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In Memoriam: Stef Postma

South Africa has lost one of her most colourful and eminent computer scientists. Professor Stef Postma passed away peacefully in his sleep on May 5, 2000 after a short illness. He will be remembered for his forthright views and total integrity. Never a man to shy from controversy, he always debated his position with vigour, displaying his extensive vocabulary at every opportunity.

Those who knew him mourn the loss of a very good friend.

Stef was born on August 10, 1938 in Graaff-Reinet and matriculated from Höerskool Linden in Johannesburg. He majored in geology and mathematics at the University of the Witwatersrand and graduated with honours in mathematics from that university. Stef devoted much of his life to promoting computer science as a science and to this end spent a lot of energy and time defining syllabi for undergraduate and honours courses at our universities. He was the prime mover in creating the South African Institute of Computer Scientists and Information Technologists (SAICSIT) in 1982, providing a professional body to represent the interests of local computer scientists. He was also instrumental in establishing Quaestiones Informaticae (now the South African Computer Journal) which afforded South African computer scientists the opportunity to publish papers locally in a refereed journal.

-Doug Laing

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Technological Experience and Technophobia in South African University Students

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Abstract

In an earlier study co-ordinated by Weil and Rosen, university students in 23 countries were surveyed in order to compare their levels of technological sophistication and technophobia. The countries sampled did not include South Africa and little is known about levels of technophobia in this country. The author replicated Weil and Rosen's study at a South African university in order to position South Africa relative to the 23 previously-studied countries. The South African sample showed higher levels of technological experience than expected, but also higher levels of technophobia, in particular, high levels of computer anxiety.

Keywords: *Technophobia, Attitudes to computers, South Africa, Technological experience*
Computing Review Categories: *H.1.2, K.4.2*

1 Background

Although many studies have sought to measure people's fear of computers and related technology (see [2] and the meta-analysis in [10]), very few have been undertaken in South Africa. There are some papers examining general attitudes to technology ([3], [4], [5], [6]) but only one which focuses on technophobia ([1], [3] forthcoming). Nevertheless, like most countries, South Africa is experiencing rapid changes in the use of technology and the subsequent impact of technology on industry, education, commerce and social structures. New government policies have been formulated to address technological issues (Department of Arts, Culture, Science and Technology, 1996) and work has been done on directing the development of future technologies (notably the Department of Arts, Culture, Science and Technology's Foresight project). However, all this change seems to occur without any reference to the population's attitudes towards technology. Since the success of technology depends largely on its acceptance by users, it is crucial that we understand such attitudes, and in particular the fears of technology which may lead to resistance. In 1995, Weil and Rosen published a report which compared levels of technological sophistication and technophobia in first-year university students across 23 countries [13]. Their study was based on instruments they have developed and validated in numerous other studies (e.g. [9]). These instruments include a demographic and technology experience questionnaire and three questionnaires designed to measure aspects of technophobia. The term "technophobia" has been defined as follows (note that this definition restricts technophobia to computers and does not encompass psychological reactions to other types of technology):
... 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; and/or (c) specific negative cognitions or self-critical internal dialogues during present computer interactions or when contemplating future computer interaction. ([8]) This present study sought to add to the understanding of South Africans' attitudes towards computers by replicating the Weil and Rosen study. The Weil and Rosen study was chosen because the results would allow a comparison of South African attitudes to those in other countries. Since this paper reports on a replication of previous research, it does not include detail on the structure of the instruments or their validation, nor on the reasons why certain demographic factors were considered but not others. The reader who wishes to grapple with such details is referred to the original work by Weil and Rosen. The countries included in the original study by Weil and Rosen are listed in Table 1.

2 Method

2.1 Subjects

Data was collected over a one-month period in 1997 from students at the University of Natal, Pietermaritzburg[1] The subjects were students from the faculties of Science, Commerce and Arts. The basic demographic characteristics of Weil and Rosen's original data and of the new South African sample are shown in Table 2. Although the mean age of the South African sample is lower than the global figure, all subjects in both studies were first-year students.

[1] A similar data sample was collected in 1998, with very similar results as those reported here. The 1997 sample was chosen for this detailed analysis because it was closer in time to the data reported by Rosen and Weil.

1	Australia
2	Austria
3	Belgium
4	Czechoslovakia
5	Egypt
6	Germany
7	Greece
8	Hungary
9	India
10	Indonesia
11	Israel
12	Italy
13	Japan
14	Kenya
15	Mexico
16	Northern Ireland
17	Poland
18	Saudi Arabia
19	Singapore
20	Spain
21	Thailand
22	USA
23	Yugoslavia

Table 1: Countries Included in Weil and Rosen's Study

Sample	Size	Mean Age	Male	Female
23 Countries	3392	20.92	35%	65%
South Africa	129	18.66	43%	57%

Table 2: Characteristics of Data

2.2 Instrumentation

This study was conducted using Rosen and Weil's Measuring Technophobia Instruments (MTI), comprised of the four questionnaires described below.

