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The Psychological Impact of Technology From a Global Perspective: A Study of Technological Sophistication and Technophobia in University Students From Twenty-Three Countries

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Abstract — *This study examined technological sophistication and the level of technophobia in 3,392 first year university students in 38 universities from 23 countries. Technological sophistication was measured by the use of consumer technology (video-cassette recorders, microwave ovens, automated banking machines, computer/video games), university computing (classroom computers, word processing, programming languages, and library computers) and computer ownership. Technophobia was assessed by instruments measuring anxiety, cognitions and attitudes toward computer technology. Results indicated that many countries showed a majority of technophobic students while others showed very few technophobes. Consistent with expectations from prior research, age and gender were only mildly correlated with technophobia in less than one-fourth of the countries and computer/technology experience was negatively related to*

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technophobia in the majority of country samples. Male students had more computer/technology experience than female students in half the samples. Technological sophistication varied greatly. A Discriminant Function Analysis indicated that two variables, a composite computer/technology experience measure and a composite technophobia score, were sufficient to provide maximal discrimination between the 23 country samples. Differences between country sample placement on this two-dimensional representation are discussed as a function of public attitudes toward technology, cultural characteristics, political climate, computer use in the educational system and general availability of technological innovations.

The world is in the midst of a revolution of sorts — a technological revolution. In the past 30 years the typical United States university has changed from using free-standing, massive, mainframe computer systems accessible only through punch-cards handed to a computer operator to having small, desktop, personal computers available in campus libraries and computer laboratories. Some universities even require all entering freshmen to purchase their own computer and modem so that they can access campus computing services from on or off campus. University students see a proliferation of technology throughout the campus including library catalogs, periodical databases, voice mail, computerized registration, and on and on.

This explosion of technology has been accompanied recently by a wealth of research on the psychological effects of computers on university students. In a 1990 meta-analysis of the literature, Rosen and Maguire (1990) found 39 empirical studies (published between 1970 and Summer, 1989) that: (a) collected interval scale data, (b) included at least 20 university student subjects, and (c) were published in a professional journal, a book, a doctoral dissertation, or an ERIC documents. Today, a review of the literature a mere 3 years later, finds over 100 studies that pass these criteria, reflecting nearly a threefold increase in three years! This acceleration in research parallels the growing awareness and interest in the psychological effects of technology.

Technophobia

Beginning with Robert Lee's 1963 nationwide study of the beliefs and attitudes of the American public toward the electronic computer (Lee, 1970), behavioral scientists have used a variety of approaches to assess psychological reactions toward computers and computerized technology. Most use self-reports of attitudes, beliefs, anxieties, and/or cognitions, while very few have used direct behavioral assessments (Rosen & Maguire, 1990).

Depending on the researcher's perspective, these studies have examined computerphobia, computer anxiety, computer attitudes, technostress, cyberphobia, or technophobia. Jay (1981) was one of the first to provide a comprehensive definition of "computerphobia" as "(1) resistance to talking about computers or even thinking about computers, (2) fear or anxiety toward computers, and (3) hostile or aggressive thoughts about computers" (p. 47). In more recent work, Rosen and Weil (1990) updated Jay's definition and defined "technophobia" as evidence of "one or more of the following: (a) anxiety about present or future interactions with computers or computer-related technology; (b) negative global attitudes about computers, their operation or their societal impact; and/or (c) specific negative cog-

nitions or self-critical internal dialogues during present computer interactions or when contemplating future computer interaction" (p. 6).

Crosscultural Research

Although a wealth of data have been collected on university students' attitudes toward computers and technology, most of this work has been completed in United States universities. Notable exceptions include Lieskovsky's (1988) study of personality and social determinants among Czechoslovakian students; Fariña, Arce, Sobral, and Carames' (1991) study of computer anxiety correlates among students in Spain; Farnill's (1985) study of computer anxiety reduction of Australian students; Sigurdsson's (1991) study of personality, demographic, and experience correlates of computer anxiety in Scottish students and Pancer, George, and Gebotys' (1992) evaluation of the theory of reasoned action as a predictive model of computer-related attitudes. However, due to the use of different measurement instruments and different research designs, the results of these investigations do not permit direct, crosscultural comparisons.

Three studies have administered identical measures of negative affect toward computers and/or computerized technology to university students from more than one country. Two of the three found cultural differences. In the most recent, Omar (1992) compared 286 students from a private university in the United States and 130 students from the University of Kuwait using Nickell and Pinto's (1986) Computer Anxiety Scale. Results indicated that the United States students' attitudes were more positive on nearly every item. In addition, while no gender differences were found for the U.S. sample, Kuwaiti women had significantly more negative attitudes toward computers than Kuwaiti men. In contrast, the Kuwaiti students showed no relationship between computer experience and computer attitudes, while American students showed the typical finding that more experienced students possess more positive computer attitudes. Finally, while American students showed increasingly positive attitudes with age, Kuwaiti students did not show the same trend.

Allwood and Wang (1990) administered a 23-item questionnaire to 165 students from a single university in China and three universities in Sweden. Each country sample was divided equally between students majoring in clinical psychology and computer science. The questionnaire included questions concerning the effects of increased computer utilization on society, moral responsibility of computers, and properties of computers now and 30 years in the future. All analyses indicated strong crosscultural differences, but few differences between major areas of study. Allwood and Wang discussed these findings in terms of the cultural characteristics of the two countries.

Marcoulides and Wang (1991) administered the Computer Anxiety Scale (Marcoulides, Rosen, & Sears, 1985) to 225 students enrolled in a large urban university in Los Angeles and 212 Chinese students enrolled at a college in Hunan, Peoples' Republic of China. Using LISREL (Joreskog & Sorbom, 1985), Marcoulides and Wang tested the invariance of a two-factor model of computer anxiety. The analyses indicated that both Chinese and American students displayed the same two-factor structure of computer anxiety, a general computer anxiety factor, and an equipment anxiety factor.

In summary, previous studies of the psychological impact of technology among university students have, in general, dealt with populations of students from the

United States. Only a few studies have examined technophobia in other countries. These studies have been limited in three ways. First, only two compared samples from the United States with samples from other countries. Second, all three cross-cultural studies measured the psychological impact of technology from a single perspective (attitude measurement or anxiety measurement), with no common measurement instruments between studies. Third, each study provided only a limited view of the availability and utilization of technology for their sample making conclusions about the impact of these factors difficult.

Present Study

This study provides a direct comparison of the amount of technological sophistication and the level of technophobia among university students in 23 countries. Technological sophistication is assessed as a function of the availability and utilization of home technology, university technology, and consumer technology, while technophobia is measured across three dimensions — anxiety, attitudes, and cognitions.

METHOD

Subjects

Over a 2-year period data were collected from 3,392 first-year university students at 38 universities in 23 countries. The sample sizes, mean ages, and gender distributions are displayed in Table 1. Of the 23 countries, eight were represented by samples from two or more universities, with three countries having samples from three universities. The United States had samples from six universities that ranged from large, state-funded universities to small private colleges. The USA university samples were obtained from the Western, Northern, Eastern, and Southern areas of the country and reflected a mix of USA universities.

Table 1 indicates that the mean age and gender distribution differed widely between country samples. This may be a function of the samples themselves, of the particular university or of the demography of university students in some countries. For example, in a country like Israel, where all students serve in the armed forces before they may enter college, the mean age was 26. Overall, the mean age of the entire sample was 20.92, with 35% male students and 65% female students.

Instrumentation

The Computer Anxiety Rating Scale (CARS), Computer Thoughts Survey (CTS), and Attitudes Toward Computers Scale (ATCS; Rosen, Sears, & Weil, 1987) were modified for the present crosscultural study. First, items that were potentially biased toward the American culture were deleted. Second, based on earlier factor analytic results (Rosen et al., 1987), redundant items were removed. Third, potentially ambiguous items were reworded. Finally, new items were added that reflected advances in technology in the late 1980s. These added items had previously been validated in a study of elementary and secondary school teachers (Rosen & Weil, 1995).

The final form of the Computer Anxiety Rating Scale — Form C (CARS-C) included 20 items rated on the same scale (1 = "not at all", 2 = "a little", 3 = "a

Table 1. Number of Universities, Sample Size, Mean Age, and Gender Distribution from 23 Countries ($N = 3392$)

Country	Number of Universities	Sample Size	Mean Age	Gender	
				Male	Female
USA	6	473	21.99	28%	72%
Yugoslavia	1	179	21.15	18%	82%
Thailand	1	121	18.80	44%	56%
Spain	2	195	20.70	20%	80%
Singapore	1	52	19.00	8%	92%
Saudi Arabia	1	93	21.86	100%	0%
Poland	1	28	23.21	25%	75%
No. Ireland	1	73	19.74	21%	79%
Mexico	1	50	27.84	36%	64%
Kenya	1	98	20.31	75%	25%
Japan	3	428	19.47	57%	43%
Italy	2	166	20.78	14%	86%
Israel	1	136	26.12	11%	89%
Indonesia	1	60	18.90	70%	30%
India	1	80	16.20	9%	91%
Hungary	2	232	21.17	35%	65%
Greece	1	63	20.25	44%	56%
Germany	3	235	23.06	42%	58%
Egypt	1	93	18.89	50%	50%
Czechoslovakia	2	134	17.11	42%	58%
Belgium	1	82	19.10	23%	77%
Australia	3	278	21.20	20%	80%
Argentina	1	43	25.93	14%	86%

fair amount", 4 = "much" and 5 = "very much") as the original CARS (taken from the Mathematics Anxiety Rating Scale; Richardson & Suinn, 1972), yielding a total possible score ranging from 20 to 100, with higher scores reflecting more computer anxiety.

The modified Computer Thoughts Survey — Form C (CTS-C) included 20 items, each rated on the same scale as the CARS-C. Nine of the items expressed positive cognitions and the others expressed negative cognitions while using or contemplating using a computer. Scores ranged from 20 to 100, with higher scores showing more positive cognitions.

The new General Attitudes Toward Computers Scale — Form C (GATCS-C) showed the most change from the original measure. Only 13 of the original ATCS items were retained and new items were added from the study of school teachers (Rosen & Weil, 1995). Each GATCS-C statement was addressed on a five-point Likert scale (Strongly Agree to Strongly Disagree). Half the GATCS-C statements were phrased in the positive direction and half in the negative direction. Responses were reverse-scored to yield a score ranging from 20 (negative attitudes) to 100 (positive attitudes).

A fourth instrument (Demographic Data and Technology Experience Questionnaire) assessed demographic characteristics (age, gender), current and planned computer ownership, and technological experience in 10 different domains (used computers as a student, written a computer program, used computerized library card catalog, used computerized library literature search, used word processing, played computer games, played arcade games, used a programmable video-cassette recorder, used a programmable microwave oven, used automated banking machines). For each of the 10 computer experience items subjects indicated how often they had

performed that activity on a four-point scale (never, 1–2 times, 3–5 times, and 6 or more times).

Procedure

Requests were sent to colleagues world-wide for assistance in this project. Most of these were members of STAR (Society for Stress and Anxiety Research), or faculty at the authors' universities, with the remainder coming from other national and international contacts. Each colleague was sent a copy of the four measures and a set of instructions to read to the students. The measures were to be administered in the following order (CARS-C, CTS-C, GATCS-C, Demographic Data, and Technology Experience Questionnaire). Where English was not the "dominant" language, colleagues were asked to provide their own translation of the measures. Each translation was completed by one or more university professors and verified by an additional colleague. Translations were made for the measures in Argentina, Egypt, Germany[1], Greece, Hungary, Indonesia, Israel, Italy, Japan, Mexico, Saudi Arabia, Spain, and Thailand. The English version of the measures was used in Australia, Belgium, Czechoslovakia[2], India, Kenya, Northern Ireland, Poland, Singapore, Yugoslavia (Croatia)[3] and the United States.

RESULTS

Measurement Characteristics

The measurement instruments were developed and adapted from instruments that have established reliability and validity characteristics (Rosen et al., 1987). Before making any between-country comparisons, it was important to reestablish the reliability of each of the adapted measurement instruments. For the CARS-C, Cronbach's alpha coefficient of the entire sample was .90, with 20 of the 23 countries showing alpha coefficients above .80. For the CTS-C, the alpha of the entire sample was .85, with 14 of the 23 countries showing alpha coefficients above .80 and four more with alphas between .60 and .79. Thus, both of these measures were considered to be reliable indicators of the constructs that they were measuring.

The GATCS-C was not shown to be reliable. In only one country, the United States, was the alpha coefficient above .60. All other countries had alpha coefficients that indicated unreliable measurement of the construct of computer attitudes. It is interesting to note that the CARS-C and the CTS-C were both measured on the same "anxiety rating scale" of "not at all" to "very much" in assessing how much anxiety a situation caused or how often certain thoughts or cognitions were internally voiced about computer interaction. The GATCS-C was the only one of the three scales measured on a standard five-point Likert scale ("strongly agree" to "strongly disagree"). Perhaps this Likert-scale format may not be as appropriate for assessing a construct such as technophobia in cultures other than the United States.

