High School Male and Female Learning-Style Similarities and Differences in Diverse Nations

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ABSTRACT **The authors investigated gender differences among the learning styles of 1,637 adolescents from 5 countries—Bermuda, Brunei, Hungary, Sweden, and New Zealand. Statistical analyses included a multivariate analysis of variance with 22 dependent variables (learning-style elements) and 2 between-subjects variables (gender and country) and a discriminant analysis. The alpha level was established at the $p < .05$ level. There were significant main effects for gender with medium effect sizes and statistically significant and large effect sizes for country main effects. There also were statistically significant and medium effect sizes for the interactions of country by gender. On the basis of these findings, the authors maintain that gender-based patterns of differences in learning styles are observable, and they encourage educators to consider all learners' learning-style strengths to maximize instructional outcomes.**

Key words: gender differences, international research, learning styles

Exploratory studies of adolescents in Grades 7–12, in nations as diverse as Bermuda, Brazil, Brunei, Hungary, New Zealand, the Philippines, Sweden, and the United States, have revealed that, in several ways, adolescent males' and adolescent females' learning styles differ. Those differences became particularly interesting when we examined gender differences across nations.

Pioneering research has documented that gender is one of six characteristics that tends to differentiate among individuals' learning styles (DePaula, 2002; Dunn, Thies, & Honigsfeld, 2001; Hlawaty, 2002; Honigsfeld, 2000, 2001; Pengiran-Jadid, 1998; Ponder, 1990). Other differentiating variables include academic achievement (Calvano, 1985; DePaula; Hlawaty; Honigsfeld, 2000, 2001; McCabe, 1992; Pengiran-Jadid; Yong & McIntyre, 1992; Young, 1985), age (DePaula; Dunn & Griggs, 1995; Hlawaty; Honigsfeld, 2001; Price, 1980), global versus analytic processing styles (Cody, 1983; Dunn, Bruno, Sklar, & Beaudry, 1990; Dunn, Cavanaugh, Eberle, & Zenhausern, 1982), creativity domains (Honigsfeld, 2000; Ingham, Ponce Meza, & Price, 1998; Milgram, Dunn, & Price, 1993; Pengiran-Jadid; Ponce Meza, 1997), and culture (Dunn & Griggs; Milgram et al., 1993).

Context and Purpose of the Study

This article is an outgrowth of a large-scale focus on adolescents' learning-style characteristics in diverse nations (DePaula, 2002; Dunn & Griggs, 1995; Hlawaty, 2002; Honigsfeld, 2000, 2001; Milgram et al., 1993; Pengiran-Jadid, 1998). In each study, age, academic achievement level, gender, and country were used as dependent variables. This research investigated further overall gender differences and country-specific gender variances of learning styles that existed among the participating adolescents. Our purpose was to identify general tendencies of learning-style differences as well as unique variations that might have existed between boys and girls in various nations. The following questions were explored:

1. Are there significant main effects for gender and nationality?
2. Are there significant interactions between gender and nationality?
3. Are there significant country-specific differences in learning styles by gender?

Literature Background on Learning-Style Differences by Gender

Early research conducted with U.S. and international student populations indicated that boys and girls often had distinct environmental, emotional, sociological, physiological, and perceptual learning-style attributes. In the following section, we focused our literature review on studies that shared the same conceptual framework—the Dunn and Dunn

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Learning Styles Model—and used identification instruments that reflected the same variables, such as the Learning Style Inventory (LSI; Dunn, Dunn, & Price, 1975, 1978, 1979, 1984, 1985, 1987, 1989, 1990, 1996) or the Productivity Environmental Preference Survey (PEPS; Dunn, Dunn, & Price, 1979, 1981, 1982, 1989, 1990, 1991, 1993, 1996), depending on the age of the participants. Instead of detailed information about the sample, research methodology, and statistical findings of each study, we herein provide tendencies and overall patterns as summarized in Table 1.

Male students tended to be more visual (Mariash, 1983), tactual, or kinesthetic, whereas female students tended to be more auditory (Dunn, 1996). On the one hand, female students were consistently more conforming, authority oriented, and parent motivated or self-motivated than their male classmates were. On the other hand, more than 20 years ago, U.S. male students were more teacher motivated and preferred to work alone (Marcus, 1979). Yong and McIntyre (1992) confirmed that an informal classroom environment that encouraged active learning and mobility appealed more