- The Computer Anxiety Rating Scale (CARS-C) consists of 20 hypothetical experiences of computers and requires subjects to indicate how anxious or nervous they would feel in each situation. Scores range from 20 to 100, with higher scores indicating greater levels of computer anxiety.

- The Computer Thoughts Survey (CTS-C) consists of 20 items that indicate both negative and positive cognitions while using a computer. Scores range from 20 to 100, with higher scores indicating more positive cognitions.

- The General Attitudes Towards Computers Scale (GATCS-C) consists of 20 items that indicated general attitudes towards using computers and computerised technology. Scores range from 20 to 100, with higher scores indicating more positive attitudes.

- The Demographic Data and Technology Experience Questionnaire was slightly modified to suit South African terminology and culture. Instead of asking subjects to indicate their ethnic group, which may have raised objections in the current socio-political context, they were asked to indicate their home language. It was hoped that home language could act as a suitable surrogate measure for cultural background. The instrument also elicited demographic characteristics such as age, gender, and current and intended future computer ownership. Technological experience was assessed across 11 different areas ranging from having used computers as a student to having played video arcade games. Subjects indicated how often they had performed each activity in each of the 11 technological experience items by rating each item on a four-point scale.

2.3 Procedure

The study was advertised during lecture periods and volunteers were asked to come at appointed times to complete the questionnaires in groups. Sampling and data collection followed the protocol used in the earlier international study. In line with this protocol, the instruments were administered in the following order: CARS-C, CTS-C, GATCS-C and the Demographic Questionnaire. The instruments were all in English, which is the language of instruction at the University of Natal. Although the questionnaires were not translated into the subjects' home languages, the test administrator was available to assist any respondents who experienced difficulty in understanding any test items.

Sample	CARS-C	CTS-C	GATCS-C
23 Countries	.90	.85	.51
South Africa	.85	.81	.46

Table 3: Instrument Reliability

3 Results

3.1 Measurement Characteristics

Although the reliability and validity of the instruments have been well studied previously ([7]), the stability of the results is confirmed by the Cronbach alpha coefficients for the South African sample. The comparison is shown in Table 3. As expected, the CARS-C and CTS-C instruments have acceptably high coefficients, but the GATCS-C is shown to be unreliable. In line with the original international study, the rest of the statistical analysis ignores the GATCS-C scores.

Also as expected, the CARS-C and CTS-C scores for the South African sample are inversely related (r=-0.231), indicating that high levels of anxiety correlate to negative cognitions while using computers. Though related, these two measures are not identical and can be treated as two nearly independent dimensions of the technophobia construct.

3.2 Level of Technophobia

The mean scores and standard deviations are shown in Table 4. The mean score for computer anxiety for the South African sample is the ninth highest of the 24 countries. Likewise, the mean score for computer cognitions is also the ninth highest. In summary, the South African sample shows more computer anxiety but more positive computer cognitions than one would expect given the international data.

Past research has partitioned the combined CTS-C and CTS-C scores into the categories no technophobia, moderate technophobia and high technophobia. Past research among university students has shown a split of 61%, 14% and 25% in these three categories respectively ([7]), but the current South African sample is comprised of 36%, 12% and 52% of each category respectively. Rather than being skewed towards the low end of technophobia, the South African sample is skewed towards the high end. The percentage of subjects with high levels of technophobia is the eighth highest of the 24 countries. Demographic Correlates of Technophobia Table 5 shows the correlation coefficients between the technophobia scores and demographic characteristics.

The international data shows a mild relationship between age and technophobia along both dimensions. In contrast, the South African data shows quite a strong inverse relationship between age and computer anxiety, i.e. older subjects tended to be less anxious. There is no consensus from prior research regarding the relationship between technophobia and gender, although the 23 countries figures in Table 5 suggest that males are more anxious about computers than females and yet have more positive cognitions about them. In the South African sample, males tended to have more positive cognitions about computers than females. The final two columns in Table 5 are based on a measure of experience which is the summation of the subjects' frequency of use of ten different types of technology (including computers). The South African sample confirms the global result that subjects with more experience of technology are less anxious and have more positive cognitions about computers. Technological Sophistication Table 6 shows the percentages of South African subjects who had used the various types of technology, and how these figures rank compared with the other 23 countries.

The South African sample shows a remarkably high level of technological experience, especially in terms of automated banking, word processing and microwave ovens.