The CARS-C and the CTS-C were interrelated, but were not identical constructs ($r = -.34$ for the entire sample, with 15 out of the 23 countries showing significant negative relationships and an additional five showing nonsignificant negative relationships). With about a 10% overlap, these two measures have always been found to be related, overlapping, but not identical measures of technophobia and are considered to form two nearly independent dimensions of the construct (Rosen et al., 1987).

Level of Technophobia

Based on prior validation studies (Rosen et al., 1987; Weil, Rosen, & Sears, 1987; Weil, Rosen, & Wugalter, 1990), the distributional characteristics of both the Computer Anxiety Rating Scale (Form C) and the Computer Thoughts Survey (Form C) were each shown to reflect three levels of comfort with computers and technology for university students — no technophobia, moderate technophobia, and high technophobia. Based on these categories, Figure 1 displays the percentage of students with "high" levels of technophobia for each country. Table 2 displays the mean and standard deviations of the CARS-C and the CTS-C for each country. Although the data speak for themselves, several comments can be made about them. First, there is a wide range in computer anxiety scores between the 23 countries on both the CARS-C ($F(22, 3333) = 47.36$, $p < .0001$) and the CTS-C ($F(22, 3336) = 16.79$, $p < .0001$). Second, as seen in Figure 1, there is a group of country samples that shows large numbers of technophobic students including Indonesia, Poland, India, Kenya, Saudi Arabia, Japan, Mexico, and Thailand. All of these country samples showed more than 50% of the students as technophobic. In contrast, there are five countries (USA, Yugoslavia-Croatia, Singapore, Israel, and Hungary) whose samples contained less than 30% technophobic students. Third, not all country samples showed students to be technophobic on both dimensions. For example, as seen in Table 2, the sample from Indonesia appeared to have students who were both anxious and had negative cognitions about technology. In contrast, while the sample from Kenya showed quite high technological anxiety scores, the negative cognitions scores were the lowest of all 23 countries.

Demographic Correlates of Technophobia

The left two columns of Table 3 show the correlations of each scale with age and gender. As seen in the table, age was only mildly correlated with each of the

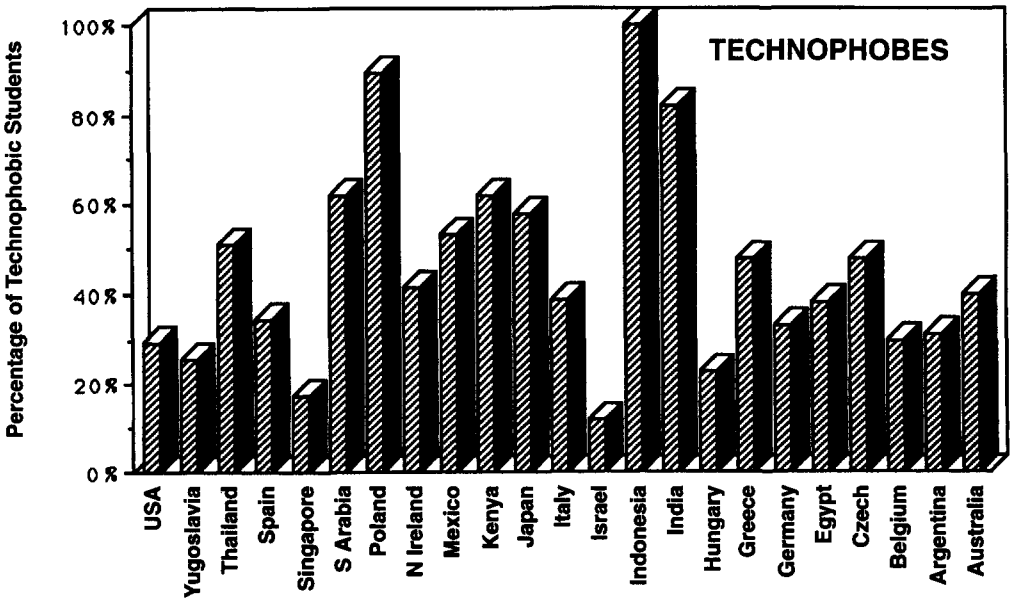

Figure 1. Percentage of students in each country who possessed high levels of technophobia.

Table 2. Mean and Standard Deviation for CARS-C and CTS-C for 23 Countries

	Computer Anxiety (CARS-C)		Computer Cognitions (CTS-C)	
Country	Mean	*SD*	Mean	*SD*
USA	37.93	14.16	71.37	15.21
Yugoslavia	37.16	11.07	70.31	10.77
Thailand	46.96	12.48	69.11	6.91
Spain	38.84	11.15	68.00	11.86
Singapore	38.50	8.44	65.96	14.56
Saudi Arabia	53.33	15.41	74.54	8.73
Poland	53.74	4.37	64.37	4.43
No. Ireland	42.83	13.42	64.81	13.79
Mexico	51.23	16.63	73.76	7.07
Kenya	55.14	20.13	79.12	11.97
Japan	47.76	14.67	63.68	11.86
Italy	42.00	12.32	69.07	9.68
Israel	32.14	10.40	72.86	11.46
Indonesia	66.05	4.90	59.34	4.00
India	62.31	16.58	72.63	12.14
Hungary	38.03	10.90	72.44	10.19
Greece	37.79	9.73	62.07	5.26
Germany	36.95	12.24	66.61	11.39
Egypt	42.86	7.73	66.93	8.93
Czechoslovakia	45.35	12.64	65.04	12.70
Belgium	32.02	9.60	65.40	9.84
Australia	38.15	12.21	66.24	14.33
Argentina	39.26	14.56	71.31	12.78

Note. Higher CARS-C scores indicate higher computer anxiety (possible range = 20–100; higher CTS-C scores indicate more positive computer cognitions (possible range = 20–100).

technophobia measures for the entire sample and only correlated significantly for four countries. The CARS-C was significantly negatively correlated with age for only the samples from Mexico and Czechoslovakia, implying that for these countries, older students had less technological anxiety. The CTS-C was positively correlated with age for the samples from Czechoslovakia, Germany, and Singapore, suggesting that older students had more positive cognitions about their interaction with technology.

The relationship between technophobia and gender was also examined for the entire sample and for each individual country (except those with only male or only female students). The middle column of Table 3 displays these results. Both the CARS-C and the CTS-C were correlated with gender with males showing more anxiety and more positive cognitions than females in the total sample. However, only three countries showed males with significantly more computer anxiety (Thailand, Italy, and Kenya), while two others showed females as being significantly more computer anxious (Israel and Hungary). Eight country samples showed males as having significantly more positive cognitions than females (USA, Singapore, Kenya, Israel, Hungary, Czechoslovakia, Belgium, and Australia), while only one showed the reverse (Northern Ireland). Thus, there is no worldwide consensus on who are more technophobic — males or females. This mirrors the results seen with samples from the United States where some show gender differences while others do not (see Rosen & Maguire, 1990 for a more detailed examination of this effect).

Male and female students were also compared on the percentage who could be labeled as "technophobic" (high technophobia on either dimension). When the

Table 3. Correlations of CARS-C and CTS-C with Age, Gender, and Experience

	Age		Gender		Experience	
Country	CARS	CTS	CARS	CTS	CARS	CTS
USA	.03	–.05	.06	–.12**	–.27***	.40***
Yugoslavia	.01	.07	.10	–.09	–.31***	.52***
Thailand	.04	–.07	–.18*	–.04	.15	.23*
Spain	.02	.02	–.11	–.03	.12	.19**
Singapore	–.12	.23*	.11	–.26*	–.37***	.08
Saudi Arabia	–.06	.00	na	na	–.05	.29**
Poland	.09	.09	–.11	–.01	–.12	.42*
No. Ireland	.06	.08	–.06	.20*	–.07	.27*
Mexico	–.26*	–.10	.00	.03	.11	.31*
Kenya	.10	–.04	–.31***	–.17*	–.01	.34***
Japan	.01	.06	.07	.00	–.02	.21***
Italy	–.09	–.06	–.17*	–.02	.03	.27***
Israel	–.03	.01	.17*	–.18*	–.47***	.48***
Indonesia	.06	.15	–.18	–.01	–.15	–.08
India	–.14	.00	–.09	–.03	–.218	.24*
Hungary	.02	.04	.16**	–.14*	–.17**	.41***
Greece	–.16	.17	–.03	–.04	–.12	–.01
Germany	–.02	.13*	–.08	–.03	–.38***	.46***
Egypt	–.06	.02	.12	–.08	–.22*	.17
Czechoslovakia	–.23**	.37***	.12	–.48***	–.07	.21**
Belgium	–.07	.14	.09	–.24*	–.01	.10
Australia	–.06	.05	.06	–.17**	–.24***	.22***
Argentina	.16	–.17	.11	.08	–.09	.25
Entire sample	–.12***	.08***	–.11***	–.08***	–.21***	.21***

Note. Correlation could not be computed for the all male Saudi Arabian sample.
$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

entire sample was examined, there was a significant, but small, difference between the percentage of male technophobes (45%) and female technophobes [39%; $\chi^2(1) = 8.96$, $p < .003$]. When individual countries were examined, only one country had significantly more male technophobes (Kenya) and another three had significantly more female technophobes (United States, Hungary, and Australia). Thus, it is difficult to make any type of generalization from these percentages.

Relationship of Technophobia With Computer/Technology Experience

Computer/technology experience was assessed in two ways. First, students were asked how often they had used 10 different types of technology including using computers as a student, learning a programming language, using automated banking machines, using a computerized library card catalog, using a computerized library literature search, playing computer games, using a programmable microwave oven, using a video-cassette recorder, and playing video arcade games (each was measured on a four-point scale). Second, the students were asked if they owned a home computer and whether they planned to purchase one in the next 5 years.

These data were analyzed in a variety of ways and all analyses suggested the same conclusion. The Computer Anxiety Rating Scale (Form C) and the Computer Thoughts Survey (Form C) were significantly related to computer/technology experience and, to a lesser extent, to computer ownership. Treating the 10 computer/technology experience items as a single, summated scale (validated by a factor analysis and a reliability assessment), the far right columns of Table 3 indicate that nine countries showed significant negative correlations between the CARS-C and

computer/technology experience (USA, Yugoslavia-Croatia, Singapore, Israel, India, Hungary, Germany, Egypt, and Australia). In these nine countries, those students with less computer and technology experience had more computer anxiety. The results for the CTS-C were even more striking: 17 countries showed significant positive correlations between computer cognitions and computer/technology experience (USA, Yugoslavia-Croatia, Thailand, Spain, Singapore, Saudi Arabia, Poland, Northern Ireland, Mexico, Kenya, Japan, Italy, Israel, India, Hungary, Germany, Czechoslovakia, Australia), indicating that nearly all countries showed that students with less computer/technology experience had more negative cognitions about computer operation. For computer ownership, three countries showed that computer owners had significantly less computer anxiety (USA, Greece, and Australia) while in nine countries computer owners had significantly more positive cognitions about computers (USA, Yugoslavia-Croatia, Saudi Arabia, Italy, Israel, Hungary, Germany, Czechoslovakia, and Australia).

A related question is whether male students have more computer/technology experience than female students. This has become somewhat of an issue in the United States with numerous empirical studies (e.g., Collis, 1985; Dambrot et al., 1985; Felter, 1985; Gilroy & Desai, 1986; Loyd & Gressard, 1984; Hess & Miura, 1985; Jay, 1985; Popovich, Hyde, Zakrajsek, & Blumer, 1987; Wilder, Mackie & Cooper, 1985) demonstrating that female students of all ages are participating less than their male counterparts in a multitude of computer activities including computer work at school, video arcades, summer camps with computers, etc. In looking at the data from the 23 country samples, one could, indeed, say that the female students had less computer/technology experience than the male students. Overall, in 10 countries this difference was significant (Yugoslavia-Croatia, Thailand, Mexico, Japan, Italy, India, Hungary, Germany, Czechoslovakia, and Australia), with one country showing significant differences in the opposite direction (in Indonesia the male students had less experience than female students). Individual items among the 11 computer/technology experience questions showed similar patterns with some interesting differences. For example, in the United States and in Greece, male students had more experience than female students playing computer games and arcade games and in Israel, male students used computers more in their university than did female students.

Technological Sophistication

Computer experience in the university. Figures 2, 3, 4, and 5 display various aspects of computer utilization in the university setting. Figure 2 displays the percentage of students who indicated that they had used computers as a student at least once. Figure 3 portrays the percentage of students who had written a computer program. The data in these two figures show quite similar trends, with the majority of students in half the countries having used a computer as a student and written a computer program. The remaining data showed that quite a few country samples were composed of students who had not written a computer program and had not even used a computer.