TABLE 1. Summary of Learning-Style Differences Between Boys and Girls

Researcher (year)	Male preferences	Female preferences
Hong & Suh (1995)	Peer motivation	Persistence Self-motivation Teacher motivation
Honigsfeld (2001)	Kinesthetic Peer motivation	Self- and parent motivation Teacher motivation Persistence Responsibility (conformity) Variety
Jenkins (1991)	Kinesthetic	Motivation Persistence Structure Authority orientation
Jorge (1990)	Structure Tactual	Learning in several ways
Lam-Phoon (1986)	Sound Intake Warm temperatures Patterns and routines Learning with peers	Quiet No intake Cool temperatures Variety Learning alone
Lo (1994)	Late afternoon	Persistence Responsibility (conformity) Self-motivation
Marcus (1979)	Teacher motivation Learning alone	Responsibility (conformity) Parent or self-motivation
Mariash (1983)	Visual Tactual Kinesthetic Formal design Structure	Auditory Persistence Responsibility (conformity)
Pengiran-Jadid (1998)	Kinesthetic Peer motivation	Motivation Persistence Structure Authority orientation
Pizzo et al. (1990)	Sound	Quiet
Roberts (1984)	Tactual Adult motivation	Learning alone Morning Kinesthetic
Yong (1991)	Tactual Intake	
Yong & McIntyre (1992)	Informal Design Mobility	Formal design No mobility

to male students than to female students. In addition, Pizzo, Dunn, and Dunn (1990) found that female students needed significantly more quiet than did male students when learning new and difficult information.

Jenkins (1991) and Pengiran-Jadid (1998) substantiated that girls' preferences were significantly different from boys' preferences in the areas of motivation, persistence, structure, authority orientation, and the kinesthetic modality. Boys also had stronger tendencies toward being peer oriented (Pengiran-Jadid) and toward learning in the morning (Lam-Phoon, 1986). Girls in Korea, the United States (Hong & Suh, 1995), and Taiwan (Lo, 1994) indicated high levels of self-motivation as well as persistence, the latter of which was reported also by female Cree students in Canada (Mariash, 1983). Mariash also found that male Cree students expressed stronger preferences for formal seating design, structure, and the visual modality, and weaker preferences for mobility and responsibility than female Cree students did.

In Jorge's (1990) study, intriguing gender differences emerged in seventh and eighth grades. On the one hand, seventh-grade girls and eighth-grade boys shared preferences for early morning and learning alone. On the other hand, seventh-grade boys and eighth-grade girls were strongly peer oriented. However, regardless of grade level, boys consistently needed more structure and more tactual learning of new and difficult subject matter content than did girls, who preferred significantly more variety than just tactual resources.

International researchers found gender-specific learning-style patterns regardless of cultural background. Roberts (1984) analyzed temperament types and learning-style preferences of high school students in Jamaica and the Bahamas. Regardless of cultural background, girls were more kinesthetic, were less tactile and less adult motivated, needed more intake, and had a stronger preference for learning alone and in the morning than their male peers.

Lam-Phoon (1986), who identified the learning-styles preferences of Asian students in a sample of Singapore and Caucasian undergraduates in Michigan, reported that regardless of cultural background, men revealed a higher preference than did women for sound, intake, warm temperatures, patterns and routines rather than variety, and learning with peers. Male students also appeared to be more conforming and more persistent than their female counterparts. Caucasian men, compared with Asian men, had stronger preferences for warmth, conformity, persistence, and intake; they indicated lesser preferences for auditory and visual learning. When Lam-Phoon compared Caucasian women and Asian women, she described Caucasian women as more conforming than Asian women and as having strong preferences for warmth, mobility, intake, and morning learning. Similar to their male classmates, Asian women had a stronger preference for auditory and visual learning than Caucasian women had.

Lo (1994) investigated the learning-style differences among Taiwanese students and found significant main effects for gender, grade, and academic group differences. Female students were more persistent, responsible, and self-motivated than were male students. Boys preferred learning in the late morning more frequently than did girls. Significant gender differences also were detected by Hong and Suh (1995) when they compared the learning-style preferences of first-generation Korean American students versus Korean students residing in Korea. Regardless of cultural background, female students were more self-motivated, teacher-motivated, and persistent than were male students.

In summary, Table 1 represents an overview of the patterns that emerged between the two genders across early studies. Nevertheless, we caution readers to recognize that although strong and consistent tendencies were reported, learning style is the way in which "each learner begins to concentrate on, process, and retain new and difficult academic material" (Dunn & Dunn, 1993, p. 3). Therefore, group tendencies do not represent individuals' learning needs.

It is important to acknowledge that Dunn and Griggs (1995) described how learning-style preferences change over time—more or less rapidly, depending on age and the strength of each specific preference. Adding another dimension, Thies (1999/2000) analyzed the Dunns' learning-style construct from a neuropsychological perspective and postulated that style is related directly to each individual's biology. Therefore, we encourage researchers to conduct longitudinal studies to uncover systematic changes among learning-style preferences by academic achievement, age, culture, gender, or nation to determine the extent to which biology influences how each person learns.

Method

Population and Sample

Participants in this investigation were between 231 and 422 students from Bermuda (n = 231, boys = 127, girls = 104), Brunei (n = 406, boys = 186, girls = 220), Hungary (n = 384, boys = 167, girls = 217), New Zealand (n = 306, boys = 160, girls = 146), and Sweden (n = 422, boys = 217, girls = 205), with an overall sample of 1,749 representing a total population of 13,215. Boys and girls participated in approximately even numbers. Students attended Grades 7 through 13, depending on the local school system in their country of residence. Valid LSIs (Dunn, Dunn, & Price, 1996) with consistency scores of 70 or above were received from 1,637 students who constituted the final sample for this investigation.

