Cross-Cultural Comparison of Gender Differences in Adolescents' Attitudes Toward Computers and Selected School Subjects

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ABTRACT **The attitudes of two samples of adolescents (total N = 2,105) from Victoria, British Columbia, and Shanghai, People's Republic of China, toward computer studies and selected school subjects were surveyed and compared. The Chinese students were significantly more positive in their attitudes toward computers, science, and writing than were the British Columbia students. In addition, the students from Shanghai displayed fewer sex or age differences among themselves, except when asked to give opinions about the competence of females with regard to computer use and science. Both samples of females agreed that women have as much ability as men in these areas, whereas males in both countries were significantly more skeptical. The study also supports the validity and reliability of attitude research in a cross-cultural context.**

Because students' attitudes toward specific school subjects are related to their achievement and participation in those subjects, differences in attitudes among various groups of students are frequently of interest to educators. In particular, secondary school students' attitudes toward mathematics and science have been studied extensively in North America (Fennema & Sherman, 1980; Fox, Brody, & Tobin, 1980) and western Europe (Kaminski, 1982; Manthorpe, 1982). In both of these subjects, persistent sex differences have been found, with males consistently more positive than females in their attitudes, self-confidence levels, and participation rates. Similar patterns are now being documented with regard to computer studies in secondary school (Lipkin & McCormick, 1985; Lockheed, Thorpe, Brooks-Gunn, Casserly, & McAloon, 1985).

Hypotheses about the factors underlying these sex differences frequently suggest that social and cultural expectations for males and females differ in Western society and that these differing expectations fuel a pervasive sense of gender-related inappropriateness among females with regard to mathematics, science, and technology (Fennema & Sherman, 1977). All do not agree, however, that social and cultural expectations explain the sex differences in attitudes as well as in participation and achievement. Benbow and Stanley (1980), for example, argue that even after controlling for environmental and associated demographic variables, sex differences still exist. The interaction of culture, gender, and attitude and the effect of this interaction on participation remain important research topics in education. A comparative study involving students from different cultures may yield additional insights into this interaction.

The People's Republic of China has only recently been opened to interaction with Western cultures. Little is known about the attitudes of its students toward various school subjects or if sex differences in those attitudes occur. A comparative study of samples of Chinese and North American adolescents can supply valuable information not only about Chinese adolescents' attitudes, an area where little research has occurred, but also about the interaction of gender and attitude in the context of two very different cultures.

To begin this process of comparison of Chinese and North American students' attitudes toward various

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school subjects, an attitude measurement survey was administered to samples of secondary school students in Victoria, British Columbia, and in Shanghai, People's Republic of China. Data from the survey are used to address the following questions:

1. Do adolescents in Shanghai differ from adolescents in Victoria in their attitudes toward computer studies, mathematics, science, and writing?
2. Do sex- and age-related differences in attitudes occur among the sample of Chinese students in the same manner as they occur among the sample of Canadian students?
3. Do adolescents in the Victoria and Shanghai samples differ in their expectations about the general competence of females in technological and scientific pursuits?

Method

Subjects

The students involved in this study were 1,818 Canadian and 287 Chinese adolescents, all in Grades 8 or 12. The Canadian sample involved approximately 50% of the Grade 8 and 12 population, selected at random, in Victoria. This sample included 1,018 Grade 8 students (539 boys and 479 girls) and 800 Grade 12 students (419 boys and 381 girls). Although only a single British Columbia school district was involved in this particular comparative study, previous studies using the same instrument on adolescent samples in different areas of western Canada and the United States have yielded data similar to that obtained from the Victoria sample used in this study (Collis, 1986; Smith, 1986; Temple, 1986). Given the general correspondence of the responses from the particular British Columbia sample used in this study with the results reported both from other applications of the instrument used in this study and from other research (Lockheed, 1985; Wilder, Mackie, & Cooper, 1985), the representativeness of the sample relative to the suburban, middle socioeconomic level population of Canadian adolescents seems to have reasonable support. The British Columbia district has been active in computer education for secondary school students. All eighth graders in the district at the time of the survey included a 20-hour locally developed computer literacy unit within their mathematics course. Each of the schools had a computer laboratory.

The Chinese sample included all Grade 8 and Grade 12 students from five secondary schools in Shanghai. The five schools included one "key" school for students with strong academic potential, whereas the other four schools included a broad range of students and were judged to be typical of secondary schools in Shanghai. All of the schools had several microcomputers available for student coursework. The samples included 139 Grade 8 students (70 males and 69 females) and 148 Grade 12 students (74 males and 74 females).

Procedure

Student attitudes were measured with a survey using a 5-point Likert-type response format. The instrument was developed and validated in previous studies (Collis, 1985, 1986; Collis & Ollila, 1986). Items in the instrument appear in Table 1.