Figure 4 shows the percentage of students who had used a computerized library card catalog (striped bar) or used a computerized library literature search system (dark bar). This graph shows quite a separation between countries where students use computerized library systems (USA, Singapore, Israel, Germany, and Australia) and countries where such tools are either not available or not used (Yugoslavia-Croatia, Thailand, Spain, Saudi Arabia, Poland, Mexico, Kenya, Italy,

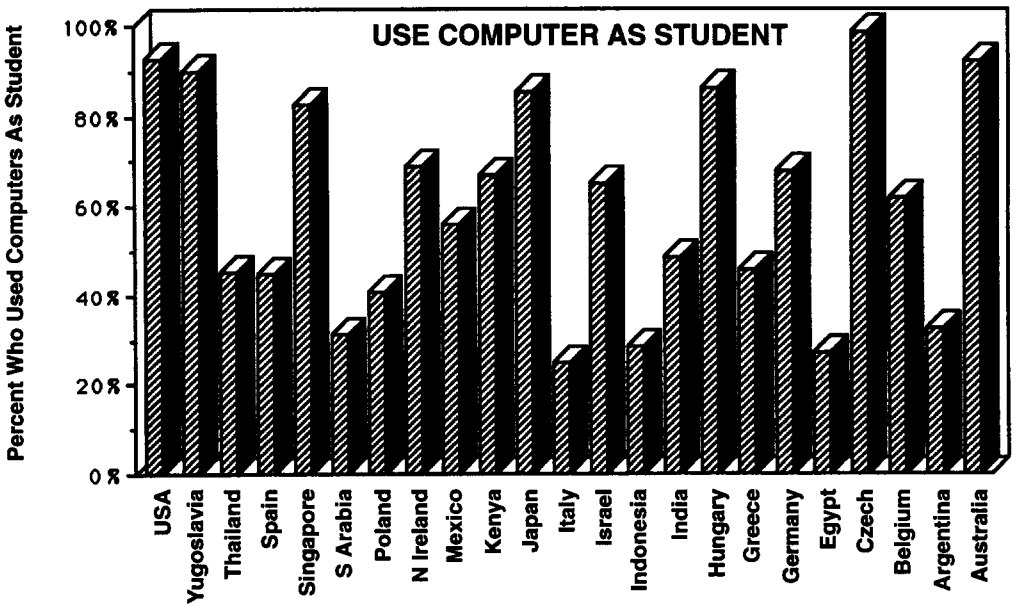

Figure 2. Percentage of students in each country who indicated that they had used computers at least once as a student.

Indonesia, India, Hungary, Greece, Egypt, Czechoslovakia, Belgium, and Argentina). Two countries (Northern Ireland and Japan) appeared to have more moderate use of these tools. These figures match data recently reported by Chen and Raitt (1990) who reported that 58.6% of USA academic libraries and 9.5% of European libraries had CD-ROM's and other optical devices.

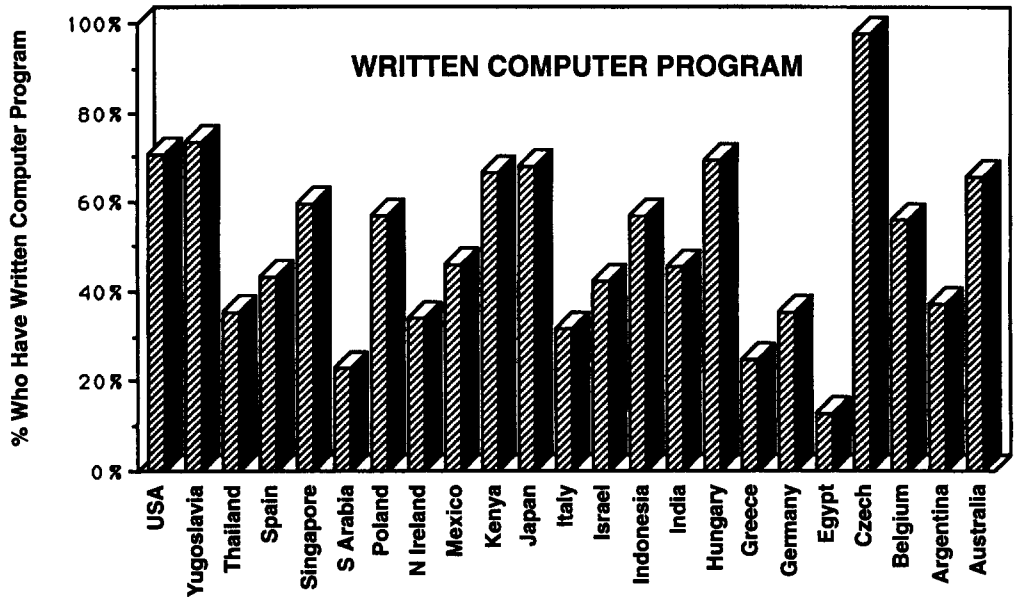

Figure 3. Percentage of students in each country who had written a computer program.

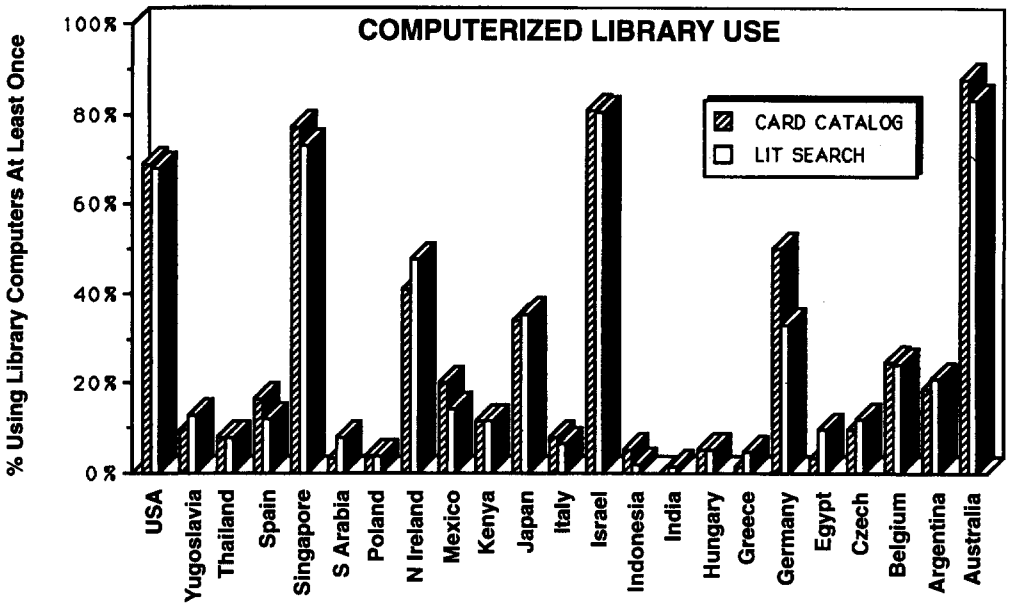

Figure 4. Percentage of students in each country who had used a computerized library card catalog (striped bars) or used a computerized library literature search system (clear bars).

Figure 5 shows the percentage of students who had used word processing at least once. Again, these results are similar to the three previous figures, showing that some country samples used this computer tool more often than others. In terms of absolute usage, however, word processing was used much less by the students than writing computer programs.

Computer ownership. Personal computers can be purchased by citizens in nearly all countries of the world. A question on the demographic questionnaire asked each student if they currently owned a personal computer and if they planned to purchase one in the next 5 years. The data on computer ownership are displayed in Figure 6. Although one might have predicted that more students in the United States would own personal computers, this was not the case. In fact, as seen in Figure 6, the United States students were only the sixth most likely to own personal computers after the samples from Israel, Spain, Singapore, Germany, and Belgium. The data concerning whether the students plan to own a computer within 5 years provide an interesting assessment of the future of home computer technology in each country. Although the data are not displayed here, eight country samples showed over 50% of the students claiming that they did not plan to own a computer within 5 years (Poland, Northern Ireland, Kenya, Hungary, Greece, Egypt, Czechoslovakia, and Argentina), with another five indicating that between 40% and 50% did not plan to own a computer within 5 years (Japan, Italy, India, Germany, and Belgium). Thus, 13 of the 23 countries showed a limited future of home computer technology. However, this may be due only to the level of technophobia. As shown by Rosen, Sears, and Weil (1993), once the technophobia is removed, this interest in home computers should increase dramatically.

Computer game playing. Students were asked how often they played computer games and how often they played arcade games. While the former require a per-

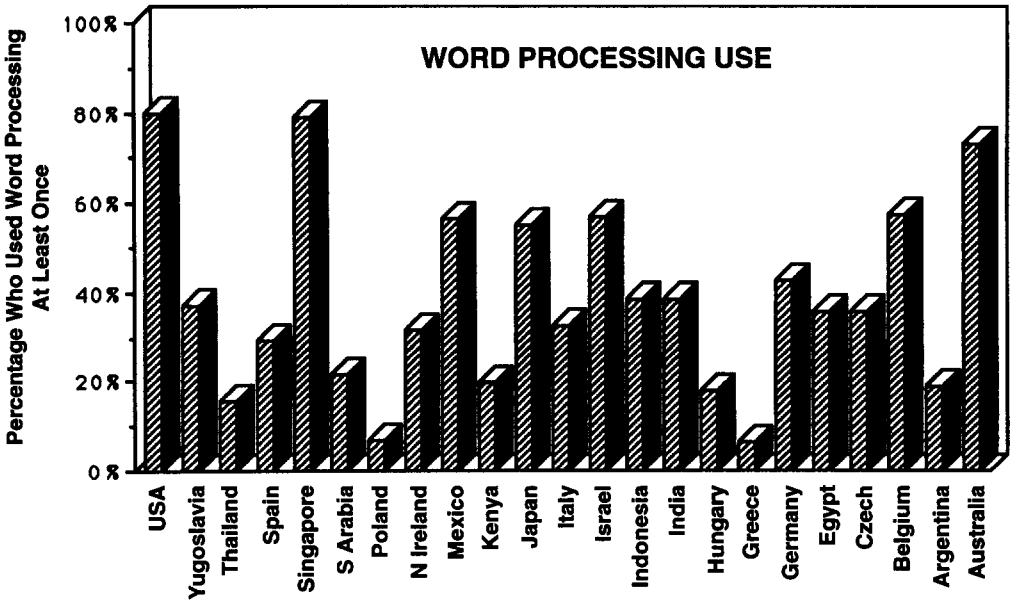

Figure 5. Percentage of students in each country who have used word processing at least once.

sonal computer, the latter are housed in arcades with other adolescent-oriented games. These data are displayed in Figure 7 with the light-colored bar reflecting computer game playing and the darker colored bar indicating arcade games. From this figure, it is immediately evident that most students in most countries have vast experience with computer and arcade games.

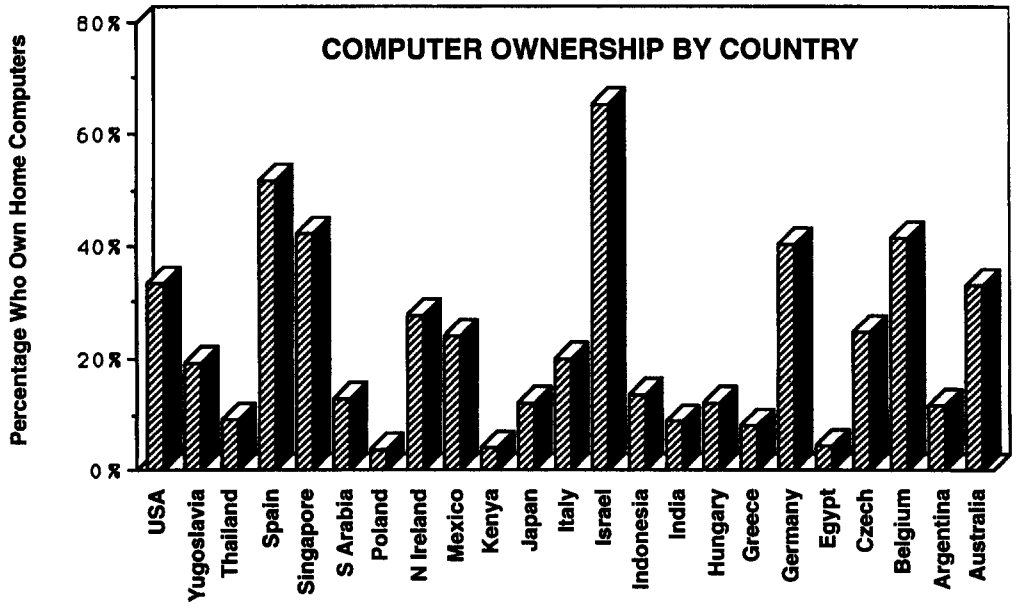

Figure 6. Percentage of students in each country who own a home computer.