In every nation except Brunei, we sampled from typical middle-class schools. In Brunei, in which extremely different types of schools exist by government design, Pengiran-Jadid (1998) selected an equal number of high- and low-socioeconomic schools. Aggregation of the data provided a

cross-section of the student population. Conventional (Schools 5 and 6) and elite secondary schools (School 7) represented academic differences. The elite secondary institution served as a preuniversity center on the basis of preselection of the highest achieving students in the nation.

In Bermuda, the four participating institutions included one private school (School 1) and three government schools (Schools 2, 3, 4). Although some teachers in two of the government schools (Schools 3 and 4) were familiar with learning-style-based instructional methodologies, at the time of the data collection, each of these schools was considered traditional in both instruction and evaluation strategies (D. Lister, personal communication, July 18, 2000).

In Hungary, the six participating groups included two upper primary schools (Schools 8 and 9); the former serviced highly achieving upper primary students and the latter was a general education upper primary school. Also included were four secondary schools; one was a high-achieving model high school (School 10), one was a drama and performing arts high school (School 11), one was a music high school (School 12), and the fourth school was a secondary vocational school (School 13). The two participating schools in New Zealand were public secondary schools. One of these schools (School 14) was the largest school in its region and offered a great diversity of courses, whereas the other (School 15) was a low-performing rural school. In Sweden, all four participating schools were municipal (public) schools. Two schools were compulsory schools (Schools 16 and 17), whereas the other schools (Schools 18 and 19) were upper secondary schools. Table 2 provides further data on the population and sample used for this study.

Instrumentation

The English or appropriate foreign language (Hungarian, Malay, and Swedish) versions of the LSI (Dunn, Dunn, & Price, 1996) for Grades 5–12 identified the learning-style preferences of participants in 22 areas with the following subscales: Sound, Light, Temperature, Design, Self-Motivation, Persistence, Responsibility, Structure, Alone/Peers; Authority Figures, Several Ways, Auditory, Visual, Tactual, Kinesthetic, Intake (the need for food or drink); and Morning Versus Evening, Late Morning, Afternoon, Mobility, Parent Motivation, and Teacher Motivation. We selected the LSI because it had both high reliability and face and construct validity (Kirby, 1979; Miller & Edgar, 1994). Among nine different instruments that measured learning styles, researchers rated the LSI as having good or better validity and reliability than the others (Curry, 1987; DeBello, 1990; Tendy & Geiser, 1998–1999). In 1997, Price and Dunn found that 95% (21 out of the 22) of Hoyt's reliabilities are greater than .60, with one learning-style subscale (Late Morning) being at only .56.

We also studied the instrument's psychometric properties for each of the five countries' subsamples. With the exception of the Swedish sample, the overall findings indicated that no less than 90% of the reliabilities for each subsample were .60 or above. For the Brunei and New Zealand subsamples, 100% of the subscales were .60 or above. For the

TABLE 2. Population and Sample Sizes by Country, School, and Geographic Location

School	Country	Geographic location and description	Total school population	Participants (*n*)
1 (private)	Bermuda	Southampton (N/A)	500	69
2 (public)	Bermuda	Devonshire (N/A)	900	33
3 (public)	Bermuda	Somerset (N/A)	260	52
4 (public)	Bermuda	Somerset (N/A)	270	77
5 (public)	Brunei	Bandar Seri Begawan (urban + rural)	1,005	175
6 (public)	Brunei	Bandar Seri Begawan (urban)	950	153
7 (public)	Brunei	Bandar Seri Begawan (urban)	1,240	78
8 (public)	Hungary	Debrecen (urban)	700	58
9 (public)	Hungary	Debrecen (urban)	845	65
10 (public)	Hungary	Debrecen (urban)	195	68
11 (public)	Hungary	Debrecen (urban)	700	44
12 (public)	Hungary	Debrecen (urban)	755	67
13 (public)	Hungary	Debrecen (suburban)	735	81
14 (public)	New Zealand	Wanganui (urban)	1,345	221
15 (public)	New Zealand	Taihape (rural)	215	85
16 (public)	Sweden	Älvsbyn (rural)	800	146
17 (public)	Sweden	Arvidsjaur (rural)	800	120
18 (public)	Sweden	Arvidsjaur (rural)	500	121
19 (public)	Sweden	Solna (urban)	500	35

Bermuda subsample, all reliabilities ranged from .63 to .83, with the exceptions of the subscales for Late Morning (.43) and Several Ways (.59). Reliabilities for the Brunei subsample ranged from .68 to .95, the strongest, on average, of the five subsamples.