The survey was administered to the samples of students selected for the study. The instrument was administered to the Victoria students in their English classes under standard conditions.

The survey was translated into Mandarin Chinese for the Shanghai sample. One item, dealing with word processing, was replaced for the Chinese instrument because of translation difficulties, and two of the participation variables were reworded. These changes are noted in Table 1. The Chinese educator who administered the survey met with the Canadian researchers to ensure that the data collection procedures were similar in both countries. Translation of the instrument was verified by two additional Chinese-Canadian scholars.

Analysis

Means and standard deviations were computed for each of the attitude statements by sex/grade group and country and are included in Table 1.

Validation of instrument for the Shanghai sample. Because attitude measurement is uncommon in China, it was important to verify the validity of the Likert-type response format for the Chinese students. Eight pairs of variables, with each pair logically related, were identified. Some of the item-pairs contained two similarly worded variables, but most involved one positively worded and one negatively worded item. Correlation coefficients for these pairs of variables were calculated for the Shanghai sample. All correlations were significant, $p < .01$. The strong correlations between responses to each pair of items support the reliability and the validity of the attitude assessment format for at least this sample of Chinese adolescents.

Construction of composite variables. In order to facilitate interpretation of the data, the variables were grouped according to focus using the following categories: Attitudes Toward Computers, 11 variables; Attitudes About the Impact of Computers on Society, 3 variables; Stereotypes About Computer Users, 4 variables; Self-Confidence About Computer Use, 2 variables; Attitudes Toward Mathematics, 4 variables; Attitudes About Science, 3 variables; Attitudes Toward Writing, 5 variables; and Attitudes About the Competence of Females with Computers and Science, 3 variables. Three variables from the instrument were not included in any

Table 1.—Attitude Survey Means and Standard Deviations

Items	Victoria, British Columbia, Canada				Shanghai, People's Republic of China			
	8th grade		12th grade		8th grade		12th grade	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Computer Interest								
1. I think that a computer can be very interesting.	4.30 (.94)	4.13 (.84)	4.15 (.80)	4.13 (.77)	4.30 (.59)	4.36 (.57)	4.03 (.89)	4.15 (.67)
2. I would like to learn how to use a computer.	4.24 (1.02)	4.10 (.96)	4.06 (.99)	4.09 (.89)	4.51 (.85)	4.54 (.61)	4.38 (.87)	4.59 (.67)
3. Computers are exciting.	4.05 (1.05)	3.67 (1.08)	3.49 (1.07)	3.37 (1.01)	3.84 (.87)	4.00 (.78)	3.57 (.95)	3.72 (.87)
4. Computers are fun.	4.26 (.98)	3.96 (1.02)	3.79 (.98)	3.72 (.87)	4.23 (.62)	4.26 (.70)	3.85 (.93)	4.04 (.66)
5. If my family had a home computer, I would probably use it more than anyone else.	3.92 (1.19)	3.52 (1.28)	3.62 (1.28)	3.17 (1.22)	3.61 (.97)	3.75 (.94)	3.05 (.86)	3.34 (1.01)
6. I think I would enjoy working with computers.	4.06 (1.00)	3.74 (1.02)	3.56 (1.07)	3.35 (.94)	4.01 (.67)	4.10 (.71)	3.84 (.98)	4.07 (.58)
7. I would be glad to tell my friends that I have joined a computer club (Canadian) or been accepted into a computer institute (Chinese).	3.85 (1.21)	3.87 (1.09)	3.68 (1.17)	3.95 (.99)	3.94 (.84)	3.94 (.92)	3.89 (1.11)	3.69 (1.03)
8. I would rather play computer games than other types of games.	2.69 (1.31)	2.14 (1.14)	1.86 (1.05)	1.71 (.88)	3.70 (1.07)	3.74 (1.04)	3.11 (1.25)	3.54 (1.04)
9. Using a computer in mathematics class would make math more fun.	4.27 (1.04)	4.21 (1.04)	3.85 (1.07)	3.80 (.99)	3.69 (1.07)	4.00 (.91)	3.77 (1.01)	3.85 (.91)
10. People managed before without computers, so computers are not really necessary now. (N)	2.38 (1.14)	2.79 (1.09)	2.40 (1.25)	2.64 (1.12)	1.76 (.82)	1.91 (.66)	1.80 (.92)	1.72 (.76)
11. Computers will never interest me. (N)	1.73 (1.06)	1.92 (1.00)	1.92 (1.02)	1.96 (.96)	1.49 (.65)	1.65 (.74)	1.77 (.97)	1.77 (.66)
12. The world would be better off if computers were never invented. (N)	2.00 (1.15)	2.19 (1.04)	2.08 (1.18)	2.19 (1.08)	1.55 (.85)	1.48 (.58)	1.66 (.91)	1.36 (.54)
13. Working with computers is not my idea of fun.	2.18 (1.17)	2.36 (1.14)	2.61 (1.20)	2.71 (1.16)	2.13 (.80)	2.23 (.77)	2.45 (1.06)	2.13 (.81)
14. Computers do not interest me. (N)	1.98 (1.19)	2.22 (1.16)	2.24 (1.19)	2.37 (1.12)	1.87 (.81)	1.84 (.87)	2.19 (.97)	2.00 (.83)
15. I am worried about what people will do for work if computers become more powerful in the future. (N)	3.19 (1.25)	3.67 (1.11)	3.35 (1.36)	3.88 (1.07)	2.77 (1.33)	2.96 (1.12)	2.57 (1.27)	2.20 (.94)
16. Computers are boring. (N)	1.83 (1.15)	2.03 (1.15)	2.23 (1.15)	2.24 (1.03)	1.64 (.80)	1.77 (.67)	2.01 (1.06)	1.97 (.82)
Stereotypes								
17. People who like computers are often not very sociable. (N)	3.51 (1.21)	3.60 (1.19)	3.30 (1.19)	3.65 (1.08)	3.89 (1.02)	4.00 (.85)	3.72 (1.05)	3.87 (.80)
18. People who like computers are the types who like science. (N)	3.38 (1.06)	3.62 (.98)	3.41 (1.09)	3.49 (1.04)	2.46 (.96)	2.33 (.91)	2.97 (.88)	2.60 (.94)
19. You have to be intelligent to like computers. (N)	4.05 (1.00)	4.16 (.97)	3.94 (1.04)	4.03 (.94)	3.44 (1.20)	3.71 (1.13)	3.57 (1.20)	3.39 (1.10)
20. I would not expect a good athlete to like computers.	3.63 (1.19)	3.67 (1.09)	3.69 (1.10)	3.93 (.97)	3.76 (.75)	3.83 (.64)	3.65 (1.04)	3.77 (.68)
21. Females have as much ability as males when learning to use a computer.	3.86 (1.24)	4.56 (.91)	4.05 (1.15)	4.74 (.66)	3.03 (.93)	4.43 (.80)	2.96 (1.02)	4.22 (.87)