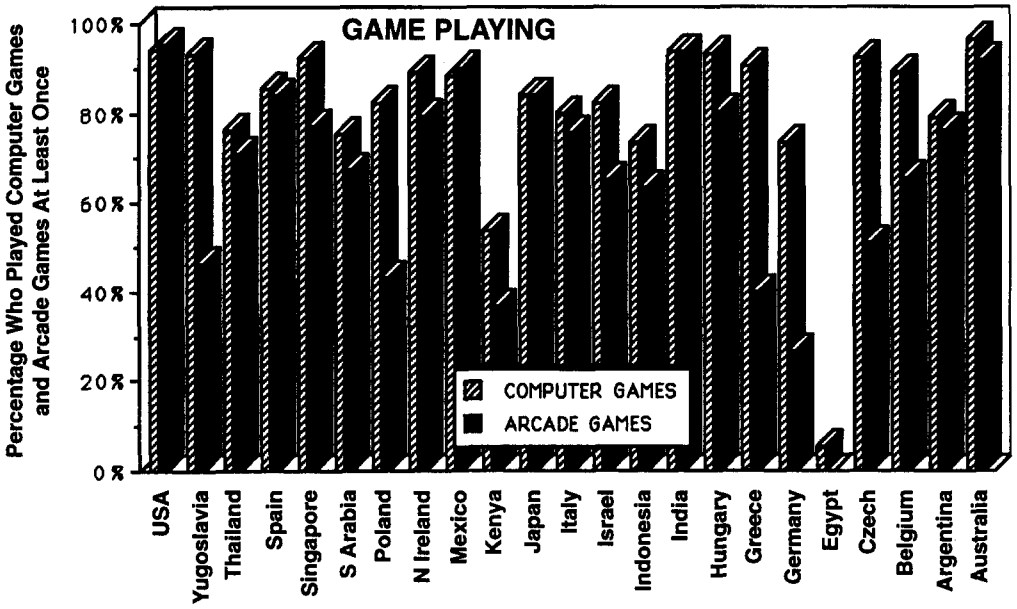

Figure 7. Percentage of students in each country who played computer games (light-colored bar) and arcade games (dark bar) at least once.

Household and consumer computer uses. Figures 8, 9, and 10 show the percentages of students who have used video-cassette recorders — VCRs (Figure 8), programmable microwave ovens (Figure 9), and automated banking machines — ATMs (Figure 10). Not surprisingly, the vast majority of students in most countries had used a VCR at least once. In fact, most students had used a VCR many, many times. Only two student samples (Egypt and Argentina) showed less than 50% use of VCRs. Microwave oven utilization showed quite a different pattern. Only six country samples (USA, Singapore, Northern Ireland, Mexico, Israel, and Australia) showed more than half the students using these kitchen appliances. Nearly all other countries showed minimal use of these household inventions. Figure 10 shows that the distribution of ATM usage is even more dichotomous. Students in 12 countries showed much computer banking experience, while students in the other 11 countries showed nearly no computerized banking experience.

Two-Dimensional Country Representation

Using a stepwise discriminant function analysis with multiple discriminator variables, it was found that two variables were sufficient to provide maximal discrimination between the 23 countries [Function 1: Eigenvalue = 1.11, Canonical Correlation = .73, $\chi^2(44) = 2{,}865.70$, $p < .0001$; Function 2: Eigenvalue = .15, Canonical Correlation = .36, $\chi^2(21) = 460.04$, $p < .0001$]. These two variables included a composite computer/technology experience measure based on an average of all 10 computer/technology experience items and a technophobia measure based on an average of the Computer Anxiety Rating Scale (Form C) and the Computer Thoughts Survey (Form C); with the latter reverse scored. As shown by the standardized canonical discriminant function coefficients, Function 1 was best represented by computer/technology experience ($\beta_{experience} = 1.03$ compared with

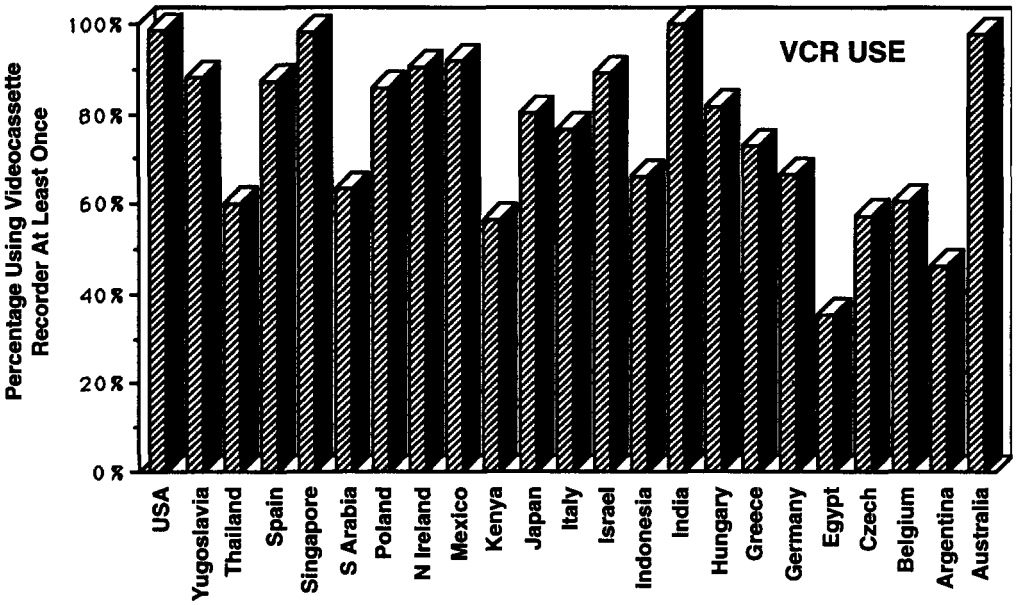

Figure 8. Percentage of students in each country who have used a video-cassette recorder (VCR) at least once.

$\beta_{technophobia}$ = .17), while Function 2 was best captured by technophobia $\beta_{technophobia}$ = 1.02 compared with $\beta_{experience}$ = .11).

These functions are depicted in Figure 11 with the individual country centroids shown in the first two columns of Table 4. Each country sample is given a location

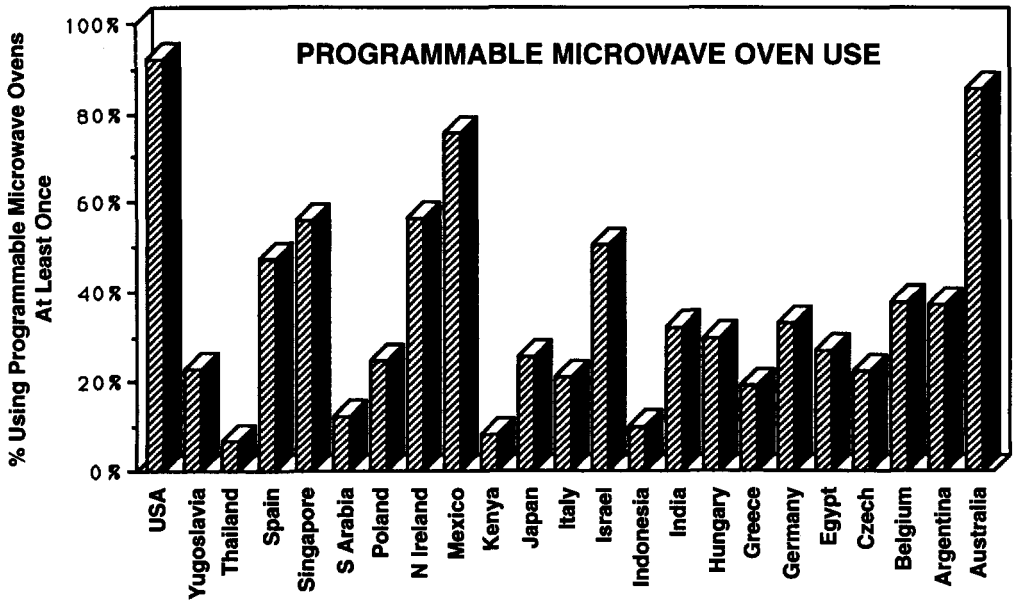

Figure 9. Percentage of students in each country who have used a programmable microwave oven at least once.

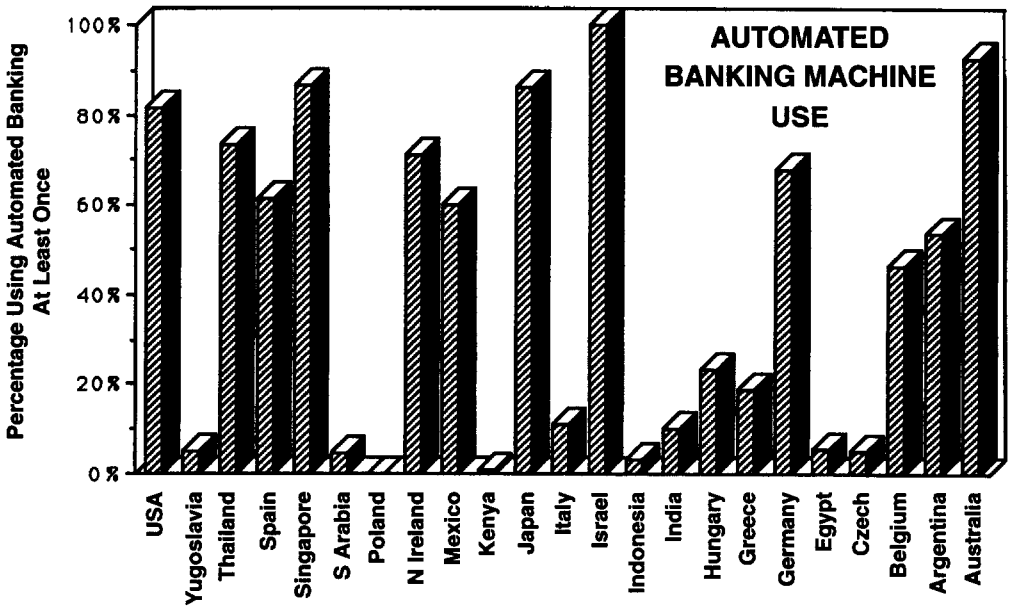

Figure 10. Percentage of students in each country who have used an automated banking machine (ATM) at least once.

in this two-dimensional plot as a function of its computer/technology experience on the horizontal axis and its technophobia on the vertical axis. For example, the sample from Indonesia, plotted in the upper left corner, showed high technophobia and little computer/technology experience. In contrast, the sample from the USA (plotted on the right center of the graph) would indicate much computer/technology experience and moderate technophobia (halfway between moderate technophobia and high technophobia).

Figure 11 shows seven subgroupings of countries: (1) low-to-moderate technophobia with much experience (USA, Israel); (2) low-to-moderate technophobia with little-to-moderate computer/technology experience (most European countries including Yugoslavia-Croatia, Spain, Hungary, Germany, Belgium, and Argentina); (3) high technophobia with moderate experience (Japan); (4) high technophobia with little-to-moderate experience (Indonesia, India, Poland); (5) moderate technophobia and little computer/technology experience (Saudi Arabia, Thailand, Kenya, Egypt, Greece, Italy); (6) moderate technophobia with moderate-to-high experience (Singapore, Australia), and (7) moderate technophobia with moderate experience (Mexico, Northern Ireland).

The right four columns of Table 4 list the group centroids using the CARS-C alone to represent technophobia (the middle two columns) and the CTS-C alone to represent technophobia (the far right pair of columns). For nearly all countries (18 of the 23), the coefficients are nearly identical regardless of the measure used to assess technophobia. For five countries, however, the coefficients are drastically different for the second function. For India, Saudi Arabia, Mexico, and Kenya, the coefficient for the technophobia dimension measured using the CARS-C is much higher than that using the CTS-C, indicating that for those four countries the predominant source of technophobia is anxiety based. For the sample from Belgium, the reverse is true, indicating that these students possessed more cognitively based technophobia.

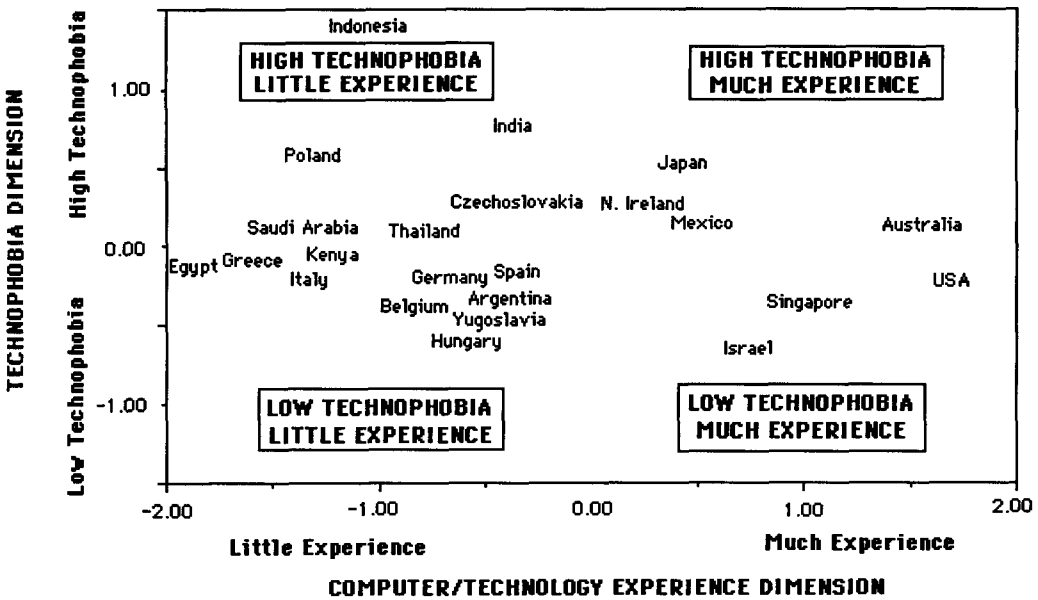

Figure 11. Two-dimensional Discriminant Function Coefficients for each country with the Computer/Technology Experience Function on the horizontal axis and the Technophobia Function on the vertical axis.

