Running Head: Technophobia and Personality Subtypes

Technophobia and Personality Subtypes in a Sample of South African University Students

---

L. M. Anthony* **M. C. Clarke*** **S. J. Anderson****

University of Natal, Pietermaritzburg — January 1999

* Department of Computer Science and Information Systems

** School of Psychology

Correspondence: Matthew Clarke
New College Institute for Values Research
New College
Sydney NSW 2052
Australia

Phone: 61 2 9381 1740 (W)
61 2 9381 1909 (Fax)

Email: M.Clarke@NewCollege.unsw.edu.au

Word count: 5100

Requests for reprints: Matthew Clarke, as above

Acknowledgement: This research was supported by the University of Natal Research Fund.

Abstract

This study examined levels of technophobia in a sample of 176 South African university students enrolled in first-year computing and psychology courses. Technophobia, which is described as negative psychological reactions towards technology, was assessed using Rosen and Weil's Measuring Technophobia instruments. The levels of technophobia were correlated with each of the five dimensions (neuroticism, extroversion, openness, agreeableness, and conscientiousness) of the NEO-Five Factor Inventory. The results indicate a positive correlation between technophobia and Neuroticism, and an inverse correlation between technophobia and Openness. Technophobia was found to be inversely correlated with computer experience, weakly correlated with age, but not associated with gender.

Keywords: attitudes towards computers, technophobia, personality

Introduction

The general study of attitudes towards computers has a long history. In 1963, Lee proposed a two-factor measurement of attitudes and his instrument has been often re-used (Clarke & Finnie, 1998; Finnie, 1987; Weil & Rosen, 1995; Weil & Rosen, 1997). Since Lee's study, many researchers have attempted to describe attitudes towards technology in more than two dimensions. For instance, Lloyd and Gressard developed the Computer Attitude Scale which measured the computer anxiety, computer confidence and computer liking (Lloyd & Gressard, 1984); Koohang and Byrd added the dimension of perceived usefulness (Byrd & Koohang, 1989; Koohang, 1989); and Kay developed the Computer Attitude Measure which comprised cognitive, affective and behavioural attitudes (Kay, 1989).

With the increasing introduction of new information technologies, new opportunities are presented which offer a highly comfortable vision of the future. However, for some people these benefits are problematic and negative emotional reactions, such as anxiety, are commonly associated with a failure to use new technologies (Moston, 1996). This fear of technology seems particularly pronounced when related to computing technology and the term "computerphobia" has been used to refer to negative attitudes towards computers (Jay, 1981). Other researchers prefer the term "technophobia", although this misleadingly suggests a broader application to forms of technology other than computer-related. Rosen and Weil (1995) define technophobia in the following way —

> … "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; and/or (c) specific negative cognitions or self-critical internal dialogues during present computer interactions or when contemplating future computer interaction.

Studies by Weil and Rosen established that technophobia is best measured on the three separate but overlapping dimensions of anxiety, negative cognitions, and negative attitudes (Rosen & Maguire, 1990; Rosen, Sears & Weil, 1987; Rosen & Weil, 1992; Rosen, Sears & Weil, 1992; Weil & Rosen, 1995; Weil & Rosen, 1997). The work of these authors led to the development of three separate instruments designed to measure different aspects of technophobia — the Computer Anxiety Rating Scale (CARS), Computer Thoughts Survey (CTS) and the General Attitudes Toward Computers Scale (GATCS) (Rosen & Weil, 1992).

A considerable amount of research has been conducted into the possible causes of technophobia. Studies have found that alienation (Ray & Minch, 1990), computer experience (Brosnan, 1998a; Brosnan, 1998c; Clarke & Finnie, 1998; Okebukola, Sumampouw & Jegede, 1992; Todman & Lawrenson, 1992; Weil & Rosen, 1995; Weil & Rosen, 1997), gender (Brosnan, 1998b; Brosnan, 1998c; Finnie, 1987; Koohang, 1989; Moore, 1994; Rosen & Maguire, 1990; Sanders & Galpin, 1994), age (Brosnan, 1998c; Rosen, Sears & Weil, 1987) and self-efficacy (Brosnan, 1998a; Brosnan, 1998b; Brosnan, 1998c) are possible correlates of technophobia, however, inter-study comparisons show that the results are often contradictory.