(*table continues*)

Table 1.—*Continued*

22. Learning science is just as important for girls as for boys.	4.16 (.99)	4.43 (.88)	4.15 (1.03)	4.61 (.675)	3.80 (.83)	4.55 (.65)	3.70 (1.19)	4.46 (.69)
23. Girls are just as good as boys in science.	3.94 (1.04)	4.46 (.92)	3.78 (1.14)	4.51 (.82)	3.06 (.95)	4.39 (.79)	2.82 (.97)	4.16 (.77)
24. Girls and boys are equally competent at using computers. (Chinese only)					3.29 (.95)	4.48 (.76)	2.96 (1.05)	4.40 (.76)
25. I think it is more important for boys to learn about computers than it is for girls to learn about computers. (N) (Chinese only)					3.10 (.23)	4.41 (.32)	2.84 (.46)	4.39 (.44)
Self-Confidence								
26. Microcomputers are easy to use.	3.19 (.99)	3.07 (.71)	3.20 (.90)	3.01 (.57)	3.20 (.87)	2.91 (.85)	2.93 (.98)	2.93 (.79)
27. It would be difficult for me to learn how to program a computer. (N)	2.53 (1.24)	2.61 (1.14)	2.51 (1.14)	2.73 (1.10)	2.73 (.99)	3.01 (.94)	2.68 (1.08)	2.82 (.79)
28. Mathematics is one of my best subjects.	3.14 (1.37)	2.78 (1.40)	2.83 (1.38)	2.59 (1.41)	2.97 (.94)	2.67 (.76)	3.22 (.92)	2.86 (.72)
29. If I don't see how to do a mathematics problem right away, I never get it. (N)	2.20 (1.15)	2.30 (1.24)	2.13 (1.12)	2.07 (.99)	1.66 (.72)	1.81 (.88)	1.80 (.93)	2.00 (.84)
30. No matter how hard I try, I cannot understand mathematics. (N)	2.04 (1.10)	2.18 (1.15)	2.09 (1.03)	2.21 (1.09)	1.97 (.88)	2.19 (1.00)	2.04 (.98)	2.31 (.90)
31. I am proud of the work I do in mathematics.	3.45 (1.61)	3.20 (1.19)	3.15 (1.20)	3.06 (1.22)	2.83 (.91)	2.73 (.82)	2.89 (1.02)	2.68 (.88)
Science								
32. I want to learn all I can about science.	3.28 (1.18)	2.99 (1.14)	3.06 (1.22)	2.83 (1.11)	4.43 (.69)	4.41 (.69)	4.11 (.88)	4.16 (.76)
33. I hope I never have a job where I have to use science. (N)	2.51 (1.23)	2.70 (1.20)	2.51 (1.17)	2.59 (1.18)	2.14 (.89)	2.16 (.90)	2.09 (1.02)	2.30 (.95)
34. I never find myself thinking about science. (N)	2.78 (1.30)	2.97 (1.22)	2.56 (1.28)	2.67 (1.21)	1.93 (.71)	2.12 (.71)	2.01 (1.00)	2.04 (.67)
Writing								
35. When I hand in an essay, I feel I'm going to do poorly. (N)	3.01 (1.16)	2.91 (1.18)	2.79 (1.18)	2.54 (1.08)	3.07 (.84)	3.22 (.89)	2.99 (.95)	2.73 (.82)
36. I like to write about my ideas.	3.10 (1.09)	3.27 (1.06)	3.17 (1.05)	3.50 (1.04)	3.17 (.98)	3.51 (.92)	3.18 (.97)	3.72 (.83)
37. I feel confident in my ability to clearly express my ideas in writing.	3.33 (1.03)	3.44 (1.00)	3.57 (1.02)	3.71 (1.00)	3.11 (.80)	3.19 (.78)	3.34 (.93)	3.54 (.78)
38. I sometimes write at home even if it is not assigned for school.	2.26 (1.27)	2.95 (1.34)	2.16 (1.28)	2.66 (1.38)	3.17 (.89)	3.36 (1.07)	3.19 (1.12)	3.49 (.98)
39. I do not enjoy writing. (N)	3.18 (1.36)	2.62 (1.29)	3.08 (1.37)	2.57 (1.31)	2.39 (.85)	2.75 (.93)	2.45 (1.02)	2.53 (1.02)