For the Hungarian subsample, the subscale Late Morning (.59) had the lowest reliability; all others ranged between .60 and .91. New Zealand subsample reliabilities ranged from .68 to .92. Finally, most Swedish reliabilities ranged from .66 to .92, with the exception of the Temperature (0.05), Design (–.14), and Teacher Motivation subscales (.57). An item-by-item analysis of the subscales of Temperature and Design for the Swedish subsample revealed potential problems with 3 items on the 104-item questionnaire. Of the 5 items that were related to the learning-style element of Temperature, when 1 item with no variability was removed, the reliability on the remaining 4 items became .56. We reanalyzed the reliability for the items related to design as well and discovered a potential problem with the translation of the words "formal and informal design" from the original LSI. When the problematic items were removed, reliability increased to .67 for the Design subscale. This item-by-item analysis alerted us to a potential limitation of the use of the data regarding the elements of temperature and design. Thus, significant findings related to these two elements should be evaluated with caution. In addition, the analysis established the need to revise the Swedish translation for these selected items and to run further reliability tests with other Swedish samples.

We also examined the reliabilities for consistently high values across the five subsamples and found that the reliabilities ranged highest for the following three subscales: Learning Alone/Peers (.83–.92), Intake (.81–.94), and Mobility (.74–.92). The three subscales for time-of-day preference (Morning Versus Evening, Late Morning, and Afternoon) caused us to suspect that the subscale for Late Morning might not have provided conclusive data because of the lower reliabilities for two of the five subsamples. Therefore, it seems prudent that researchers should evaluate the learning-style element time-of-day preference according to the other related subscales.

Procedures

Consent procedures. We collected data from Bermuda, New Zealand, Sweden, and Hungary during fall 1999 and winter and spring 2000. We also incorporated previously collected data sets from Brunei and Hungary (1997 and 1998, respectively) into this research. For the current data collection, we received permission from school principals and administrators responsible for each selected institution. Each study was subjected to official Institutional Review Board protocol at St. John's University, Jamaica, New York, where the committee agreed that the data collection procedures complied with Title 45 CFR Part 46. In schools where the LSI was not administered routinely, parental consent was obtained from potential participants. Hungary—where schools act in loco parentis in education matters—was the only country where permission was granted by school administrators. In addition, all students were given the option to withdraw from participation at any time during or after data collection. In the Bermuda schools, in which administering the LSI was a routine annual process involving normal educational practices and a procedure for which parental consent normally was not required, parents received a letter describing the research. The statement indicated that the data the school routinely collected about their children would be used for research purposes. Parents were advised that they could withdraw the learning-style information about their children from the data collection. None chose to do so.

Data collection procedures. To control for extraneous variables during data collection, we gave identical written directions to each LSI administrator concerning how to introduce the Dunn and Dunn Learning-Styles Model and how to administer the LSI. Each student self-reported his or her gender and age on the questionnaire. Completed LSIs were processed by the publisher, Price Systems, in Kansas. As a benefit of participating in the study, each participant received an individual learning-style profile and homework prescription responsive to his or her self-reported learning-style characteristics and strengths. School administrators and teachers who assisted in the data collection received an information packet on learning-style-responsive instructional strategies.

Statistical procedures. We conducted three types of statistical procedures. We administered a multivariate analysis of variance (MANOVA) with 22 dependent variables (learning-style elements) and 2 between-subjects variables (gender and country) using the general linear model approach. The purpose of this procedure was to determine main effects of, and interaction effects between, the 2 variables. The MANOVA was followed by simple main-effect tests to investigate gender differences within each country, a series of univariate analyses of variance, and post hoc comparisons.

In the two-way MANOVA, the variables were country (Bermuda, Brunei, Hungary, New Zealand, and Sweden) and gender (boy, girl) with the levels indicated in parentheses. We tested for gender and country main effects and gender by country interactions. We evaluated gender main effects for each subscale (learning-style variable). We also conducted a discriminant analysis based on gender in addition to the factorial MANOVA design.

Results

Main Effects and Interactions

To investigate whether there would be main effects for gender differences, main effects for country differences, and interaction effects for gender by country, we performed a MANOVA. The results of the MANOVA are shown in Table 3. There were significant main effects for gender, with

TABLE 3. Main Effects and Interaction Effects for Gender, Country, and Gender by Country, for Adolescents' Learning-Style Preferences

Effect	Wilks's lambda	*F*	Hypothesis (*df*)	Error (*df*)	Effect size η^2
Gender	.921	6.272*	22	1,606.000	.079
Country	.178	39.457*	88	6,353.055	.350
Gender by country	.893	2.103*	88	6,353.055	.028

*$p < .05$.

medium effect sizes (Cohen, 1988). There were statistically significant and large effect sizes for country main effects, and there were statistically significant and medium effect sizes for the interactions of country by gender. Two univariate procedures and post hoc comparisons were used for follow-up.