3.3 Discriminant Function Analysis of Technological Sophistication and Technophobia

Using a stepwise discriminant function analysis, Weil and Rosen found that two variables were sufficient to provide maximal discrimination among the 23 countries (Weil and Rosen, 1995). These variables were technological experience (a composite of ten of the items from Table reftable6) and technophobia (the average of CARS-C and reversed CTS-C scores). Following their procedure, the South African data can be represented by a technological experience level of 1.79 and technophobia level of -0.04. The positions of all 24 countries are plotted in Figure 1.

It is notable that South Africa (labelled as country 24) lies in the highest position with respect to the technological experience dimension and in almost the central position with respect to the technophobia dimension.

4 Discussion

The students in the South African sample show an interesting difference between the cognitive and affective dimensions of technophobia. Although they have more positive thoughts when using a computer than the norm, they display higher levels of anxiety. This suggests a certain degree of dissonance and perhaps indicates that subjects hold beliefs about the potential of computers which are not transferred into a confidence in actually using them. The males in the South African sample expressed more positive cognitions about computers than females. Those with greater experience of computers were less technophobic on both the cognitive and affective dimensions. In both of these demographic factors, the South African sample mirrored the global sample. Contrary to the global sample, however, older students in the South African sample showed less anxiety than younger ones. This is certainly counter to the often assumed understanding that it is primarily the old who are scared on computers, but most empirical research

Sample	CARS-C (Computer Anxiety)		CTS-C (Computer Cognitions)	
	Mean	SD	Mean	SD
23 Countries	41.99	14.68	68.36	12.59
South Africa	45.40	16.49	70.88	14.00

Table 4: Mean and Standard Deviation for CARS-C and CTS-C

Sample	Age		Gender		Experience	
	CARS-C	CTS-C	CARS-C	CTS-C	CARS-C	CTS-C
23 Countries	-.12*	.08*	-.11*	-.08*	-.21*	.21*
South Africa	.23**	.03	-.01	-.18**	-.18**	.21**

* $p<0.001$ ** $p<0.05$

Table 5: Correlations of CARS-C and CTS-C with Age, Gender and Experience

refutes this assumption anyway. However, in this case, the correlation could not reliably be generalised due to the very small age range among first-year university students. The results tabulated above give a confused picture of the level of technophobia in the South African sample. Whereas the categorisation into no/moderate/high levels indicate that the South African subjects are far more technophobic than the global norm, the discriminant function analysis plots South Africa in a central position on the technophobia axis. The former indication should be accepted above the latter for the following reason. The discriminant function coefficient for technophobia is based on the average of the CARS-C and reverse-scored CTS-C measures. But, as we have noted, these two measures are not in agreement in the South African data. Whereas the CARS-C scores for South Africa are higher than the global mean, the reverse-scored CTS-C scores are lower, and hence their average tends towards a central point. Averaging the two scores is misleading in this case and indicates that the two dimensions of technophobia need to be treated independently. Weil and Rosen comment 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". In order to compare the 23 countries, they reported various statistics related to literacy levels and the availability of technology. Although this data comes from the early 1980's and thus quite out-dated, the same statistics for South Africa are shown in Table 7 for comparison with the earlier study. The literacy figure shows the estimated percentage of the population older than 15 who can read and write. ([12])

In terms of technological experience, it seems surprising that South Africa should rank as highly as it does in the data of this current study. The only areas in which South African subjects were not favourably ranked were computer programming and game playing. Certainly the sample of university students is not representative of the whole population, but even so, what can account for this sample having a higher overall level of technological experience that the sample of university students from six universities in the USA? This most likely reflects the biggest deficiency of global studies such as this, namely, the lack of uniformity in how various data collectors selected subjects. Although the size of the global data sample is adequate to give statistically significant results, the sampling technique is inadequate for the results to be taken as any more than suggestive. It may also be the case that the gap of several years between the original data collection and the collection of the South African sample affected the results. Changes to computer technology continue to advance rapidly and the consequent effects on social structures may mean that three-year-old attitudes are as outdated as three-year-old computers. The general population of South Africa has much less access to technology than university students. Thirteen percent of South Africans over 20 have no formal education and despite initiatives such as the Year of Science and Technology in 1998, public awareness of computers and information technology is low. Given overcrowding of schools (average of 42 pupils per classroom), low levels of teacher training (35teaching degree), and inadequate provision of basic facilities (e.g. 59electricity), even those with formal education may receive little or no exposure to modern technology (statistics from the South African Survey, 1998). It can only be hoped that the introduction of an Information Technology and Computer Sciences subfield within the National Qualifications Framework may help to increase the emphasis on this area of education.