DISCUSSION

Three measures of technophobia along with demographic and technology experience data were collected from 3,392 students at 38 universities in 23 countries. Two of the three measures (anxiety and cognitions) were found to be equally valid and reliable across all country samples. The attitude measure was not found to be reliable in any country sample except the United States. Based on earlier validation work with university students in the United States, each country sample was partitioned into students showing no technophobia, moderate technophobia, or high technophobia. Results indicated a wide range of technophobia from a low of 12% in Israel to a high of 100% in the sample from Indonesia. Technophobia was not found to be related consistently with either age or gender but was shown to be strongly related to all forms of computer/technology experience. Female students were also found, in most country samples, to have had less computer/technology experience than male students.

Vast differences were evident in computer/technology utilization in the university, the home, and other consumer arenas. Overall, it was demonstrated that a simple two-dimensional function, using composite computer/technology experience in all areas and composite technophobia (anxiety and cognitions), was sufficient to discriminate several clear subgroupings of countries.

It is important to note four possible explanations for the differences found among the 23 countries in this study. First, both technological sophistication and technophobia may be simply a function of the "availability" of technology. For example, people who live in countries where little technology is available may either fear the unknown or have little discomfort about what they have never experienced. In contrast, people who live in countries where technology abounds may

Table 4. Discriminant Function Centroids for all 23 Countries Using Both CARS-C and CTS-C Combined, CARS-C Alone, and CTS-C Alone to Represent Technophobia

	CARS + CTS		CARS Alone		CTS Alone	
Country	F1	F2	F1	F2	F1	F2
USA	1.59	−0.17	1.60	0.01	1.60	−0.26
Yugoslavia	−0.55	−0.38	−0.45	−0.48	−0.56	−0.14
Thailand	−0.79	0.12	−0.81	0.20	−0.85	−0.02
Spain	−0.47	−0.18	−0.41	−0.34	−0.44	0.05
Singapore	0.98	−0.50	0.96	−0.53	1.08	−0.48
Saudi Arabia	−1.32	0.10	−1.36	0.62	−1.56	−0.52
Poland	−1.32	0.60	−1.44	0.58	−1.36	0.35
No. Ireland	0.09	0.28	0.04	0.11	0.17	0.37
Mexico	0.45	0.23	0.35	0.85	0.25	−0.50
Kenya	−1.26	−0.01	−1.29	0.73	−1.59	−0.82
Japan	0.35	0.53	0.23	0.50	0.40	0.38
Italy	−1.31	−0.16	−1.25	0.25	−1.35	−0.03
Israel	0.70	−0.63	0.84	−0.61	0.71	−0.39
Indonesia	−1.05	1.48	−1.38	1.60	−1.08	0.77
India	−0.38	0.77	−0.60	1.53	−0.64	−0.32
Hungary	−0.61	−0.44	−0.50	−0.43	−0.66	−0.31
Greece	−1.51	−0.03	−1.44	−0.65	−1.36	0.60
Germany	−0.54	−0.22	−0.46	−0.52	−0.47	0.16
Egypt	−2.00	−0.09	−1.94	−0.35	−2.01	0.16
Czechoslovakia	−0.45	0.28	−0.50	0.15	−0.42	0.30
Belgium	−0.73	−0.40	−0.60	−0.92	−0.60	0.27
Australia	1.55	0.08	1.52	0.01	1.65	0.16
Argentina	−0.55	−0.32	−0.47	−0.29	−0.60	−0.24

Note. Higher centroids on F1 = more experience; F2 = more technophobia.

range from fearing the known (and its actual or potential threats) to embracing the wide variety of techno-gadgets.

Second, characteristics of the culture itself may lead directly or indirectly to technophobia. For example, some cultures stress conformity while others value individualism. This cultural dimension may affect technology's acceptance. Third, the political structure of the country may either inhibit or encourage the use of computers and may inadvertently (or purposely) promote technophobia. A country whose government leaders have the power and money to allocate funds for technological expansion may thrive on technological change compared with other countries where poverty is the norm. Fourth, the time and manner in which technology is introduced into the educational system may have a profound impact on how it is received. In addition, the attitude of the "introducer" may also affect its reception.

The following sections will summarize these issues by groups of countries seen in the two-dimensional representation displayed in Figure 11. Data on availability of technology are displayed in Table 5 for all 23 countries and in Table 6 for the world leaders in additional forms of technology.

Individual Country Analyses

In Figure 11, the USA, Israel, Singapore, and Australia showed more computer/technology experience than all others and only low-to-moderate technophobia. From the data shown in Table 5, it is clear that the USA is far and above the leader in consumer technology usage with more telephones, televisions, radios, and automo-

Table 5. Statistical Data for 23 Countries(1983–1985)[a]

Country	Telephones (per 1000)	Radios (per 1000)	TVs (per 1000)	Autos (per 1000)	Literacy (% read/write)
USA	755	2030	785	537	99%
Yugoslavia	132	235	209	125	90%
Thailand	14	148	17	8	88%
Spain	359	285	257	240	93%
Singapore	399	272	188	87	83%
Saudi Arabia	152	307	256	184	25%
Poland	105	247	254	98	99%
No. Irelandb	252	456	249	199	100%
Mexico	86	291	111	64	83%
Kenya	12	50	4	6	47%
Japan	533	710	562	230	100%
Italy	426	249	404	392	94%
Israel	381	267	253	143	92%
Indonesia	5	138	23	6	67%
India	4	62	3	2	41%
Hungary	134	540	371	135	99%
Greece	356	406	178	127	90%
Germany	621	401	360	428	100%
Egypt	17	174	44	19	38%
Czechoslovakia	226	270	280	171	100%
Belgium	431	468	301	339	100%
Australia	532	1300	429	500	99%
Argentina	104	536	198	123	94%
WORLD AVERAGE	123	310	135	78	70%

[a]Data compiled from Showers (1989), The World in Figures (1987), Central Intelligence Agency (1989).
[b]These data reflect Ireland and Northern Ireland combined. No separate data available for No. Ireland.

biles per 1,000 people than any of the other countries. The data in Table 6 confirm this superiority in nearly every other category. Australian citizens also appear to own many communication and entertainment devices (as seen in Tables 5 and 6). As seen in Table 6, they are also not far behind the USA in business applications, evidenced by the ownership of computers (6th in the world) and fax machines (4th in the world). These data confirm that these two countries do, indeed, belong at the far right of the Computer/Technology Experience Dimension as seen in Figure 11. Singapore and Israel, the two country samples that had the next most computer/technology experience in this study, do appear to have a moderate amount of technology available in their countries, although neither is at or near the top of any category in Table 5 and neither appears in Table 6 (indicating that they were below all the listed countries in each category).

How then might one explain why Israel had the least technophobia among all the countries and Singapore had the same level of technophobia as the USA and Australia in spite of their clearly advanced technological availability? At the same time, why did the Australian and USA samples show more technophobia than many European country samples who, according to Tables 5 and 6, had much less technology available in their countries? To answer these questions, it is important to examine the cultural characteristics of each of these countries.

Israel. The people of Israel have been under siege for all of biblical and modern time. A small country, Israel's population of around 5,000,000 has become

Table 6. Statistical Data for Major Users of Consumer Technology[a]

Type of Technology	USA	Spain	Japan	Italy	Greece	Germany	Belgium	Australia
Answering machine	42%	2%	<1%	2%	1%	4%	5%	< 1%
Fax/1000 people	50	17	65	26	11	84	41	45
Computers/1000 people	202	17	75	43	22	82	70	66
Home computers	26%	8%	8%	12%	6%	16%	15%	< 5%
Cable TV	55%	22%	12%	< 1%	< 1%	29%	< 1%	< 1%
Remote Control	72%		100%	81%		84%	68%	
Color TV	97%	93%	100%	88%	69%	94%	93%	97%
TV hours/day	7:00	3:00	9:12	2:04	< 2:00	2:13	2:55	< 2:00
Video camera	18%	4%	12%	4%	< 1%	6%	6%	< 1%
VCR in home	62%	40%	55%	25%	37%	42%	42%	66%

[a]Data compiled from Wolff, Rutten, and Bayers (1992).

accustomed to continual struggles with their neighbors in the Middle East. These struggles have made Israelis a driven, positive people who have embraced technology for how it can help them survive. In spite of its size, Israel is among the world leaders in producing state-of-the-art technology that is used throughout the world; for example, their Scitex computer graphic technology is used by many major magazines including Time, Newsweek, and National Geographic. Israel is also firmly committed to the introduction of technology early and comprehensively in the school system. Control of government funding for software and hardware resides with a high-level committee of the Ministry of Education. With a distribution ideology aimed at all levels, virtually all high schools and over half the elementary schools are now using computers (Pelgrum & Plomp, 1991). Millin and Barta (1991) report that of the 7,000 Kindergartens and 2,650 schools, 70% have computers and "are using them mainly for various ways of enhancing education, improving teaching/learning and computer sciences" (p. 172). Further, Millin and Barta report that this computer integration has boomed in the past half decade with the number of schools with computers increasing from 29% in 1985 to 70% in 1990. Since 1983, all students attending teacher's colleges have been required to take at least one, 120-hr computer literacy course (Davis, 1986; Millin & Barta, 1991). This national character and commitment to technology, clearly evident during the recent Desert Storm maneuvers, has produced a compatibility between the Israeli people and high technology.

Israel's Center for Educational Technology adapted and implemented a nationwide Computer Assisted Instructional program called TOAM in 1975. By 1991, it was the most widely used computer system in the Israeli primary educational system. According to Levy, Navon, and Shapira (1991), TOAM is used by 60% of all elementary schools in the country. Levy et al. (1991) indicate that the typical elementary school in Israel has between 32 and 40 computers in a computer lab, with students spending an average of 1 hr per week each at the computer. In their study of nearly 500 parents of elementary school children across the country, Levy et al. (1991) found that 59% of the families in high socioeconomic status neighborhoods owned home computers compared to only 26% of the parents from low socioeconomic status neighborhoods. Since the data in the present study were collected from university students in a fairly high socioeconomic status area of Israel, the data concerning technological utilization and home computer ownership parallel those reported by Levy et al. (1991).

In summary, Israeli students grow up in an environment that embraces technology. This cultural integration, in addition to a school system that teaches the "naturalness" of technology, leads Israeli students to utilize all available forms of technology without discomfort.

Singapore. A relatively new country (established in 1965) with a population of only 2.6 million, Singapore is called one of the "four little dragons" and is considered a powerful player in the technological arena (Wessells, 1990). Singapore has a National Computer Board that sets national policy concerning information technology. Through government subsidies, Singapore has integrated computers into the secondary and postsecondary schools at a rapid rate. All secondary school students are required to take a 20-h computer familiarization course in computer facilities subsidized by the government (Wong, Lim, & Low, 1988). A survey in 1986 indicated that there were computers in every secondary school, with an average of eight computers per school; 18 of the 134 schools also have laboratories with 20 or more machines. An average of seven teachers per school had taken the Curriculum Development Institute of Singapore's 100-h computer training course by 1988 (Hawkridge, Jaworski, & McMahon, 1991; Talisayon, 1989). At the tertiary (university) level, computer applications are taught in nearly every course. Finally, across the country, all libraries in Singapore are completely computerized through a project known as SILAS (Singapore Integrated Library Automation Service) begun in 1983 (Pong, 1990).

Singapore has a national computer network, Comet, that can be accessed freely by any of the half million people who have a personal computer. In addition, Teleview, a project that incorporates fiber-optic cables, videotext, radio wave technology, and interactive computer capabilities, plans to bring a comprehensive communications network into each Singaporean home, business, and automobile by 1995 (Ihlwan, 1992; Gurbaxani et al., 1990). The population of Singapore has a strong, positive view of technology, particularly in light of the fact that most of the skilled and unskilled laborers work directly in the production of technological applications. Coupled with the government's goal of making Singapore an "intelligent island" by 1995, Singaporeans are both familiar and comfortable with technology. As reported by Barker (1988) "Singapore is a highly modernised nation and makes extensive use of the most advanced telecommunications, computer and manufacturing technologies. The people are very diligent, business-oriented and extremely enthusiastic about the use of computer technology — particularly in education" (p. 194).