The first set of univariate procedures that we used to test for gender differences revealed significant *F* values for nine subscales (learning-style variables) with moderate to small effect sizes (see Table 4 and Figure 1). On the basis of these findings, we concluded that when compared with female students, male students, on the one hand, tended to prefer more peer interaction rather than learning alone and more kinesthetic activities. On the other hand, female students on average needed higher temperatures and more social variety of learning, and they were more self-motivated, parent motivated, and teacher motivated; more persistent; and more responsible or conforming.

The second set of univariate tests that we used to examine country differences identified significant *F* values for 21 out of the 22 learning-style variables, with moderate to large effect sizes (see Table 5), indicating that when adolescents' learning styles were compared by country, significant and more substantial differences emerged for all learning-style variables except for auditory perceptual strength. The findings related to temperature and design should be evaluated with reservations because of the Swedish reliability values.

The gender by country interaction effects examined for each of the 22 variables revealed *F* values significant at the $p < .05$ level for 8 learning-style variables with small effect sizes: sound level, $F(4, 1{,}627) = 4.057$, $\eta^2 = .010$; light, $F(4, 1{,}627) = 2.946$, $\eta^2 = .007$; persistence, $F(4, 1{,}627) = 3.969$, $\eta^2 = .010$; responsibility, $F(4, 1{,}627) = 2.424$, $\eta^2 = .006$; authority figure, $F(4, 1{,}627) = 2.684$, $\eta^2 = .007$; kinesthetic, $F(4, 1{,}627) = 3.149$, $\eta^2 = .008$; late morning, $F(4, 1{,}627) = 2.530$, $\eta^2 = .006$; afternoon, $F(4, 1{,}627) = 2.828$, $\eta^2 = .007$. Post hoc follow-up results are available to interested readers.

Simple Main Effects

As a follow-up to the main effect and interaction procedures, we conducted tests of simple main effects for country and gender to identify the differences within the levels of the other variable (see Table 6). The purpose of these analyses was to detect contrast within levels of the two variables. The first set of simple main effects tests contrasted countries within each gender, whereas the second set of simple main-effects tests examined gender differences within each country (Maxwell & Delaney, 1990). All simple main effects were significant at the $p < .05$ level. The country simple effects within the two levels of gender had medium effect sizes, whereas the gender simple effect within the five country levels had small effect sizes.

Post hoc tests confirmed that there were larger country differences between the two genders than there were gender differences among the five countries. Because of the focus of this article, we combined the findings related to gender differences among the five countries in a summary table (see Table 7). In this table, all 22 learning-style variables, all five countries, and both genders are represented. To avoid redundancy, the plus (+) sign indicates that boys have a statistically higher value for a particular learning-style element in a particular country, and a minus (–) sign indicates that boys have a statistically lower value for a given element. A blank space for any given element and country implies no significant differences between preferences for boys and girls. Thus, male Bermuda students tended to be more tactual, kinesthetic, and peer oriented, whereas female Bermuda students tended to be more self-motivated, teacher motivated, and persistent. Male Brunei students tended to have more energy in the late morning, whereas female Brunei students tended to be more parent motivated and auditory, preferred more variety, and felt more energetic in the afternoon.

Male Hungarian students needed more background sound, whereas female Hungarian students tended to be more self-motivated, teacher motivated, persistent, responsible (conforming), and authority-figure oriented. Female students in Hungary also preferred to learn in many more varied ways than did their male counterparts. On average, male New Zealand adolescents preferred kinesthetic experiences. In comparison, female New Zealand adolescents needed brighter illumination, preferred warmer temperatures, were more responsible (conforming), and enjoyed learning through a variety of ways more than their male

TABLE 4. Male and Female Adolescents' Learning-Style Preferences

Learning-style subscale	Male (n = 789) M	Male (n = 789) SD	Female (n = 848) M	Female (n = 848) SD	F (df = 1, 1,627)	Effect size η^2
Temperature	15.03	4.24	15.36	4.50	6.567*	.004
Motivation	30.99	4.34	32.19	4.03	30.744*	.019
Persistence	16.23	2.84	16.86	2.92	28.537*	.017
Responsibility	13.15	3.32	14.13	3.20	36.278*	.022
Alone versus peers	21.11	6.96	20.31	6.34	6.397*	.004
Learn several ways	12.20	3.70	12.76	3.61	10.468*	.006
Kinesthetic	25.69	4.02	25.20	4.08	9.496*	.006
Parent motivated	17.48	2.26	17.79	2.25	4.338*	.003
Teacher motivated	19.37	3.05	20.08	2.90	20.929*	.013

*$p < .05$.