Studies by Fariña, Arce, Sobral and Carames (1991) as well as by Chen and Vecchio (1992) suggest that computer attitudes may be directly related to personality. Chen and Vecchio (1992) reported that an introverted orientation was associated with improved ability at computer programming. Fariña et al. (1991) found that trait anxiety and anxiety towards mathematics both influenced anxiety towards computers. The present study sought to clarify the nature of this relationship between personality traits and computer attitudes. Recent conceptualisations of personality suggest a five-factor model incorporating Neuroticism, Extroversion, Openness, Agreeableness and Conscientiousness (Costa & McCrae, 1992;

Howard & Howard, 1998; Sternberg, 1995). The primary aim of this exploratory study was to establish whether any of these dimensions correlate with technophobia.

Methodology

Subjects

An opportunity sample of undergraduate students enrolled in psychology, computer science and end-user computing courses at the University of Natal served as subjects in this study. This sample of 176 subjects consisted of both men and women, and was reasonably representative of the university's first-year student population in terms of faculty and cultural background. Table 1 indicates the key characteristics of the sample.

Table 1. Demographic Characteristics of Study Sample

Sample	Age		Gender		Home Language			
Size (n)	Mean	SD	Males	Females	English	Afrikaans	Zulu	Other
176	19.4	1.9	44%	56%	75%	2%	12%	11%

The "Other" category includes French, German, Xhosa, Sotho and Telegu.

Instrumentation

This study was conducted using Rosen and Weil's Measuring Technophobia Instruments (MTI) and the NEO-Five Factor Inventory (NEO-FFI). The MTI consists of the Computer Anxiety Rating Scale (CARS-C), Computer Thoughts Survey (CTS-C), General Attitudes Towards Computers Scale (GATCS-C) and Demographic Data and Technology Experience Questionnaire. The NEO-FFI instrument that was used to measure personality traits was the revised NEO-FFI (Form S) (Costa & McCrae, 1992).

The CARS-C consists of 20 hypothetical experiences of computers and requires subjects to indicate how anxious or nervous they would feel in each situation. The CTS-C consists of 20 items that indicate both negative and positive cognitions while using a computer. The responses to both CARS-C and CTS-C are given by selecting one of Not at All, A Little, A Fair Amount, Much or Very Much. The GATCS-C presents 20 statements of attitudes towards using computers and computerised technology to which the subjects using the five-point Likert Scale.

Rosen and Weil's 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 elicits 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 were required to indicate how often they had performed each activity in each of the 11 technological experience items by rating each item on a four-point frequency scale.

The revised NEO-FFI (Form S) is the shortened version of the original NEO Personality Inventory (NEO-PI-R). The questionnaire consisted of 60 statements that reflect the five domains, or dimensions, of personality. In response to each of these statements, subjects were required to rate themselves using the five-point Likert Scale. The NEO-FFI was chosen over the NEO-PI-R as the latter consisted of 240 items which would have taken a much longer time to administer and may have introduced a fatigue factor, especially when combined with the further 80 items of the MTI.

Procedure

Subjects were randomly chosen from class lists of the psychology, computer science and end-user computing courses. Ethical considerations required that participation was voluntary and about 60% of the randomly-selected students agreed to participate in the study. The psychology students completed the NEO-FFI during a lecture period and were contacted at a later stage to complete the MTI in a controlled environment with the administrator. The subjects who were not psychology students completed all of the instruments during a tutorial period. They filled in the NEO-FFI followed by the MTI.

The MTI were designed to be self-administering and could be given either individually or in groups. Subjects were told to answer these instruments in the following order: CARS-C, CTS-C, GATCS, Demographic and Technological Experience Questionnaire, as requested by the designers. The Demographic and Technological Experience Questionnaire was administered last in order to minimise hypothesis guessing on the part of the subjects (Rosen & Weil, 1992).