5 Conclusion

This paper has reported on the incidence of technophobia in a sample of South African university students as measured by Rosen and Weil's Measuring Technophobia Instruments. This data has been compared to similar research from 23 other countries, showing that the South Africa subjects have a higher degree of technological experience than expected. Nevertheless, they also show high levels of technophobia, and in particular, high levels of computer anxiety. This research is only the start of an important task which needs to be expanded to the broader community of South Africa. Since the sample was restricted to

Type of Technology	Percentage of sample who have used the technology	Rank out of 24 countries
Used computers as a student	90	Equal 4th
Learned a programming language	47	12th
Used automated banking machine (ATM)	92	3rd
Used computerised library catalogue	60	5th
Used computerised library literature search	50	5th
Used computers for word processing	90	1st
Played computer games	88	Equal 13th
Used a programmable microwave oven	76	Equal 3rd
Used a Video Cassette Recorder (VCR)	94	5th
Played video arcade games	83	7th
Own a personal computer	39	6th

Table 6: Levels of Technology Usage in South African Sample

	Telephones	Radios	TVs	Passenger cars	Literacy (% read/write)
		(per 1000)			
World Average	123	310	135	78	70%
South Africa	138	282	75	90	80%
S.A. rank out of 24 countries	14th	14th	20th	17th	19th

Table 7: Statistical data for countries of the world

university students, we would not expect it to reflect the levels of either technological experience nor of technophobia in the total population of South Africa. Given the socio-political history of South Africa since the invention of computers, we would expect a very low level of technological experience, and, given the correlation between experience of computers and technophobia established by prior research, we should expect that the broader population of South Africa would have correspondingly high levels of technophobia. The uptake of technology depends not just on the availability of the technology but largely on the attitudes of potential users. If a large proportion of potential users are anxious about technology, they are less likely to view technological change optimistically and may either avoid making use of new technology, or use it ineffectively. Since the success of technology depends on it being used effectively, it will be important to design and introduce technology in a way which adequately addresses public anxieties.

6 Acknowledgements

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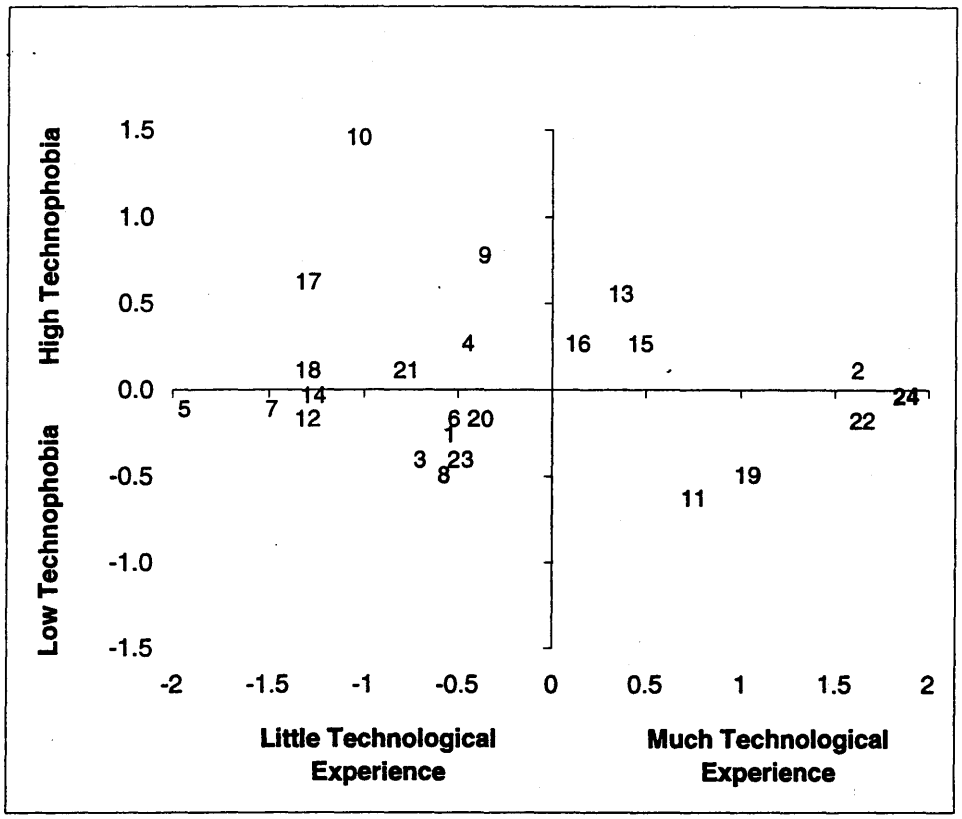

Figure 1: Two-dimensional discriminant function coefficients for 24 countries (numbers represent countries as listed in Table 1)

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- References should be listed at the end of the text in alphabetic order of the (first) author's surname, and should be cited in the text according to the Harvard. References should also be according to the Harvard method.

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