Note. 1 = strongly disagree; 5 = strongly agree. Standard deviations are given in parentheses. Negatively worded stems are indicated with an N and were recoded in subsequent analyses.

of these subsets because of possible variations in interpretation in the Shanghai sample. Intercorrelations within each of these clusters were examined to support the possible reduction of each cluster to a single variable. Because of the large number of correlations, the significance level was set to .001 to ensure a degree of practical significance.

The 11 variables comprising the Attitudes Toward Computers cluster were those identified as relating to interest in computer studies and use and were internally consistent among themselves, alpha = .91. Based on this, a composite variable, COMPATT, was formed for each subject using the nonweighted average of his or her score on the 11 variables. Although the reliability of a summated variable cannot be estimated by coefficient alpha, its reliability has been shown to increase with the average correlation among component variables as long as the variables are taken from the same domain (Nunnally, 1967, p. 227). Therefore the reliability of the linear combination of variables, COMPATT, is supported by the strength of the average correlation among the 11 component variables (r = .494) and by the correlations of the composite computer-attitude variable with each of the component variables. These correlations range from r = .602 to r = .797 and are all significant (p < .001). A similar rationale supported the reduction of the Impact of Computers on Society cluster into one averaged variable, named IMPATT (average correlation among component variables = .348); the Self-Confidence About Computer Use variables into an averaged variable, CONFICOMP (average r = .230); and the variables relating to attitude about females' competence into a variable, FEMATT (average r = .491). In each of these clusters, all component variables were significantly intercorrelated (p < .001), and each component variable was significantly correlated with its summated variable (p < .001).

The mathematics, science, and writing variables were also significantly intercorrelated among themselves. An inspection of the intercorrelations, however, showed combinations of positive and negative correlations. The strong positive correlation (r = .624) between two of the mathematics variables, Items 28 and 31, suggested a linear combination of those two variables would form a more reliable sum. This was calculated as the variable MATHATT. Although the intercorrelations among the three science variables and among the five writing variables were mixed in sign, each was significant (p < .001), and the logical homogeneity of the sets was felt to be adequate justification for the reduction of the three science variables into the unweighted sum, SCIATT, and the reduction of the writing variables into WRITATT. Finally, the set of four variables relating to stereotypes about computer users was seen to be only weakly intercorrelated. Although five of the six correlations were statistically significant (p < .001), the average intercorrelation was only .161 and the variables themselves were more logically heterogeneous than those in any other cluster. In consequence, it was decided not to attempt to sum these variables but instead select two with the most potential for interpretation and use both as separate dependent variables in subsequent analyses. Item 19, "You have to be intelligent to use computers" (SMART), and Item 17, "People who like computers are often not very sociable" (NOT SOCIAL), were selected. Finally, in order to provide a comparison of students' self-confidence in the context of two different types of school subjects, Item 35, relating to self-confidence in writing ability (CONFIWRIT) was selected as a specific dependent variable. Means and standard deviations of the derived set of variables are given in Table 2. The full intercorrelation matrix involving the original set of variables is available on request.