Since the research was carried out with English instruments but in a multi-lingual context, the test administrator was available to assist any respondents who experienced difficulty in understanding any test items. For example, in item 12 of the NEO-FFI perhaps 10% of subjects did not understand the meaning of the word light-hearted.

Time limits were not imposed for any of the instruments, however, no subject took longer than 45 minutes to complete the whole set of questionnaires.

Results

Measurement Characteristics

The reliability of each instrument has been established previously (Rosen & Weil, 1992; Howard & Howard, 1998) but was confirmed by calculating Cronbach's alpha coefficient from the data collected in this study.

Table 2. Reliability Coefficients for all Instruments

Measuring Instrument		Cronbach's alpha coefficient	
		Current Study	Previous Studies
CARS-C	Computer Anxiety Rating Scale	0.86	0.90–0.95*
CTS-C	Computer Thoughts Survey General	0.84	0.81–0.93*
GATCS-C	Attitude Towards Computers Scale	0.39	0.15–0.75*
NEO-FFI	NEO Five Factor Inventory	0.73	0.68–0.86**

* Rosen &Weil, 1992

** Costa & McCrae, 1992

From Table 2, it is evident that a high degree of reliability characterised all of the measures used except the GATCS-C. The low alpha co-efficient for GATCS-C casts doubt on the reliability of that instrument, but this coincides with the results of Rosen and Weil (1995). The GATCS-C data was consequently excluded from further statistical analysis.

Personality Profiles

There have been no published studies reporting the use of the NEO-FFI on South African samples; as a result, base rate profile data is lacking. Nevertheless, in order to check how typical our sample was, the raw NEO scores were converted to T-scores in accordance with the scales printed on the NEO form. These converted scores should have a mean of 50 and standard deviation of 10, but the actual values are shown in Table 3. As can be seen, the distributional characteristics for our sample are very close to the sample on which the NEO T-score transformation is based in terms of Neuroticism and Openness. However, our sample is more Extroverted, less Agreeable and less Conscientious than may be considered typical.

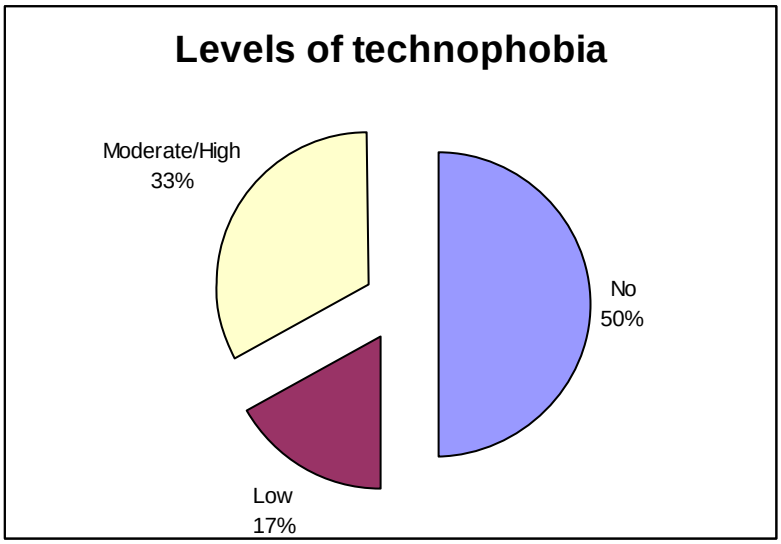
Table 3. Personality characteristics of the present study

Neuroticism		Extroversion		Openness		Agreeableness		Conscientiousness	
Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
53	10	57	11	52	11	45	12	44	13

Levels of Technophobia

Rosen and Weil define three levels of comfort with computers and technology based on the combined scores from CARS-C and CTS-C — no technophobia, low technophobia and moderate to high technophobia (Rosen & Weil, 1995; Weil & Rosen, 1995; Weil & Rosen, 1997). Figure 1 displays the percentages of the sample in each of these three categories. Similar studies in other countries show a wide range of technophobia levels, but our sample, showing 33% of subjects with moderate to high technophobia, is not atypical. For instance, in a study across 23 countries, the samples from 10 countries had between 20% and 40% of subjects in the moderate to high category (Weil & Rosen, 1995).