In a recent comprehensive overview of the government's role in Singapore's information technology (IT) policy, Gurbaxani et al. (1990) concluded: "more specifically, the Singaporean government has been the driving force behind information technology in Singapore by taking a large participatory role and a smaller, but significant regulatory and coordinating role in the development and diffusion of IT throughout the country" (p. 180).

Australia. As seen in the data presented in Tables 5 and 6, Australian consumers rank among the top five countries in ownership of most consumer technology. In addition, as of 1985, two-thirds of all elementary and secondary schools had computer activities, with an average of eight computers per school across the country (Hattie & Fitzgerald, 1987). Given this infusion of technology in Australia, why did the present study show moderate levels of technophobia among university students?

A key to some of the technophobia in Australia might be seen in data collected from over 11,000 people in the 1985 Australian Study of Values (reported by Stubbs in Williams & Mills, 1986). Stubbs reports that "Australians are, on balance, favourably disposed towards science, technology and change, but also that a significant proportion are worried by the pace of that change, and are cautious about new things and new ideas" (p. 191). The same study found that men were more optimistic than women and that Australian women were less convinced of the benefits of modern technology. Another recent report by Clarke (1990) reached the same conclusion. Given that 80% of the Australian sample in this study were women, this differential attitude might explain some of this sample's elevated technophobia. Clarke and Chambers (1989) also found vast differences between male and female tertiary students in computer experience and computer attitudes. Strikingly, the best predictors of intention to continue computing courses were attitudes toward computing and gender! Further evidence to explain Australia's level of technophobia comes from Morrison (1983) and Noble and O'Connor (1986). Both studies found that when measures of computer attitudes from Australian students were factor analyzed, the factor accounting for the most variance was composed of negative attitudes. These results were contrasted to similar work with American adults that found the first factor to be composed of positive attitudes.

Additional insights about the Australian attitudes can be found in Walker's (1991) excellent review of the development of an educational computing policy in the Victorian School System during the last half of the 1970s and the first half of the 1980s. Walker makes a strong case that computers were placed initially into classrooms without much input from the teachers. Through heated controversy, Walker concludes that the Australians have: "... an educational computing policy which was to guide a major and costly educational innovation characterized by managerial rhetoric, confused conceptual thinking and no substantial notion of the social relations of such an important and influential innovation" (p. 311). This result was corroborated by Khamis (1987) who found rather negative attitudes toward computers among the primary teachers that he tested in 1987. Khamis concluded that "Responses of the teachers surveyed suggest substantial inservice courses are necessary to develop teacher competence and foster more positive attitudes towards using micros" (p. 4). Galbraith et al. (1990) also reported similar negative attitudes and fears among teachers.

These "implementation problems" are further validated by two final studies. First, Zammit (1992) reported that when she compared teachers who used computers with their students and those who did not, she found the biggest differences between the two groups were lack of confidence and amount of in-service training. Second, Hickling-Hudson's (1992) recent study showed that Australian secondary schools in wealthy areas were much more likely to have and use computers than those in poor areas, thus exacerbating the socioeconomic divisions that already exist between the two populations. Thus, it may be that some of the technophobic Australian students either came from schools that had few computers or were taught by teachers who were neither confident nor trained.

In summary, despite the availability and proliferation of technology, Australian students were found to be moderately technophobic. The research quoted here suggests that this technophobia may be caused by either the manner of top-down introduction of technology in the educational system, the teachers' technophobia, and/or a sense of public fear of new technology.

USA. In the USA, it appears that nearly every household owns a dozen or more computerized gadgets including VCRs, microwave ovens, digital clocks, telephone answering machines, cable TV, and on and on and on (see Tables 5 and 6). As seen in Figures 2–10, the USA sample students were among the top users in each category. In addition, as early as 1983, 100% of all elementary and lower and upper secondary schools had computers for instructional use (Pelgrum & Plomp, 1991), with the number of computers per school rising over threefold between 1985 and 1989 (Becker, 1991). Yet, even with this continued inundation of computer technology, nearly 30% of the USA sample were technophobic, higher than the student samples from Singapore, Israel, and Hungary. When the combined anxiety and cognitions scores were plotted in Figure 11, the USA scored higher (more technophobic) than seven countries (see Table 4). As a partial explanation, Dorothy Nelkin (reported in Williams & Mills, 1986) chronicles public concerns over technology. Tracing public opinion polls from the 1950s through the 1980s, Nelkin concludes that public opinion about technology has declined, most likely due to the growing concern over the potentially harmful consequences of technology. She cites a number of factors for this trend including the Santa Barbara oil spill in 1969, the Three Mile Island nuclear accident in 1979, and frequent media coverage of toxic waste disposal problems.

Several additional factors might account for the negative public attitudes toward technology in the USA. First, media coverage of "negative events" is high. The fact that a typical USA household (two adults, two children) possesses one to two television sets and four or more radios, coupled with the staggering statistic shown in Table 6 that USA adults watch an average of 7 h of television per day (Wolff, Rutten, & Bayers, 1992), suggest that the media might have an adverse effect on the attitudes of the American viewing public.

Second, although computers are available in nearly all elementary and secondary schools in the United States, *they are not necessarily being used by all teachers or all students.* In their study of nearly 600 public school teachers from five urban school districts, Rosen and Weil (1995) reported that "between one-third and two-thirds of those teachers are not using computer technology personally or with their students because they lack confidence and feel uncomfortable and even a bit frightened by computers and modern technology. They are scared to set up and work with new computer equipment. They are troubled by computer errors and often feel "victimized" by the computer" (Rosen & Weil, 1995, p. 26). Martinez and Mead (1988), in a comprehensive, nationwide study done by the Educational Testing Service, found that even the computer coordinators who were surveyed did not feel that they had the skills and preparation to teach computing. This result was also validated by Vine's (1985) international study where he reported that 64% of the USA adults felt that the greatest obstacle to the development of new technologies is our school system. In a summary of a study of 1,416 schools by the International Association for the Evaluation of Educational Achievement in 1989, Becker (1991) concluded that ". . . in spite of the changes that computers have brought to schools, only a small minority of teachers and students can be said to yet be major computer users." (p. 405). Further, Kondracke (1992) reported that even though computers are "placed" in nearly all public schools in the USA, they are used at school by only 14.7% of the elementary students, 52.3% of the Grade 1–8 students and 39.2% of the Grade 9–12 students. Further, Piller (1992) claimed that computers helped create a "technological underclass" in America based on the statistic that white children use computers at

twice the rate of African American and Hispanic children at the elementary and secondary levels.

Like Australians, it appears that Americans may be technophobic because of the perceived adverse effects of technology and either the lack of introduction of technology or the introduction of technology by technophobic school teachers. Unlike Israel, the USA has no cultural attitude promoting the integration of technology nor does it have an educational system that philosophically and practically embraces technology.

Western European countries. In 1985, in conjunction with the Louis Harris polling agency, the Atlantic Institute for International Affairs polled 9,000 people in six European countries (including three countries sampled in this study — Germany, Italy, and Spain), the USA, and Japan (Vine, 1985).

Italy. Vine's adult subjects from Italy answered most of the questions on the public opinion survey in a favorable direction. Vine found the Italian sample to be inexperienced with technology; only 7% had said that they had used a computer or word processor. However, Vine reported that many more Italian women used computers than Italian men, and that these women had more positive attitudes toward information technology than the men. The data from Figures 2–10 confirm the lack of experience of the Italian students (as well as their location on the two dimensional representation in Figure 11), while the results from the gender comparison in Table 3 confirms that the Italian male students were more technophobic than their female counterparts (who also had more computer experience).

The moderate level of technophobia seen in the Italian sample has been corroborated by Calvi, Colombino, Fazio, and Zampaglione (reported in Williams & Mills, 1986). Calvi and her colleagues point out that "there is a widespread conviction that science and technology are substantially removed from the basic values, life styles and culture of the Italian people" (p. 226). They further note that the historical heritage of the Italian people, based more in art than science, *views technological developments suspiciously*, potentially leading to increased technophobia. In support of this, Calvi et al. supply numerous examples of delays and limitations of technological development in their country. However, they also point to recent trends that indicate that the Italian people, including trade unions and political parties, have become more open toward technological innovations.

Spain. In Vine's summary of the data from Spain he concludes: "Though less technologically developed than some of the other countries polled, Spain reflects, at all levels, unusually high interest in, and very positive attitudes to, the use of information processing systems" (p. 23). For example, while only 12% of the Spanish sample had used a computer system, 41% stated that, although that had not used one, they would be interested in using one. This figure was the highest of any country in Vine's study. Further, this interest was similar across all age groups (except the 50 and older adults) and all professions. Finally, an overwhelming majority of the Spanish sample agreed that the use of computers will reduce the more tedious tasks and will simplify everyday problems and 53% stated that they would be prepared to be retrained in the use of computers if requested by their employer. It should be noted, however, that Vine's study also found the sample from Spain to be the most concerned about computers adversely affecting employment and infringing on privacy.

These trends among the Spanish people were supported by Lopez-Pintor and Ramallo (1986) who found that, in general, the Spanish populous think that technological progress has made work safer, easier, and less boring. However, the same authors also reported that since 1974 the public's attitude toward technology has become more negative, particularly among the youth. This may explain why the Spanish students in the study showed moderate technophobia. Additional evidence concerning Spanish attitudes toward technology comes from Fariña et al.'s (1991) study predicting anxiety toward computers among university students. In their study, Fariña et al. found that the best predictor of computer anxiety was perceived impact of computers on society, suggesting that a positive attitude toward the impact of computers on society may reduce computer anxiety. In January 1987, the Ministry of Education and Science created the Programa de Neuvas Technologias de la informacion y de la Comunicacion (New Information and Communication Technologies Program) to support the introduction of information technology into Spanish schools. Unfortunately, as a report by the Council of Europe (1989) concluded: ". . . it may be said that the introduction of new information technologies into schools with the aim of integrating these into curriculum areas is slow, and that it must be carefully designed and generously planned" (p. 31).

Belgium. Summarizing the data from a study of 1,000 Belgian adults, Eraly (1986) found that, in general, although large numbers of Belgians are not ignorant of computer technology (46% have seen a computer at close quarters), the vast majority (78%) have never utilized it. Eraly quotes the results of another study that suggests that ". . . (Belgian) people need to participate because they would like to control technologies" (p. 306). In summarizing several studies of public attitudes toward technology, Eraly concluded that Belgians are essentially ambivalent toward most forms of technology. On the one hand, they see technology as personally responsible for unemployment, requiring long study and primarily made for young people while, on the other hand, they agree that computers save time, improve daily life, improve the quality of public services, and offer more advantages than disadvantages. As seen in Figures 2–10, Belgian students have a modest amount of computer/technology experience. Eraly also found the same feelings among Belgian adults — although most people were ready to admit the utility of technology devices, they were unwilling to accept them in their homes or their schools. These observations are also confirmed by the data displayed in Tables 5 and 6.

The moderate technophobia seen in the Belgian sample was validated in a study by Weinsier (1990), who found similar results for students at a liberal arts university in French-speaking Belgium.

Germany. The Federal Republic of Germany (this study was undertaken before the unification of West and East Germany) is somewhat of an anomaly in Western Europe. Although the data in Figures 1 and 11 show only a moderate amount of technophobia among the university students (primarily cognitive in nature as seen in Table 2), these results must be qualified for the adult population in general. For example, Vine (1985) summarizes the results for his sample of West German adults by admitting that "Despite its renowned industrial efficiency and expertise, Germany has one of the lowest rates of usage of computers and word processors and is the most apprehensive about their application." (p. 22). Only 11% of the German sample had used computers and an additional 51% had no interest in using one in the future, regardless of their age or profession. German adults were

concerned about the effect of technology on unemployment and privacy, and nearly half felt that computers would not simplify everyday tasks. When asked if they would be prepared to undergo special computer training to keep their jobs, only 37% agreed, second lowest in Vine's study. Peter, Mann, and Thurn (1986), in their examination of various surveys of public opinions toward technology, concurred with Vine's assessment. They found that Germans have a widespread skepticism toward technology, particularly in light of the risks seen in nuclear technology, the politicization of technology and the inability of scientists to use technology to solve society's problems. Siegfried (1983) also found that the highly educated professional youth in West Germany were skeptical of technology. This finding was also supported by Weinsier (1990) who reported that students at a technical university in Germany demonstrated highly negative attitudes toward computers and technology.

Pelgrum and Plomp (1991) reported that nearly all secondary schools in their German sample had computers available for instructional use. However, they also reported that the student–computer ratio in these schools was 47:1, considerably higher than other industrialized countries (the ratio in the USA was 15:1 and in Israel was 26:1). Frey (1988) found that most use of computers in secondary schools was optional, and that computers were essentially nonexistent in primary schools. Further, Frey commented that there were no political forces at work to initiate computer technology introduction in Grades 1 through 6 as of 1988. Thomas et al. (1986) found that German youth were much more positive toward technology than the German adults, perhaps confirmed in this study by the correlation seen between age and negative cognitions in the German university students. Finally, Shears and Dale (1983) refer to Germany as "developed but reluctant" when it comes to its commitment to computers in education.

