately, the invariance literature presents less concern for intercept than factor loading noninvariance (Byrne & Stewart, 2006; Cooke, Kosson, & Michie, 2001), because noninvariant factor loadings suggest that the item importance differs between the groups, whereas noninvariant item intercepts indicate that one group responds to an item at a higher level (i.e., higher item mean) when the factor score is zero. However, the intercepts tend to have the larger impact on the latent factor means (Schmitt & Kuljanin, 2008), although this depends on the type of invariance (uniform vs. nonuniform), thereby making between-group comparisons more dubious for factors or subscales with noninvariant items. Due to space limitations, not all the statistically significant nonvariant items can be discussed. Instead, space limitations allow our discussion of only a few items.

The largest difference ($\Delta\chi^2$) was the item "I usually like my teachers" (Item 50/44), which displayed noninvariant intercepts *but* invariant factor loading. This indicates an equal relationship between the item response and the teacher connectedness factor between the groups, but U.S. students had higher average item responses across the latent factor continuum. Thus, holding the teacher factor constant U.S. students liked their teacher more than Chileans. Note, this is the only item that measures how much students like their teachers (affect), whereas the other items measure students' efforts related to earning trust and getting along with their teachers. One, "I want to be respected by my teachers," possessed smaller unstandardized factor loading for Chile students, which suggests that being respected by one's teacher made a smaller contribution to the teacher connectedness factor for Chile students. However, Chile students revealed a much higher intercept on this item than U.S. students. This implies that at a latent factor score of zero (average factor score) being respected by their teacher is more important for Chile than U.S. students. This underscores why the factor loadings and intercepts should be interpreted in tandem.

Regardless of the cause of noninvariance for several subscales, administrators and researchers have several options for addressing the issues (Cheung & Rensvold, 1999; Millsap & Kwok, 2004). They can (a) delete the noninvariant items, (b) use all the items, assuming that differences are small in the population and will not adversely influence the results, (c) avoid using the scales all together, (d) use the scores, but interpret the results independently and avoid group comparisons, and/or (e) use a partial invariance model. Users are encouraged to employ several methods to assess consistency across procedures. For example, if the results are similar for the full and partial invariance models this provides some evidence of not only result stability, but the lack of invariance may not be too detrimental. Dropping an item or using the partial invariance model may be appropriate for the Connectedness to Teachers scale; yet this approach may be insufficient to allow cross-cultural group comparisons on School and Self-in-the-Future factors.

Limitations and Future Research

Despite the interesting and at times promising results, several limitations and areas of future research should be addressed. This study does not provide strong empirical evidence for why the subscales are not always invariant. One potential explanation, which is also a limitation, is that the items were given in a slightly different order for the English and Chilean version. This is important considering that the response to one item may influence the response to another item. Future research might replicate this study after the items have been arranged in a complementary order. Future research should also consider revising the Hemingway slightly to increase its cultural sensitivity. Based on the factorial validity and reliability evidence provided here, items that make strong contributions to the five academic connectedness factors should be retained and additional items added to increase the overall psychometric properties across cultures.

Another limitation is that only data from schools in or near Santiago were collected, and therefore results may not generalize to other regions of Chile. A next step in measurement development and validation is to test for measurement invariance across different school structures and cultures within Chile. In addition, only five Hemingway subscales were evaluated, so whether Chile and U.S. students differ on other connectedness factors remains unknown.

Conclusions

Results indicate that only the Peer and Self-in-the-Present scales are invariant and conceptualized similarly across cultures, and therefore are appropriate for use in statistical comparisons both between cultural groups. The connectedness to school, teachers, and self-in-the-future factors were noninvariant across groups from a statistical perspective, although a reasonable argument can be made that the connectedness to teachers subscale demonstrates invariance. Nevertheless, statistical comparisons between groups on this subscale should be interpreted with some degree of caution. Nor should researchers make cultural comparisons using the second-order factor of Academic Connectedness.

These findings underscore the importance of research related to measurement invariance across cultures. Figuratively speaking, as the world becomes smaller, more universal measures are needed to allow cross-cultural and international studies that assess human behavior and psychological traits. Researchers should first test for measurement invariance across cultures, as without this statistical conclusions between cultures may lead to invalid conclusions. Perhaps more importantly, studies such as these demonstrate how different cultures experience factors associated with academic connectedness both at the item and factor level.

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Bios

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