A series of 10, 2 × 2 × 2 ANOVA analyses was performed, using the derived set of variables shown in Table 2 as consecutive dependent variables and country, sex, and grade as two-level factors. Because of the independence of at least some of the variables, individual ANOVAS were conducted instead of a single MANOVA analysis. Although the large sample sizes reduce the threat of spurious significance when a series of ANOVA procedures is applied, significance levels were set at the .01 level as an additional precaution. When significant effects were obtained, Scheffé comparison analyses were used to provide more specific information about the sources of variation in the data.

Results

Overall Differences

Table 3 shows the results of three ANOVA procedures, each of which relates to attitudes toward a subject studied in school. The results of each ANOVA reveal a significant main effect for country (p < .001) with the Chinese students more positive than the Canadians in science and writing. The differences are most pronounced in attitudes toward science. Inspection of individual means for SCIATT using a Scheffé analysis of multiple comparisons shows this attitudinal difference to be significant (p < .001) for each subgroup of Shanghai students when compared to any subgroup of the Victoria students. With the writing variable, the overall country effect is strongly influenced by the Chinese Grade 12 females, whose attitudes are significantly (p < .001) more positive than any group of the British Columbia students.

Table 4 presents the results of four ANOVA procedures, each examining some aspect of attitude toward computers. Significant main effects for country were

Table 2.—Derived Variables Means and Standard Deviations

	Victoria				Shanghai			
	8th Grade		12th Grade		8th Grade		12th Grade	
Variables	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
COMPATT—Attitudes Toward Computers	4.12 (.75)	3.89 (.79)	3.77 (.81)	3.67 (.74)	4.08 (.42)	4.13 (.41)	3.83 (.58)	3.97 (.49)
IMPATT—Impact of Computers on Society	3.48 (.83)	3.12 (.76)	3.39 (.98)	3.10 (.84)	3.93 (.58)	3.88 (.55)	4.00 (.75)	4.24 (.52)
CONFICOMP—Confidence About Computer Use	3.33 (.86)	3.23 (.72)	3.35 (.85)	3.14 (.66)	3.05 (.72)	2.94 (.74)	3.18 (.80)	3.05 (.61)
SMART—Stereotype About Computer Users Being Smart	4.05 (1.00)	4.16 (.97)	3.94 (1.04)	4.03 (.94)	3.44 (1.20)	3.71 (1.13)	3.57 (1.20)	3.39 (1.10)
NOTSOCIAL—Stereotype About Computer Users Being Nonsociable	3.51 (1.21)	3.60 (1.19)	3.30 (1.19)	3.65 (1.08)	3.90 (1.02)	4.04 (.85)	3.72 (1.05)	3.89 (.80)
FEMATT—Females' Competence Compared to Males'	3.98 (.84)	4.48 (.70)	4.03 (.90)	4.62 (.52)	3.30 (.74)	4.46 (.68)	3.13 (.86)	4.29 (.66)
MATHATT—Attitudes Toward Mathematics	3.29 (1.13)	2.99 (1.15)	2.99 (1.16)	2.82 (1.22)	2.85 (.84)	2.65 (.72)	3.07 (.88)	2.75 (.74)
SCIATT—Attitudes Toward Science	2.85 (.60)	2.88 (.61)	2.72 (.60)	2.69 (.56)	4.11 (.46)	4.05 (.55)	4.02 (.71)	3.94 (.51)
WRITATT—Attitudes Toward Writing	2.98 (.52)	3.04 (.47)	2.95 (.51)	3.00 (.43)	3.21 (.62)	3.25 (.71)	3.28 (.69)	3.49 (.67)
CONFIWRIT—Confidence About Writing Ability	2.99 (1.17)	3.07 (1.18)	3.21 (1.18)	3.46 (1.08)	2.93 (.84)	2.78 (.89)	3.01 (.95)	3.27 (.82)

Note. All negatively worded items have been recoded, so that scores range from 1 (least positive, most stereotyped) to 5 (most positive, least stereotyped). Standard deviations are in parentheses.

obtained ($p < .002$ for COMPATT, $p < .001$ for IMPATT, SMART, and SOCIABLE). The students from Shanghai were again more positive overall than those from Victoria and were clearly more positive with regard to their opinions about the impact of computers on society. Scheffé multiple-comparisons analysis shows that each sex/grade group of Chinese students was significantly more positive on IMPATT ($p < .03$) than any subgroup of the Canadian students.

Analyses of the two variables measuring stereotypical impressions about computer users show contrasting results. Although main effects for country are significant for each ($p < .001$), the Chinese show a greater tendency to stereotype computer users as smart than do the British Columbia students, but less of a tendency to identify computer users as not very sociable. Perhaps the contrast in the directions of the country effect for these two stereotype variables reflects a larger cultural contrast; in North America, being smart may be associated with lack of social status for adolescents, whereas in China being bright may have more positive social value. This contrast may provide a profitable hypothesis for further comparative research.