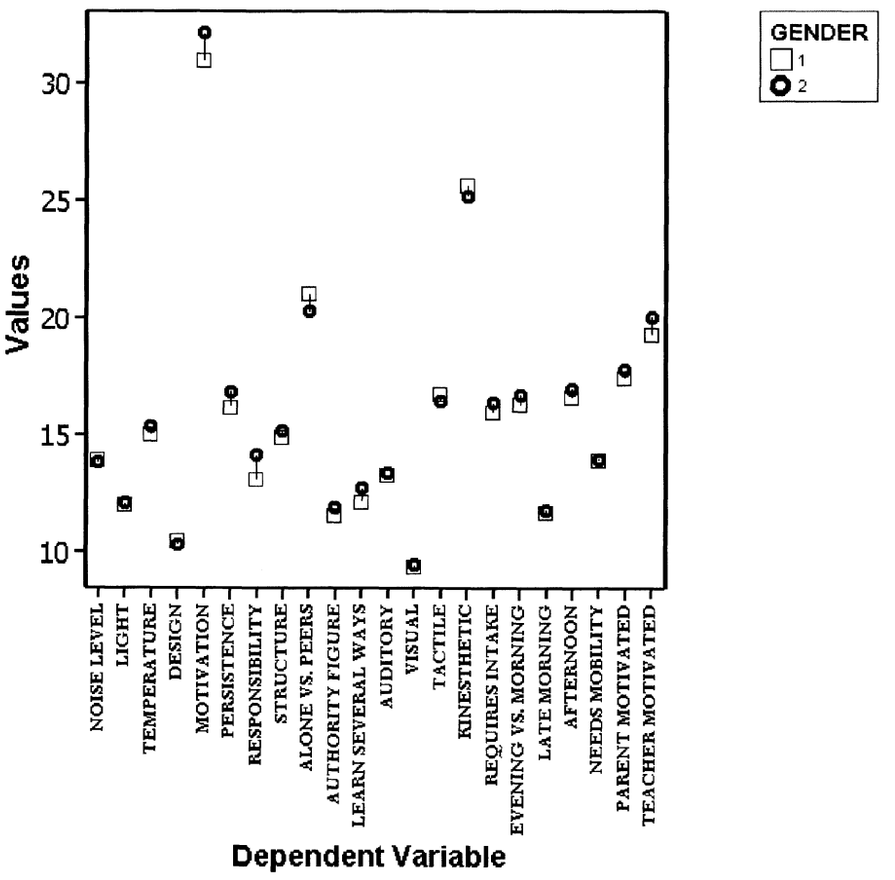

FIGURE 1. Drop-line chart of group means, by gender.

Note. 1 indicates boys, and 2 indicates girls.

counterparts did. Finally, male Swedish students were more kinesthetic, whereas female Swedish students tended to be more self-motivated and responsible (conforming).

Because of the extensive amount of data and multiple variables involved in these analyses, discussing the results of the post hoc tests in greater detail is beyond the scope of our article; however, statistical tables are available to interested readers from the first author.

TABLE 5. Adolescents' Learning-Style Preferences in Five Countries

Element	Bermuda (n = 170)		Brunei (n = 402)		Hungary (n = 376)		New Zealand (n = 292)		Sweden (n = 397)			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	η^2
Noise	14.40	4.46	13.06	4.76	13.11	4.61	13.74	4.81	15.29	4.76	15.055*	.035
Light	11.59	2.92	12.82	2.86	10.91	3.26	12.48	3.04	12.25	3.73	20.078*	.045
Temperature	15.88	3.61	10.04	2.79	18.63	3.36	16.38	3.44	16.03	2.51	418.547*	.506
Design	9.11	2.84	9.64	3.03	9.68	3.29	11.27	3.67	11.81	2.34	45.973*	.103
Motivation	31.32	4.74	33.18	2.84	31.72	3.73	32.21	4.52	29.62	4.57	41.373*	.092
Persistence	16.72	2.95	15.44	2.25	17.15	3.10	16.85	2.90	16.85	2.97	21.742*	.050
Responsibility	13.85	3.56	12.50	2.92	14.10	2.93	14.38	3.23	13.82	3.60	18.972*	.046
Structure	13.98	3.09	15.66	2.29	15.62	3.27	15.04	3.12	14.44	2.74	18.555*	.042
Alone versus peers	23.64	6.27	24.02	5.83	16.93	5.12	19.85	6.38	20.25	6.91	77.228*	.158
Authority figure	12.10	2.88	12.45	3.23	10.74	3.12	11.86	3.04	11.81	3.22	15.260*	.039
Learn several ways	14.01	2.62	14.49	2.97	10.41	3.75	12.26	3.42	11.94	3.48	84.484*	.173
Auditory	13.46	3.12	13.37	3.23	13.33	3.50	13.44	3.33	13.24	3.21	.221	.001
Visual	9.14	2.52	10.81	2.41	8.89	2.73	8.99	2.84	9.06	2.54	36.804*	.085
Tactual	17.76	3.90	17.77	3.39	14.52	4.31	17.57	4.30	16.27	4.16	42.184*	.093
Kinesthetic	24.65	4.06	27.42	3.46	24.35	3.80	24.92	4.01	25.18	4.19	36.893*	.083
Requires intake	17.81	4.27	15.15	5.13	15.26	5.44	17.46	4.46	16.53	4.87	17.622*	.043
Evening versus morning	16.48	4.54	21.12	4.43	16.41	4.32	15.60	5.31	12.73	4.28	174.591*	.299
Late morning	11.48	2.60	12.94	2.53	11.83	2.84	11.53	3.22	10.86	3.13	27.316*	.064
Afternoon	17.25	3.03	15.23	3.51	17.30	3.81	17.45	3.57	17.34	3.17	28.275*	.069
Needs mobility	14.17	3.90	14.83	3.51	14.32	4.22	13.46	4.50	13.14	4.19	10.488*	.026
Parent motivated	17.54	2.32	18.07	1.58	18.23	1.91	17.12	2.45	17.10	2.72	20.664*	.046
Teacher motivated	19.27	3.12	21.07	2.29	19.76	2.99	18.87	3.38	19.21	2.83	32.609*	.072