Figure 1. Levels of technophobia experienced by sample



Factor analysis

Using the factor analysis procedure with principle components and varimax rotation factors were derived for CARS-C, CTS-C and NEO-FFI. The factor structure of the NEO-FFI data was virtually identical to the intended five personality dimensions. The factor structure for CTS-C was virtually identical to that obtained by previous studies (Rosen & Weil, 1992). However, some differences were evident in the structure of the CARS-C responses.

Previous studies have grouped the 20 items in CARS-C into the three factors Interactive Computer Learning Anxiety (e.g. anxiety while learning about computers, dealing with computer errors, thinking about purchasing a computer), Consumer Technology Anxiety (e.g. resetting digital clocks, programming microwave ovens) and Observational Computer Anxiety (e.g. looking at computer printouts, watching someone else use a computer, watching a movie about an intelligent computer).The first factor extracted from our data was almost identical to Rosen and Weil's Interactive Computer Learning Anxiety, except that three items were identified as a separate factor. We have labelled this new factor Computer Feedback Anxiety since it reflects anxiety when something goes wrong while interacting with

a computer — getting error messages, the computer being "down", or deleting information from the computer. Rosen and Weil's second and third factors were combined as one factor in our data.

Technological Sophistication

The results of the Demographic Data and Technology Experience Questionnaire are listed in Table 4 .

Table 4 . Technological Experience Reported by Study Sample (n=176)

Technological Experience	Percentage of Students
Used computers as a student	99%
Written a computer program	58%
Used an Automated Teller Machine (ATM)	94%
Computerised Library use	83%
Word Processing use	99%
Game Playing	91%
Programmable microwave oven use	94%
Video Cassette Recorder (VCR) use	97%

This table shows that a high percentage of the students in the sample have been exposed to the various types of technology currently in common use.

Demographic Correlates of Technophobia

Correlation coefficients of the various continuous measures are summarised in Table 5 and chi-square results for the categorical measures in Table 6.

Table 5. Correlation Matrix for Technophobia and Demographic Characteristics

	CTS-C	Age	Experience	Gender
CARS-C	-0.35*	-0.11	-0.35*	-0.03
CTS-C		0.041	0.393*	-0.14
Age			-0.029	-0.01
Experience				0.011

* $p < 0.05$

The correlation coefficient between CARS-C and CTS-C implies that the two measures are interrelated, but not identical. This coincides with previous research which suggests that these measures are related, overlapping, but not identical measures of technophobia and can be considered as two nearly independent dimensions of the construct (Rosen & Weil, 1992; Weil & Rosen, 1995; Weil & Rosen, 1997). The negative correlation coefficient indicates that a person who experiences high levels of computer anxiety would have more negative thoughts about using computers.

The correlation coefficient between CARS-C and experience indicates that experience with technology relates to reduced computer anxiety. This is consistent with previous findings showing that computer anxiety levels drop as experience with computer usage increases (Okebukola et al., 1992; Ray & Minch, 1990). The correlation coefficient of CTS-C and experience indicates that experience results in positive thoughts about using technology.

Age correlates weakly with the CARS-C and CTS-C, but this could reflect the restricted age range of the study subjects. While gender correlates weakly with CARS-C, a stronger association is evident for the CTS-C (p=.059).

Table 6. Chi-square associations for Rosen and Weil's Technophobia Measure and Demographic Characteristics

Variables	Chi-square	p value
Technophobia and Gender	0.595	0.743
Technophobia and Home Language	7.421	0.115

The chi-square analysis in Table 6 fails to show any significant association between the categories of technophobia and either gender or home language. While not statistically significant, the Zulu speakers tended to display higher levels of technophobia than English speakers (p=.08).