Finally, significant differences were found between the Chinese and the Canadian students with respect to their self-confidence about computer studies and about writing ability. Although the Chinese students are more confident about their writing than are the students from British Columbia ($p < .006$), they are significantly less self-confident about their ability in computer studies compared to the Canadian sample ($p < .001$). Table 5 shows the results of the ANOVAs relating to self-confidence.

The lower self-confidence of the Chinese students with respect to computer studies is very likely a function of the fact that they have had less opportunity to study about or use computers in school. Only 9% of the Chinese Grade 8 students indicated they had studied computers in school compared to 44% of the Victoria sample. By Grade 12, however, the percentages are closer (24% of the Chinese sample as compared to 42% of the Canadian sample).

Sex and Age Differences

Examining age and sex differences among and between the Chinese and Canadian samples can help to provide an interpretation of the overall significant differences between the countries that were found in each of the previous attitude analyses. As can be seen in Tables 3–5, significant main effects for sex were found for each variable except SCIATT (attitudes toward science). Boys overall were significantly more positive than girls with respect to attitudes toward mathematics ($p < .001$), computers ($p < .001$), the impact of computers on society ($p < .001$), as well as in self-confidence about computer work ($p < .001$) and about writing ability ($p < .004$). In spite of being less self-confident than males about writing, females were significantly ($p < .006$) more positive overall about writing than males. Although Chinese male/female cohorts were not significantly different in their attitudes in any specific comparison of means, these overall directions of significant effects were consistently reflected in each comparison of Shanghai and Victoria students.

Significant country-by-sex interactions were found for COMPATT ($p < .004$). In the Shanghai sample, girls were more positive about computer studies than were same-grade boys, but the differences were not significant; however, in the Victoria sample, boys were more positive about computers than were girls, a difference that was significant for Grade 8 students ($p < .001$). Significant country-by-sex interactions ($p < .001$) were also obtained by IMPATT where Chinese Grade 12 girls indicated a more positive attitude than their male peers (although the difference was not significant), whereas Grade 12 girls from British Columbia were significantly ($p < .001$) more negative than their male peers.

The most striking information from a closer analysis of the overall sex effects using Scheffé procedures is the homogeneity of the Chinese sample. For every variable, the standard deviation of the Chinese sex/grade group was smaller than that of the corresponding Canadian sex/grade group (see Table 2). In addition, on none of the variables where significant overall effects were found was there any significant difference between the attitudes of Chinese students among themselves. In contrast, significant differences between sex/grade groups occurred within all of the Canadian sample's attitude clusters except that relating to science. In contrast, differences among the Chinese adolescents either with respect to age or grade were not significant.

A comparison of girls in the Chinese and Canadian samples shows many similarities in attitude. Girls in both countries show a decline in the attitudes of females toward mathematics, science, and computer studies between Grade 8 and Grade 12 (significant, $p < .009$, for

Table 3.—ANOVA Results: Attitudes Toward Mathematics, Science, and Writing

Source of variation	Sum of squares	*df*	Mean square	*F*	Significance of *F*
Attitudes Toward Mathematics (Variable MATHATT)					
Country	9.02	1		7.19	0.007
Sex	31.00	1		24.72	0.000
Grade	17.86	1		14.24	0.000
Country × Sex	0.06	1		0.05	ns
Country × Grade	9.87	1		7.87	0.01
Sex × Grade	1.28	1		1.02	ns
Country × Sex × Grade	1.06	1		0.85	ns
Residual	2630.12	2097	1.25		
Total	2702.65	2104	1.29		
Attitudes Toward Science (Variable SCIATT)					
Country	383.33	1		1094.82	0.000
Sex	0.01	1		0.01	ns
Grade	12.50	1		35.70	0.000
Country × Sex	.31	1		0.89	ns
Country × Grade	.25	1		0.70	ns
Sex × Grade	.22	1		0.70	ns
Country × Sex × Grade	.01	1		0.62	ns
Residual	734.22	2097	0.35		
Total	1124.76	2104	0.54		
Attitudes Toward Writing (Variable WRITATT)					
Country	24.54	1		92.28	0.000
Sex	1.98	1		7.46	0.006
Grade	0.02	1		0.06	ns
Country × Sex	0.32	1		1.20	ns
Country × Grade	2.02	1		7.59	0.006
Sex × Grade	0.01	1		0.05	ns
Country × Sex × Grade	0.59	1		2.22	ns
Residual	557.73	2097	0.27		
Total	587.48	2104	0.28		