Note. *df* for *F* value = 4, 1,632.
*$p < .05$.

TABLE 6. Simple Main Effects of Gender and Country for Adolescents' Learning-Style Preferences

Simple main effect	Wilks's lambda	*F*	Hypothesis (*df*)	Error (*df*)	Effect size η^2
		Gender			
Boys	.346	22.226*	88	6,353.06	.233
Girls	.342	22.511*	88	6,353.06	.235
		Country			
Bermuda	.966	2.542*	22	1,606.00	.034
Brunei	.961	2.946*	22	1,606.00	.039
Hungary	.962	2.916*	22	1,606.00	.038
New Zealand	.973	2.056*	22	1,606.00	.027
Sweden	.941	4.552*	22	1,606.00	.059

*$p < .05$.

Discriminant Analysis

We also conducted a canonical discriminant analysis to explore the data in greater depths and to reveal linear combinations of learning-style variables that significantly discriminated between the two gender groups. The Wilks's lambda was significant, $\Lambda = .923$, $\chi^2(22, N = 1,637) = 130.522$, $p < .0001$, indicating that overall, the linear combinations of the learning-style elements significantly discriminated between boys and girls. The analysis resulted in

TABLE 7. Gender Differences for Learning Styles, by Country

Element	Bermuda	Brunei	Hungary	New Zealand	Sweden
Noise			+		
Light				–	
Temperature				–	–
Design					
Motivation	–		–		–
Persistence	–		–		
Responsibility			–	–	–
Structure					
Alone versus peers	+				
Authority figure			–		
Learn several ways		–	–	–	
Auditory		–			
Visual					
Tactual	+				
Kinesthetic	+			+	+
Requires intake					
Evening versus morning					
Late morning		+			
Afternoon		–			
Needs mobility					
Parent motivated					
Teacher motivated	–	–	–		

Note. + indicates that boys had higher raw scores for a particular learning-style variable; – indicates that girls had higher raw scores for a particular learning-style variable. A blank space indicates no significant differences between boys and girls.

one discriminant function, with an eigenvalue of .084 and a canonical correlation of .284 in the moderate-to-weak range. The structure matrix indicated that the function comprised responsibility, self-motivation, teacher motivation, persistence, several ways, and parent motivation. The group centroids placed girls on the high end (.279) and boys on the low end (–.300) of the function.

Discussion

Without consideration of country group membership, significant gender differences emerged for 9 of the 22 learning-style variables (see Table 4). These overall findings indicated that boys were more kinesthetic and peer oriented than were girls—corroborating previous findings by Hong and Suh (1995), Jenkins (1991), Lam-Phoon (1986), Mariash (1983), and Pengiran-Jadid (1998). Marcus (1979) was the only researcher to report that boys were more alone preferenced than were girls, and Roberts (1984), who conducted a similar study in Jamaica and the Bahamas, was the only investigator to report a stronger kinesthetic modality preference for girls than for boys. Those traits could have been specific to the population that those researchers examined.

In the present investigation, girls revealed higher levels of self-motivation, persistence, responsibility, need for warmer temperatures and sociological variety, parent motivation, and teacher motivation than did boys. Findings related to motivation and persistence were consistent with previous investigations by Hong and Suh (1995), Jenkins (1991), Lo (1994), Mariash (1983), and Pengiran-Jadid (1998). Lo, Marcus, and Mariash also found that girls were more responsible and conforming. Stronger parent motivation and teacher motivation were reported previously by Hong and Suh and by Marcus (parent motivation only). Results concerning girls' need for variety rather than routines and patterns supported Jorge's (1990) and Lam-Phoon's (1986) conclusions.

When data for the five countries were examined independently, apparent overall and country-specific patterns developed (see Table 7). Three elements in the emotional stimulus strand of the Dunn and Dunn model—self-motivation, persistence, and responsibility—were recurring variables that differentiated between the two genders. As a tendency, female adolescents were more self-motivated in three countries (Bermuda, Hungary, and Sweden). Female Hungarian and Bermuda students were more persistent than were male students in those countries. Female adolescents in Hungary, New Zealand, and Sweden were more responsible or conforming than were male adolescents in those countries. In addition, being teacher motivated often characterized female adolescents more than male adolescents in Bermuda, Brunei, and Hungary.