Personality and Technophobia

The null hypotheses "There exists no dependence between the level of technophobia and the level of any of the five personality dimensions" was tested by a chi-square analysis of the association between each of the five factors of the NEO-FFI and the three levels of technophobia obtained from the MTI. The results are listed in Table 7.

Table 7. Association between Personality Subtypes and Technophobia

Variables	Chi-square	p-value
Technophobia and Neuroticism	10.610	0.031*
Technophobia and Extroversion	2.626	0.622
Technophobia and Openness	16.950	0.002*
Technophobia and Agreeableness	2.335	0.674
Technophobia and Conscientiousness	3.094	0.542

* $p < 0.05$

The p values imply that the null hypotheses should be accepted except in the cases of Neuroticism and Openness.

As both CARS-C and CTS-C were established to be independent constructs of technophobia, the two measures were correlated separately with each factor of the NEO-FFI separately to verify the relationship established in Table 7. The relevant correlation coefficients are listed in Table 8.

Table 8. Correlation of CARS-C and CTS-C with each NEO-FFI Factor

NEO-FFI Factor	Correlation with CARS-C score	Correlation with CTS-C score
Neuroticism	0.282*	-0.405*
Extroversion	-0.069	0.124
Openness	-0.248*	0.060
Agreeableness	-0.129	-0.033
Conscientiousness	-0.060	0.135

* $p < 0.05$

The p values in Table 8 indicate that Neuroticism correlates positively with computer anxiety (i.e. the higher the level of neuroticism, the higher the computer anxiety experienced) and inversely with computer cognitions (i.e. the higher the level of neuroticism, the more negative computer cognitions would be experienced). Openness correlates inversely with computer anxiety (i.e. the lower the level of openness, the more computer anxiety would be experienced). These results are consistent with the earlier chi-square analysis shown in Table 7 and in addition suggest that the association between Openness and technophobia arises via computer anxiety rather than negative computer cognitions.

Discussion and Conclusions

Levels of Technophobia

Figure 1 indicates that approximately half of the sample experienced no technophobia, a percentage higher than previous studies (Rosen & Weil, 1992). This can be explained by the high levels of technological experience in the sample (Table 4). Both our data and that of prior studies (Brosnan, 1998c; Rosen & Weil, 1995) have shown technological experience to have an inverse relationship with technophobia. A sample with high levels of technological experience should be expected to have correspondingly low levels of technophobia.

In addition, the reliance on voluntary participation may have skewed the personality types. For instance, volunteers are known to be more sociable and unconventional (Rosnow & Rosenthal, 1996) and thus may score higher on Openness. It may be that the students who chose to participate in this study were those with some enthusiasm and confidence with computers and thus less technophobic.

Technophobia and Gender

The result from our data that technophobia was not associated with gender confirms the findings of Clarke and Finnie (1998). In a study of subjects at the same institution as the current sample, they found that although gender influenced attitudes towards computers twelve years ago, it no longer does so.

A possible reason for this is that many more females are now attending university and enrolling in computing courses than a decade ago (compare Finnie, 1987 with Clarke & Finnie, 1998). Thus, increased exposure to educational and employment opportunities in previously male-dominated domains may explain the disappearance of gender differences. Even though most of the subjects have never been employed, it is possible that their attitudes are shaped by the workplace environment as portrayed by significant others and the media.

Technophobia and Home Language

Although this study found no significant relationship between technophobia and home language, there are two reasons to think that this result may not generalise to the broader South African population. First, this particular sample was not representative of South African language distribution. Whereas English is the home language of 10% of South Africans, Afrikaans 15% and Zulu 22% (South African Institute of Race Relations, 1998), the proportions reflected in our sample were 75%, 2% and 12% respectively.

Second, whereas a large percentage of South Africans have relatively poor levels of formal education, this sample was of educationally-advantaged university students. Home language may give a reasonable indication of cultural background, but in a university student population it does not indicate the quality of subjects' educational history nor their technological sophistication. People of educationally disadvantaged backgrounds are less

likely to have access to advanced technology, and may display different technophobia attitudes than those of this particular sample who are representative of the more privileged backgrounds.