Table 4.—ANOVA Results: Attitudes Toward Computers

Source of variation	Sum of squares	*df*	Mean square	*F*	Significance of *F*
Attitudes Toward Computers (Variable COMPATT)					
Country	5.46	1		9.94	0.002
Sex	10.14	1		18.47	0.000
Grade	40.25	1		73.28	0.000
Country × Sex	4.99	1		8.18	0.004
Country × Grade	0.49	1		0.89	ns
Sex × Grade	2.13	1		3.88	ns
Country × Sex × Grade	0.02	1		0.01	ns
Residual	1151.72	2097	0.55		
Total	1213.65	2104	0.58		
Attitudes About Social Impact of Computers (Variable IMPATT)					
Country	143.64	1		211.96	0.000
Sex	39.25	1		57.92	0.000
Grade	0.23	1		0.35	ns
Country × Sex	10.44	1		15.40	0.000
Country × Grade	3.89	1		5.74	0.017
Sex × Grade	1.24	1		1.82	ns
Country × Sex × Grade	0.95	1		1.41	ns
Residual	1421.04	2097	0.68		
Total	1618.48	2104	0.77		
Stereotype that Computer Users are Smart (Variable SMART)					
Country	66.19	1		64.60	0.000
Sex	4.58	1		4.47	ns
Grade	6.97	1		6.80	0.009
Country × Sex	0.20	1		0.19	ns
Country × Grade	0.04	1		0.04	ns
Sex × Grade	0.95	1		0.93	ns
Country × Sex × Grade	2.65	1		2.59	ns
Residual	2148.62	2097	1.03		
Total	2232.04	2104	1.06		
Stereotype that Computer Users are not Sociable (Variable NOTSOCIAL)					
Country	34.35	1		26.20	0.000
Sex	20.19	1		15.40	0.000
Grade	5.29	1		4.03	0.045
Country × Sex	0.22	1		0.17	ns
Country × Grade	0.43	1		0.33	ns
Sex × Grade	7.01	1		5.35	0.021
Country × Sex × Grade	0.84	1		0.64	ns
Residual	2749.61	2097	1.31		
Total	2817.27	2104	1.34		

the British Columbia females with respect to computers) but an improvement in attitudes toward writing and self-confidence about writing (only the self-confidence variable for Victoria girls shows a significant improvement with age, $p < .002$, but all trends are consistent). Although the trends related to age are similar for girls in both countries, there are striking differences between Grade 12 girls in the Canadian and Chinese samples. These two groups of students differ significantly ($p < .001$) from each other in attitudes toward mathematics, science, and writing, with the Grade 12 Chinese females consistently more positive than the Grade 12 Canadian females. The Grade 12 girls in the Victoria sample have the lowest attitudes toward mathematics, science, and computer studies of all the eight country/sex/grade groups involved in this study, whereas the Grade 12 girls in the Shanghai sample have the most positive attitudes about writing among all the students. A replication of this study with larger and more representative samples should be done to determine if this is an artifact of the particular samples used in this study or a generalizable difference between young women in these two different cultures.

Ability of Females

The above analyses have shown boys to be typically more positive than girls in both the Victoria and

Shanghai samples and have also shown Chinese students to display a marked homogeneity among themselves compared to the much more heterogeneous groups within the Canadian sample. On only one cluster of items were these patterns altered. Table 6 shows the results of the analysis of the variable FEMATTS, which measured the opinions of students concerning the competence of females compared with males with regard to science and technology.

The Chinese students are not homogeneous among themselves with respect to their attitudes about the competence of women compared with men in science and technology. The Chinese girls are remarkably similar to the Canadian girls in attitudes about this issue, in that all the female subjects, regardless of country, endorse the idea that women in general have as much ability as men with respect to science and technology. In contrast, boys in both countries are significantly ($p < .001$) more skeptical about this equality of ability. Boys in the Chinese sample are also significantly ($p < .001$) more skeptical about females' abilities than are boys in the Canadian sample.

To investigate this pattern further, the Chinese students were asked to respond to two additional questions relating to female competence in science and computers. These are Items 24 and 25 in Table 1. The same patterns of responses occur in these data that were seen in the variable FEMATTS—Chinese girls of both ages are highly consistent and similar in their strong endorsement of the technological capability of females in general, whereas Chinese boys are consistent in their skepticism.

Discussion

The survey shows two major and one lesser contrast between the samples of Chinese and Canadian secondary school students. The first major contrast relates to attitudes toward various school subjects and various facets of computer study. With the exception of mathematics, adolescents in the Chinese sample are consistently more positive about these school subjects than are adolescents in the Canadian sample. The Chinese youth are more interested in the subjects and more likely to perceive them as socially and personally relevant and to enjoy them more than are the adolescents in the Canadian sample. As attitude has so frequently been shown to be related to achievement and participation, the contrasting trends seen in these small samples of students from the two different countries suggest that further cross-cultural research comparing the atmosphere in schools and the motivation of students leaving school may be valuable.