When the data in Table 6 are compared with the data shown in Figures 2–10, it appears that perhaps the German sample in this study had more technological experience than the typical German adult. For example, while only 16% of all German homes have a home computer, over 40% of the students sampled owned one. In addition, while only 42% of German homes have a VCR, 75% of these students had used one at least once. This difference in computer/technology experience may explain some of the differences between this sample and German adult surveys reported elsewhere.

Northern Ireland. The data from Figure 11 indicate that the sample from Northern Ireland had more technological experience and more technophobia than all other Western European samples. From the data in Figures 2–10, it is clear that the Northern Ireland students claimed to have used computers as students but had not written computer programs, used computerized libraries, nor used word processing. In fact, the only computer applications used by a large number of these students appeared to be computer/arcade games, automated banking, and computerized home appliances. In addition, a study by Gardner, McEwen, and Curry (1986) of over 1,400 Northern Ireland 16–18 year old students' attitudes toward computing showed that girls had more negative attitudes than boys. Since the Northern Ireland sample was over three-fourths female, this may partially explain the high level of technophobia. In addition, a recent report in the *London Times* (Jenkins, 1991) indicated that the people of Northern Ireland have the lowest weekly spending per person among the British Commonwealth countries and had the lowest rates for ownership of microwaves, telephones, video-cassette recorders, and other house-

hold appliances. Taken together, these results may explain the apprehension of the Northern Irish students.

Greece. In Figure 11, Greece appears to show similar levels of moderate technophobia as other countries in that part of the world, but also differs considerably from the other European countries in its limited computer experience. This is perhaps explained by data presented by Pelgrum and Plomp (1991), showing that as of the late 1980s only 4–5% of Greek secondary schools had computers and that these computers were used with ratios of 44–52 students to each computer.

Eastern European countries. Four Eastern European countries were sampled in this study — Czechoslovakia, Hungary, Poland, and Yugoslavia (Croatia). Results displayed in Figure 11 show that these nations were quite disparate in both their computer/technology experiences and their technophobic reactions. The students from Hungary and Yugoslavia (Croatia) showed the fewest technophobes (less than all country samples except Israel and Singapore as shown in Figure 1). The two university samples in Czechoslovakia showed nearly half of the students to be technophobic, while nearly all of the small sample from Poland were anxious and had negative cognitions about technology. The students from Hungary and Czechoslovakia also showed strong gender differences, with fewer technophobic male students than female students. In Czechoslovakia, older students were more technophobic than younger students.

All four countries were placed on the "little experience" side of Figure 11, with Yugoslavia (Croatia), Czechoslovakia, and Hungary showing similar computer/technology experience and the students from Poland showing substantially less. The data from Table 5 support these findings. Hungarians show quite high ownership of radios and televisions (5th highest among the countries in this study!) but rather low ownership of telephones, while the Czechoslovakians showed low to moderately low ownership of all three. In contrast, the Polish and Yugoslavian (Croatian) adults showed less ownership of telephones and radios than the world average. When asked if they either owned a home computer or planned to purchase one within 5 years, 82% of the Polish students said that they did not plan to purchase one within 5 years (the highest percentage of all 23 countries) compared to 55%, 52%, and 36% of the Hungarian, Czechoslovakian, and Yugoslavian (Croatian) samples, respectively. (Only 38% of all students in this study did not intend to own a computer within 5 years — 19% in the USA — so these Eastern European students' aspirations for home computer ownership was lower than many others.)

Part of these differences may be explained by the uses of computers in each country's educational system. Pelgrum and Plomp's (1991) study of computer use in elementary and secondary schools supports these results for Hungary and Poland (Czech and Yugoslavian-Croatian schools were not sampled by Pelgrum and Plomp). As of 1983, 100% of the Hungarian upper secondary schools had computers available for instructional use with a student–computer ratio of 28:1. In Poland, the data showed fewer computers available (only 72% of the schools as of 1987) with a much higher student–computer ratio (53:1). Shears and Dale (1983) classified Yugoslavia (Croatia) as one of three "under-developed and uncertain" nations in their commitment to computers in education. Botlik (1992) described the Czech educational system as a "tragicomic failure" where "Creative and active teenagers with a satisfactory amount of knowledge are not products of our educational system; rather they exist in spite of it" (pp. 59–60).

Each of these Eastern European countries has undergone a massive political change in the past few years. Along with this political upheaval has come economic instability. These two factors have combined to hinder new technological developments due to the lack of expenditure for research and development. However, as Schares (1990) points out, Hungary is the best prospect for technological development, given its relatively high government expenditure on research and development (2.5% of GNP including the newly funded Institute for Coordination of Computer Technology in Budapest).

Developing nations. Eight countries in this study, three from Asia (India, Indonesia, and Thailand), two from the Middle East (Egypt and Saudi Arabia), one from Africa (Kenya), and two from Latin America (Mexico and Argentina) can be classified as developing or Third World nations (O'Connor, 1985). Although these nations all share a goal to develop from a less industrialized status to more dependence on industry and technology, they occupy a variety of positions on the two-dimensional representation in Figure 11. For example, Egypt, Saudi Arabia, Thailand, and Kenya all show a moderate level of technophobia, but little or no technological experience. In contrast, the student samples from India and Indonesia show more computer/technology experience, but much more technophobia. Finally, the sample from Argentina groups more naturally with the European nations showing moderate experience and moderate to low technophobia, while the sample from Mexico demonstrates more technology experience (on a level commensurate with Japan) but moderate technophobia.

The samples from Egypt, Saudi Arabia, Thailand, and Kenya all appeared to have very little technological experience (as supported by the data presented in Table 5), and were moderately technophobic. Evidence from Figures 2, 3, 4, and 6 show these four countries' students to be among the lowest in academic computer experiences, while Figures 8–10 present the same picture for consumer uses. Additional data from Table 5 suggest that adults in these countries have little access to technological communication devices like telephones, radios, and televisions. In much of the Third World, governments have prohibited direct reception of satellite television as a way of protecting the country from Western values (Whiting, 1990). As also seen in Table 5, these countries were also among the lowest in literacy rate ranging from a low of 25% of the population able to read and write in Saudi Arabia to 38% in Egypt, 47% in Kenya and 88% in Thailand. These data present an interesting picture of these Third World countries. They have very little technological experience and are moderately technophobic, perhaps, because they have few opportunities to learn about new technological devices through the usual communication networks.

This hypothesis is also supported by data on the use of computers in the public school systems. In Egypt, for example, four factors work against student exposure to computers. First, only a small number of teachers have been trained to use computers (only 140 teachers out of over 33,000 were trained by 1989). Second, the only equipment available are obsolete French or English computers. Third, while nearly all Egyptian students take their lessons in Arabic, very few computer programs are written in Arabic. Finally, only 45% of Egyptian students continue on to secondary education programs where the computer courses are located (Hawkridge et al., 1991). Similar conditions exist in Kenya, where computer studies do not even appear on the list of recognized secondary school subjects and teachers are obligated to follow the syllabus set for each topic by the government (Hawkridge,

1989). As of 1988, Kenyan schools had only about 230 microcomputers (in over 3,000 secondary schools). One hundred forty of these computers were housed in the nation's 200 private secondary schools, leaving only 90 computers for the nearly 3,000 public secondary schools (Hawkridge, 1989). In Thailand (classified by Shears & Dale, 1983 as underdeveloped and uncertain about technology), only 92 out of 734 secondary schools had computers (mostly used for administrative purposes in white private schools) and only five teachers in the entire country had, by 1987, a diploma to teach computer education. Another survey of Thai secondary schools placed the estimate of computers at 4% of all secondary schools (Talisayon, 1989). Further, a microcomputer in Thailand costs the equivalent of 7.7 months of a teacher's salary compared with, for example, a cost of only 1.7 teacher months in Singapore (Talisayon, 1989).

The Saudi Arabian educational system presents a slightly different picture. Recent estimates (Hawkridge, 1991) have calculated that Saudi Arabia had 50% of all computers purchased in the Near East. Unfortunately, most available programs were written in English and were not usable by the majority of secondary and higher education students. Often when students in these countries are able to read English, the programs themselves are still unsuitable due to substantial cultural differences. For example, Gottlieb (1986), observing African students using a computer program called "Joe's Diner," heard the student's question: "What's a diner?" Finally, in most of these countries, success in secondary school is measured by examination. The few students who do succeed to the point of taking the examination spend much time taking classes and studying potential examination materials. Computer concepts are not a part of these examinations in Egypt, Saudi Arabia, Thailand, or Kenya.

Overall, it appears that people in all four countries are interested in modern technology. However, with their lack of exposure they do not have a clear enough concept of the functions of the various types of technology to be daunted by the difficulties in operation. This is substantiated by reports from Kenya that hundreds of computers and household electronic goods are being brought into Kenyan airports as hand baggage at a cost of 100% duty and 18% value added tax. In spite of this rapid influx of technology, most of these computers and appliances are soon discarded due to lack of spare parts and inadequate repair facilities (Kweyuh, 1992).

The samples from India and Indonesia had little computer/technology experience (as seen by the data in Table 5 and Figures 2–10), but evidenced a large amount of technophobia (80% in India and 100% in Indonesia). This may be a function of the educational system or it may be a function of the political structure of the countries. In the 1970s there were some computers in urban schools in India; however, most of these went unused (Nag, 1987/1988). India is currently in its ninth "Five Year Plan" for education; however, it was not until the seventh Five Year Plan in 1985 that the education policy explicitly recognized the importance of educational technologies. In 1984, the Computer Literacy and Studies in Schools (CLASS) program was instituted in India. CLASS began as a pilot program in 1984 with 250 of 60,000 secondary and higher secondary schools participating. The objectives of this program were to provide a broad understanding of the uses of computers, familiarize students with computer applications, explain to students the potential of computers, demystify computer technology, develop ease with computers, and provide hands-on experiences for secondary students. In 1985 this program was expanded to 750 schools, with an increase to 2,000 schools in the late 1980's (Hawkridge et al., 1991; Nag, 1987/1988). The program also includes 42 regional resource centers

(universities, colleges) that provide training, support, and curriculum assistance to teachers involved in CLASS. Although considered a success, CLASS has had some major problems. Perhaps the most severe has been the language of instruction; in India, at least 15 major languages are used for instruction and most Indian computer software is written in English. Other problems include a much too rapid planning and implementation stage, problems with hardware obtained from England (including an unanticipated problem caused by the dusty climate in India), and teacher anxiety caused by an extensive 80-h training program outside of normal teaching duties (Hawkridge et al., 1991). Overall, recent data by Pelgrum and Plomp (1991) have shown that only 7% of upper secondary schools in India have computers and that the ratio of students to each computer is 572:1. This indicates that the CLASS project may not be fulfilling its goals.

The political structure of India may also explain some of the resistance of students to embrace technology. India is comprised of 24 separate states, each with its own autonomy and each of whom is mainly involved in agricultural production. Educational policy is set by the central government, but is administered by the individual states, accounting for a wide variation in the perceived importance of computers and leading to sparse implementation. In spite of this, India has aspirations of becoming a major player in the area of technology.

In the late 1980s, Prime Minister Rajiv Gandhi placed a tariff on all computer equipment and supplies costing in excess of $10,000 in an attempt to spur production of software and inexpensive hardware within the country (Hawkridge et al., 1991). On some levels this has been successful and on others it has not. For much of the late 1980s and 1990s India has produced a considerable amount of software (for companies like AT&T) with growth rates as much as 40% per year (Fineman, 1990). On the other hand, power failures, poor phone lines, bureaucratic snags, corruption in government, and a premium placed on self-sufficiency have all made it difficult for technology to take a foothold (Weisman, 1986). One particularly apt cartoon showed Gandhi abandoning his smashed desktop computer because it could not find a solution to the Sikh crisis in the north.

Indonesia has 3000 islands making spread of technology difficult. As seen in Figures 2–10 and corroborated by the data in Table 5, the Indonesian people have and use little technology. The government has tried to implement universal primary education but only 50% of 13–18-year-olds are in school (Hawkridge et al., 1991). In addition, Talisayon (1989) reported that less than 9% of the Indonesian secondary schools had computers and that the cost of a computer was equivalent to 15 months of a teacher's salary (compared with 1.7 months in Singapore and 7.7 months in Thailand)! Upkeep of these computers must come from student monies which are, at best, scarce. Further, teachers from mathematics and science departments are entirely self-taught in computer use and applications, although limited computer courses are available to students at teachers colleges. This lack of computer integration in the educational system, coupled with the lack of a government policy on technology, may partially explain the fact that 100% of the Indonesian students tested as technophobic.