Ethnic differences in South Africa penetrate many aspects of human performance, particularly those dependant on education. A correlation between ethnicity and technophobia cannot be ruled out. However, with improved educational facilities and increasing acculturation, it is likely that any direct effect of ethnicity, once separated from computer experience, has all but disappeared.

Technophobia and Neuroticism

The data collected in this study indicate that technophobia is related to neuroticism, which is often assessed in terms of anxiety, anger hostility, depression, self-consciousness, impulsiveness and vulnerability to stress (Costa & MacCrae, 1992). Neuroticism is an indicator of one's susceptibility to psychological distress. Although Moston (1996) claimed that anxiety towards technology is unrelated to general levels of anxiety, it could be argued that people with high anxiety levels will be fearful and nervous of a wider array of stimuli and that this might include fear of change (both personal and environmental). This in turn could impact negatively on both learning and coping styles.

Relating this to technophobia, it seems reasonable to predict that people who rate more highly on Neuroticism might react with higher levels of anxiety and stress when exposed to a new computing environment. Their stress levels are likely to be exacerbated by software whose user-interface does not adequately allow for anxious first-time users.

Apart from the level of stress experienced, another facet of neuroticism is the way the individual responds to stress. One conceptualisation of coping styles situates people on an

avoidant/active continuum (Kaplan, 1996). Individuals with high Neuroticism scores are more likely to adopt an avoidant coping approach and consequently to display lower levels of adjustment to new technology. Increased levels of frustration may precipitate feelings of hopelessness and inferiority as computers are perceived as a source of alienation.

In our data, although Neuroticism correlates with computer anxiety, it correlates even more highly with negative computer thoughts (see Table 8). The importance of negative cognitions while using a computer may indicate that technophobia has more to do with self-consciousness, self-confidence and self-efficacy than with anxiety.

Technophobia and Openness

People who experience high levels of openness are perceived to have broader interests, have a fascination with novelty and innovation and tend to be less conventional. People who are less open tend to stay on the conventional side of life, preferring familiar situations and being unwilling to try new experiences unless they are forced to. In relation to technophobia, one might predict that people scoring low on Openness might be hesitant towards using computer technology because of their tendency to avoid the unfamiliar. Also, less open individuals may be challenged by the constantly changing environment of computers, e.g. the frequent revision of software packages. Increased levels of frustration and stress could arise from the constant need to familiarise oneself with new hardware and software.

In our data, Openness correlates with computer anxiety but not with cognitions while using a computer (see Table 8). This suggests that when less open people experience unfamiliar technology, they experience greater levels of anxiety.

Addressing Technophobia

The high occurrence of technophobia found in this study and others suggests that an important area for further study would be interventions which seek either to prevent or treat technophobia. On one hand, such interventions could address the technological causes of technophobia by improving user-interface design based on an awareness that a system's success depends largely on its usability. Electronic computing is a very young discipline with poorly developed methodologies which have primarily focused on computational techniques rather than ergonomics. However, the growing recognition that computers need to be made human-literate (see the large body of literature on human-computer interaction) offers some hope that interacting with a computer may become less threatening in the future. Even so, an underlying discomfort with the rapidity of change and with the social role of computer technology is likely to remain.

On the other hand, the findings of this study suggest that technophobia may be conceptualised in terms of definable dimensions of personality and to this extent, technophobia may operate independently of the situational variables such as user-interface quality and organisational context. This has important implications for the understanding and remediation of technophobia. For example, it may not be cost-effective to embark on intensive ergonomic or production-design manipulation without considering the impact that individual personality traits may have on the users' ability to assimilate new skills and knowledge in a computerised environment. Consequently, the most effective intervention may be in the form of appropriate training or support programs whose aim is to reduce anxiety levels and promote positive cognitions about computers.

An example is Rosen and Weil's Computerphobia Reduction Program which was implemented during a three-year period in the late 1980s (Rosen & Weil, 1997). This

program targeted university students and staff who experienced some form of technophobia. Regardless of the severity of their original levels of technophobia, the participants became less technophobic and more computer confident by the end of the program.