Male adolescents had stronger tactual (Bermuda) and kinesthetic (Bermuda, New Zealand, and Sweden) perceptual modalities than did female adolescents. Those results partially corroborated Mariash's (1983) and Dunn's (1996) findings that male adolescents tended to be visually, tactually stronger, kinesthetically stronger, or both, whereas females were stronger auditorially in Brunei and Singapore (Lam Phoon, 1986). Roberts (1984) and Yong (1991) also reported male tendencies for tactual perceptual preferences.

In addition, there were numerous other country-specific gender differences. Girls needed more light and higher temperature in New Zealand, unlike the female Asian and American Caucasian undergraduates who preferred cooler temperatures more than the male undergraduates in Lam-Phoon's (1986) investigation. Girls in Brunei, Hungary, and New Zealand also enjoyed learning more with varied strategies than in patterns and routines, essentially supporting Lam-Phoon's findings.

Of the five country groups, only Hungarian girls were significantly more authority-figure oriented than were their male peers, similar to Jenkins's (1991) findings. Furthermore, only Hungarian boys expressed a significantly stronger preference for sound than girls did, which was similar to the findings reported by Lam-Phoon (1986) and Pizzo et al. (1990). Gender differences concerning time-of-day preferences were significant only in Brunei, where boys preferred late-morning hours and girls preferred afternoon hours.

Discrepancies between (a) overall and country-specific findings and (b) results of previous and current research may suggest that cultural differences affected the learning-style preferences of the two genders or that individual differences within each group weighted the results. Furthermore, these overall results denoted small effect sizes, so they should be interpreted with caution. There may have been certain common trends particular to either boys or girls in general and within each country.

Unanticipated Findings and Their Implications

When we examined individual learning-style profiles and used them to prepare individual homework prescriptions on the basis of each student's strong preferences, preferences, nonpreferences, opposite preferences, and strong opposite preferences (categories that delineate strengths revealed by the LSI), there were no two identical learning-style profiles within each gender group for the 22 variables. Systematic cross-tabulations by gender for each element confirmed this observation.

This finding indicates that although girls' and boys' learning styles differ from each other in many ways, individuals within each group are even more unique than either group as a whole. Previous researchers have demonstrated that when students were taught with learning-style responsive instructional approaches, their standardized achievement–attitude test scores improved significantly (Dunn, Bruno, et al., 1990; Dunn & DeBello, 1999; Dunn, Thies, et al., 2001). Therefore, it is extremely important that educators respect and address the learning-style differences found among the individuals in each classroom.

Only a small percentage of secondary students in the nations we studied were capable of listening to a lecture on new and difficult academic material for between 40–50 min and of remembering at least 75% of what they heard (DePaula, 2002; Dunn, Thies, et al., 2001; Hlawaty, 2002; Honigsfeld, 2000, 2001). Of those who could remember, girls tended to be more auditory than boys. Thus, girls were likely to earn better grades than boys on tests related to the lectures that they both attended.

That boys were significantly more kinesthetic and peer oriented than girls also was likely to affect their achievement. Kinesthetic students learn by doing rather than by being passive. As early as 1979, Restak reported that boys find it difficult to sit still and continue concentrating on academic subject matter for an entire class period. Restak attributed boys' need for active participation to how their brains process information, inferring a relationship between kinesthetic movement and thinking among boys.

If Restak (1979) was correct, then consider the exasperation experienced by some boys with a kinesthetic (activity-oriented) learning style who also are designated as low auditory when they are required to sit passively and listen to teachers talk hour after hour each day. Adding to the mixture that boys are significantly more peer oriented than girls are suggests that many boys need to learn collegially with peers rather than with their teacher—whom they often perceive as authoritative and demanding rather than collegial and peerlike.

In addition, educators working with male and female adolescents should be aware of their sources of motivation (self, peers, teachers, or parents) and capitalize on these tendencies to improve learning outcomes. Teachers of female students should maximize this group's tendency for higher levels of self-motivation, teacher motivation, and parent motivation; persistence; and responsibility. Because girls also preferred to learn in more varied sociological ways than boys did, they may need more opportunities for diverse learning experiences, including working independently, in pairs, with peers, in larger groups, and with the teacher.

Educators and parents in the five countries selected for this investigation may be able to enhance students' educational experiences and academic achievement in a culturally appropriate way by identifying, understanding, and responding to the unique learning styles of students in the selected nations. At the same time, elevating students' awareness of their own learning-style preferences, teaching them how to capitalize on their strengths and to cope with instructional approaches that are incongruent with their needs, and helping them develop positive study habits and learning strategies also may have a beneficial influence.

NOTES

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