The second major contrast between Chinese and Canadian samples involved in this study is that of the homogeneity of the Chinese students among themselves compared to the heterogeneity of the British Columbia students when different sex/age groups are compared. If this difference is predominately a reflection of differences in the two cultures, in that Chinese are more

Table 5.—ANOVA Results: Self-Confidence

Source of variation	Sum of squares	*df*	Mean square	*F*	Significance of *F*
		Self-Confidence About Computer Study (Variable CONFICOMP)			
Country	10.44	1		17.39	0.000
Sex	10.32	1		17.20	0.000
Grade	0.06	1		0.10	ns
Country × Sex	0.08	1		0.14	ns
Country × Grade	1.44	1		2.39	ns
Sex × Grade	1.20	1		2.01	ns
Country × Sex × Grade	0.14	1		0.24	ns
Residual	1258.20	2097	0.60		
Total	1282.30	2104	0.61		
		Self-Confidence About Writing Ability (Variable CONFIWRIT)			
Country	9.54	1		7.57	0.006
Sex	10.44	1		8.29	0.004
Grade	24.25	1		19.25	0.000
Country × Sex	1.94	1		1.54	ns
Country × Grade	16.64	1		13.21	0.000
Sex × Grade	1.06	1		0.84	ns
Country × Sex × Grade	2.64	1		2.10	ns
Residual	2641.90	2097	1.26		
Total	2706.53	2104	1.29		

Table 6.—ANOVA Results: Attitudes About the Competence of Females (Variable FEMATTS)

Source of variation	Sum of squares	*df*	Mean square	*F*	Significance of *F*
Country	59.06	1		102.32	0.000
Sex	205.50	1		356.01	0.000
Grade	1.31	1		2.27	ns
Country × Sex	23.45	1		40.63	0.000
Country × Grade	4.10	1		7.10	0.008
Sex × Grade	0.87	1		1.51	ns
Country × Sex × Grade	0.12	1		0.66	ns
Residual	1210.47	2097	0.58		
Total	1500.99	2104	0.71		

likely to value group membership and cohesiveness and Canadians are more likely to value individualism and individual differences, or if the homogeneity/heterogeneity distinction is somehow shaped by specific school experiences, it would be another interesting area of cross-cultural inquiry.

The third contrast between the Chinese and Canadian adolescents involved in this study is more tentative and lies in the value of intelligence as a socially attractive individual attribute. Data from this survey suggest that the students in Shanghai perceive intelligence and academic success as socially desirable attributes, whereas adolescents in Victoria feel it less likely that a bright and academically successful student will be socially attractive to his or her peers. If this trend is replicated with other samples of students, the implications of this could be important, given the dominance of the need for social acceptance and desirability for adolescents, at least as has been seen in North America.

Although the Chinese and Canadian adolescents in this study were different in overall attitude and degree of internal cohesiveness, they were similar in a number of interesting ways. First, girls in both countries became less positive about science, mathematics, and computer studies as they became older but became more positive about writing. Second, girls in both countries were more positive than boys with regard to writing but less positive with respect to science, mathematics, and computer study and use.

Third, and most interesting, is the similarity between adolescents in the two countries with regard to their attitudes about the competence of females as compared to males with respect to science and technology and, particularly, computers. The fact that the Chinese students depart from their otherwise homogeneous opinions with regard to the issue of equal competence for men and women could have a number of interpretations. One is that the two cultures do in fact both endorse similar stereotypes about female competence (or incompetence) with regard to "masculine" subjects such as mathematics, science, and technology. Another interpretation may be that the women's movement in the West over the last decade has become known to the Chinese and has made the same strong impression on Chinese females as it has on North American females. Yet another interpretation is that the homogeneity of opinion shown by the Chinese students on attitudes relating to school subjects is not characteristic of Chinese adolescents once larger and perhaps more socially significant issues are involved. If, indeed, Chinese adolescents display marked sex differences in other attitude areas as well as that of female competence, then the homogeneity and positive nature of school-focused opinion becomes remarkable and deserving of careful inquiry. What are Chinese educators doing that promotes such a high degree of interest and motivation in their students?

The results from this study should be treated as exploratory data, in that they are limited by the size and representativeness of the samples relative to the populations of Canadian and Chinese adolescents. Despite the limitations of the samples, however, the results of the study are valuable for at least four reasons. First, they establish support for the reliability and validity of Likert-type attitude assessment using Chinese students. Second, they provide baseline data against which to compare subsequent research inquiries into aspects of Chinese education. Third, they support the viability of gender-culture-attitude interaction as a fruitful area of research inquiry, both for school experience and for adolescent perspectives in general. And finally, they suggest that a continued, systematic investigation of research questions relating to the comparison of attitudes of Chinese and Western adolescents is both feasible and worthwhile.

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