Latin America. Argentina appears to be a developing nation that has more computer technology experience (see Table 5 and Figures 2–10) and less technophobia than most others. Azinian (1987–88), in a summary of current Argentinean efforts in this area, stressed the new government efforts to enhance computer literacy. In 1980, the government established its first national policies on informatics and edu-

cation. In this policy, the teaching of programming at the secondary level was given priority. Elementary schools currently have LOGO labs with micro computers bought by parent associations. Unfortunately, poor working conditions and poor teacher training coupled with low budgets, absence of long-range goals because of constant political structure changes, and lack of software in Spanish have led to very low utilization of computers in the school system. In 1984, the National Committee on Informatics was established to analyze these trends. This committee's work led to the formation of a subagency for Studies in Informatics in Education (under the Ministry of Education) that develops projects, provides training, provides assistance, and disseminates projects and results to the nation's schools. Overall, however, Argentina's social problems, including poverty, jobs, and housing, have made computer implementation a difficult task. The bottom line, however, is that computers are mainly found in schools that are affluent, in big cities like Buenos Aires or in private schools.

The Mexican students in this study appeared to have quite a bit of experience with computer technology, particularly applications in the home and on the university campus. The picture is quite different when the entire Mexican population is considered. As seen in Table 5, the Mexican people rank quite low among the 23 countries when consumer technology such as telephones, radios, televisions, and automobiles are considered. Given that the literacy rate for the Mexican population is only 83%, sixth lowest in this study, these data may not accurately represent these people. In a country of contrasts, Murray-Lasso (1990) has commented that it is not unusual to "find private bilingual schools using the most recently developed educational software and the most advanced equipment in the same city block where a public school has no budget to buy chalk and paper" (p. 1). Amidst Mexico's financial crisis of the last decade and a half, the typical worker's purchasing power has decreased 40%. In spite of this, the Mexican government announced in 1984 that it was installing 100,000 computers in the public educational schools. By 1990, the actual number of computers in the school system totaled about 5,000 (Murray-Lasso, 1990). These computers are primarily ancient 8-bit machines with minimal memory and no peripherals (e.g., printers, disk drives). These computers are spread thinly throughout the country, with only one or two computers per school and with little software available for teachers or students. In contrast, the private schools, which account for only a small amount of the school students, usually have complete computer laboratories available for their students. In the conclusion of his recent article, Murray-Lasso (1990), president of the Mexican Society for Computers in Education, commented: "We may see another generation pass before Mexico is able to introduce the `computer wave' of educational technology into its education system" (p. 2).

Japan. The data from Japan present somewhat of an enigma. Most Americans assume that the Japanese are the most technologically sophisticated people in the world. The data in this study, plus data from other recent reports, suggest that this belief is largely mistaken. In this study, the Japanese students from three universities in different parts of the country demonstrated a moderate amount of computer/technology experience and quite a high level of technophobia. Nearly 60% of the Japanese students tested as "technophobic" with either high anxiety, negative cognitions, or, in many cases, both.

Japanese students were quite experienced in some academic computer applications (writing computer programs and using computers as a student), while somewhat

inexperienced in others (word processing) and extremely inexperienced in using computers in the library. Only about 10% of the Japanese students owned home computers. Although most had used a VCR and an ATM at least once, hardly any had ever used a programmable microwave oven (although Yoichi, 1990, reported that 65.1% of the population own microwave ovens). From the data in Tables 5 and 6, it is evident that most Japanese own a color television set with a remote control and an attached VCR, a radio, and a telephone. However, very few own home computers or other business applications such as fax machines and answer machines. These observations were also corroborated by Yoichi (1990) who reported that personal computers were owned by 12.2% of the population, push button phones by 47%, VCRs by 75.5%, color television sets by 196.9% (more than one per person), and cameras by 135.4%.

Perhaps this discrepancy between the use and ownership of consumer technology and business technology can be explained by the introduction of computers in the Japanese school system. Pelgrum and Plomp (1991) found that in 1987 only 25% of all elementary schools, 36% of lower secondary and 94% of upper secondary schools had computers available for instruction. Even when these computers were available, the ratio of students to computer were 14:1 (elementary), 143:1 (lower secondary), and 32:1 (upper secondary). Cassagne and Iloyshi (1992) report similar figures for 1991, with 41% of elementary, 75% of secondary, and 98.5% of high schools having computers with quite different student-to-computer ratios of 114:1, 57:1, and 27:1 in elementary, secondary, and high school, respectively. Watanabe and Sawada (1990), in their extensive surveys of the use of computers in Japanese schools report that for the past 20 years, the major use of computers is in special projects and not in the mainstream school system, per se. The vast majority of these computers were not found in either computer laboratories or classrooms, but rather, were found in "Teachers' Rooms" where students did not have access, indicating that they were used mainly for administrative or management purposes.

One reason computers are not used routinely in Japanese schools may involve a language barrier. Pelgrum and Plomp (1991) indicate that in their study, 61% of the computer programs were in the Japanese language in elementary school, compared to only 27% and 10% in lower and upper secondary schools. Shimizu (1992) traces the difficulties of computer integration to the complex Kanji characters in the Japanese language. A further problem may involve the ways in which computers are used at the elementary levels. Cassange and Iloyshi (1992) reported that computers in elementary schools were used for presentations, free study, or out of class reinforcement of classroom concepts and were not used for classroom education or computer literacy training. Further, they reported that most of these computers are archaic; over three-fourths are 16-bit PCs and an additional eighth are older 8-bit machines. Watanabe and Sawada (1990) also reported that, in 1989, between 19% and 40% of all computers at the elementary and lower and upper secondary levels were 8-bit machines and another 58% to 79% were 16-bit machines.

An additional problem concerns the training that Japanese teachers receive. In their survey of the current state of Japanese computer use in education, Cassange and Iloyshi (1992) found that only 12.8% of Japanese elementary teachers, 22.7% of Japanese secondary teachers, and 35.5% of Japanese high school teachers know how to operate a computer. In an earlier study, Watanabe and Sawada (1989) found that while 7.6%, 14.5%, and 30.2% of elementary, lower secondary, and upper secondary teachers (respectively) knew how to operate a computer, only a small portion of these "computer users" (ranging from one-fifth of the 7.6% elementary

teachers to less than half of the 30.2% upper secondary teachers) responded that they could "teach" about computers. Hitotumatu (1986) contends that this indicates poor teacher training and blames the training style (not enough "recreational" usage) and the language difficulties.

Why are computers not a routine part of Japanese education and Japanese society? When asked why she did not use computers with her third grade students, one mathematics teacher said "class time is too precious to use on machines" (White, 1991, p. 8). The Japanese attend school 240 days a year (compared to 180 in the USA), and this does not include additional tutoring on Sundays, *juku* (after school classes), or *yobiko* (cram schools) that a large number of children attend. It has been estimated that in urban areas, 86% of all 9th graders have attended a juku at some time. All elementary and secondary school work is geared toward the examinations required for the students to earn their places in the Japanese elementary and secondary schools and universities (Hawkins & Tanaka, 1992). This philosophy has fostered a disdain for technological gadgetry and a penchant for rote learning processes. Further, each Japanese high school student takes courses in chemistry, biology, physics, calculus, and earth sciences, areas where software programs, particularly in the Japanese language, are not readily available. Finally, it was not until 1985 that the Ministry of Education, Science and Culture started to express a positive attitude toward placing microcomputers into the Japanese school system and not until 1986 that a Center for Microcomputer Education was established (Sakamoto, 1986).

What are the ramifications of these political decisions and cultural philosophy on Japanese school students? In a recent study of 262 first and second grade school children, Knezak and Miyashita (1991) compared the attitudes toward computers of Japanese students in Tokyo, American students in Sanger, TX, and a group of Japanese students attending a special school for Japanese dependents in Dallas, TX. Using the Young Children's Computer Inventory, Knezak and Miyashita found that the American students were more positive than the Japanese students living in Tokyo with the American Japanese students living in Dallas falling in between. Perhaps this suggests that the lack of computer technology available to Japanese youth has fostered a negative attitude toward computers at this very early age.

A final positive note for the introduction of computer technology into the Japanese school system was reported by Gross (1992) when he stated that "Worried that computer phobia will become a competitive liability, Japan is going on a school-computer buying spree" (p. 89). Gross detailed Japan's Education Ministry's current 5-year plan (1991–1996) to spend more than $200 million to help or rural and suburban schools purchase computers and software. Coupled with local government plans, Gross projects that this 5-year effort will cost nearly $2 billion dollars!

Japan is a prime example of what has already been noted for many countries, including the USA. The manner of introduction of this massive influx of technology will strongly effect whether it increases technophobia or decreases technophobia.

Limitations

There are several limitations to using the results of this study to quantify the use of technology and/or the level of technophobia in any of the 23 countries. First, there was no attempt to gather samples that were representative of all university freshmen in any of the countries. In some countries, multiple samples were collected, while in others, only one sample from one university was available. It should be

noted that given the known limitations in crosscultural research (Oyen, 1990) it is not possible to assert that the samples are "representative" of typical freshman university students in any particular country. It should also be noted in Table 1 that sample sizes varied widely, making comparisons between large and small samples difficult. Additionally, only a small number of universities were sampled (not randomly) out of the total number of universities in each country. For some nations, this study's sample represented only a small fraction of the total number of universities in each country (e.g., only 6 of the 3,406 universities in the USA and only 3 of the 1,123 Japanese universities were sampled), while for the other nations, this sample represented a larger proportion (e.g., 3 of the 110 West German universities, 2 of the 36 Czechoslovakian universities, 3 of the 95 Australian universities, and 1 of the 4 Kenyan universities; Central Intelligence Agency, 1989).

A second limitation concerns sample sizes. As seen in Table 1, sample sizes ranged from 473 USA students to a low of 28 Polish students. Twelve countries had samples of fewer than 100, and two had samples of fewer than 50. This makes generalizations exceedingly tenuous.

A third limitation concerns the actual translations of the three technophobia instruments. Translated measures were used in 13 countries, with the original English versions used in the remaining 10. Few controls were performed to check for the adequacy of these translations (although each translation was verified by an additional native speaking colleague), nor were "back translations" completed in any systematic manner. No assessment was made of the English proficiency of the students in the nine countries other than the USA who used the English language versions. As noted by Hocevar and El-Zahhar (1993), these issues may present interpretation problems.

Implications

The results of this study present an interesting worldwide view of the psychological impact of technology. From the analysis of each country's experiences with technology, it is clear that the amount and type of technophobia and the level of technological sophistication can be viewed as a complex interaction between the amount of available technology, the manner of introduction of technology into the school system, the cultural characteristics of the country's population, the present and past political climate, and the levels of literacy and poverty.

These findings suggest that the strongest criteria for students with no technophobia or low levels of technophobia include a culture that: (a) values technology, (b) integrates technology early in the formal educational system, and (c) has a supportive political climate. This combination leads to a total integration and identification of technology with a sense of comfort and "naturalness." On the other hand, certain factors are evident that lead to technophobia. A lack of cultural or political identification, little or no early educational exposure, and/or a "top-down" infusion of technology (with no inherent sense of naturalness) leads to technological confusion, fear, and a sense of isolation.

In some countries, all factors work toward a comfortable, successful integration of computer technology. For example, in both Israel and Singapore, computers are a part of everyday life of a school child from a very early age. The political processes and cultural characteristics in both countries support the use of technology for the betterment of the country as a whole. In other countries, all factors are working against the integration of technology. For example, in most Third World

countries, computers are all but absent from the educational systems. This is due to a combination of the lack of funds and political systems that do not support technological change. This should be contrasted to some of the newly evolving Eastern European powers (e.g., Hungary) who have the government, the educational system, and the people all pushing for the immediate advancement of technology in all areas of life.

Finally, some countries present a mixed picture. Japan, for example, seems, on the surface, to have a very positive view of technology. However, computers are almost absent from the educational system during the primary years, and the political structure has only recently begun to support the use of computers in education at all levels. Cultural values may also be responsible for the large number of technophobes found in the Japanese universities sampled. Traditional Japanese values are placed on educational success that does not, necessarily, include computer skills.

Overall, however, it appears that countries that place a great deal of emphasis on comprehensive and well-integrated early computer education appear to have the university students who are most comfortable with computer technology. Countries who had the fewest technophobes were those that introduced computers at the early primary grades and allowed students ample time to work on the computer without sharing with other students (i.e., a low student-to-computer ratio). However, when the teachers who were introducing these computers felt that they were inadequately trained and/or uncomfortable with computers themselves, the students did not fare as well when they reached the university level. These conclusions were supported by the work of Rosen and Weil (1995) in their study of primary and secondary school teachers. Rosen and Weil concluded that the early introduction of computers in a nonevaluative, play-like atmosphere by teachers (or parents) who were, themselves, comfortable with technology, were necessary ingredients for the successful introduction of computer technology. This study suggests that this is also true in countries other than the United States.

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NOTES

[1]At the time of data collection, all three universities were part of the Federal Republic of Germany (West Germany). Since that time, West and East Germany merged into one republic. This country will be referred to as Germany throughout the text.

[2]The two participating universities from Czechoslovakia now reside in the Czech Republic.

[3]At the time of data collection, the University of Zagreb was part of Yugoslavia. Although it is now part of Croatia, the data will be referred to as coming from Yugoslavia-Croatia for the sake of general comprehension.

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