Using a similar approach in a university or work environment, one could conduct a survey at the beginning of an academic year or at the commencement of employment to determine the technophobia levels experienced by the students or employees. Based on the extent of technophobia discovered, appropriate intervention programs can be implemented for these individuals to help combat or pre-empt the effects of their technophobia. Our results indicate that people with high levels of Neuroticism and low levels of Openness are very likely to be technophobic and thus could be placed in a technophobia reduction program before being exposed to a new system of technology.

Further Research

This study needs to be replicated across a broader population to assess the stability of the relationship between technophobia and the identified personality traits. A demographically sensitive study across cultural and ethnic groups, age, gender and social class would be an important avenue for further research. Such studies would clarify which facets of Neuroticism and Openness correlate with technophobia and lead to a stronger model which could predict technophobia and technological resistance based on the five dimensions of personality.

The design of interventions to reduce technophobia also needs to be examined more closely to establish the effectiveness of different approaches for different personality types.

Conclusions

In a sample of university students, we have found typically high levels of technophobia as measured by Rosen and Weil's instruments. When correlated to the subjects' personality traits, as measured by the NEO-Five Factor Inventory, we found significant relationships between technophobia and both Neuroticism and Openness.

Technophobia represents a substantial challenge to the effective use of technology in our increasingly technology-dependent lives. The early identification of technophobia would facilitate timeous remediation so as to maximise knowledge and skills acquisition. Our findings suggest that technophobia may relate to certain personality traits and that this could provide an avenue for appropriate remedial intervention.

References

Brosnan, M. J. (1998a). The impact of computer anxiety and self-efficacy upon performance. Journal of Computer Assisted Learning, 14, 223–234.

Brosnan, M. J. (1998b). The role of psychological gender in the computer-related attitudes and attainments of primary school children (aged 6–11). Computer Education, 30 (3/4), 203–208.

Brosnan, M.J. (1998c). Technophobia : The psychological impact of information technology. London: Routledge.

Byrd, D. M. & Koohang, A. A. (1989). A professional developmental question: Is computer experience associated with subject's attitudes toward the perceived usefulness of computers? Journal of Research on Computing in Education, Summer, 401–410.

Chen, H. & Vecchio, R. V. (1992). Nested IF-THEN-ELSE constructs in end-user computing: personality and aptitude as predictors of programming ability. International Journal of Man-Machine Studies, 36, 843–859.

Clarke, M. C. & Finnie, G. R. (1998). Changes in entry-level university students' attitudes to computers. South African Computing Journal, 21, 26–33.

Costa, P. T. & McCrae, R. R. (1992). NEO PI-R: Professional Manual. Revised NEO Personality Inventory (NEO PI-R) and NEO Five Factor Inventory (NEO-FFI). Odessa, FL: Psychological Assessment Resources (PAR).

Fariña, F., Arce, R., Sobral, J. & Carames, R. (1991). Predictors of Anxiety Towards Computers. Computers in Human Behavior, 7 (4), 263–267.

Finnie, G. R. (1987). Novice attitude changes during a first course in computing: a case study. Quaestiones Informaticae, 5 (2), 56-62.

Howard, P. J. & Howard, J. M. (1998). An introduction to the five-factor model of personality for human resource professionals. http://www.centacs.com/quik-pt1.htm.

South African Institute of Race Relations (1998). South African Survey.

Jay, T. B. (1981). Computerphobia: What to do about It. Educational Technology, 21, 47–48.

Kaplan, B. H. (1996). Psychosocial stress: Perspectives on structure, theory, life-course, and methods. CA: Academic Press, Inc.

Kay, R. H. (1989). A practical and theoretical approach to assessing computer attitudes: the Computer Attitude Measure (CAM). Journal of Research on Computing in Education, Summer, 456–463.

Koohang, A. A. (1989). A study of attitudes toward computers: anxiety, confidence, liking, and perception of usefulness. Journal of Research on Computing in Education, Winter, 137–150.

Lloyd, B. & Gressard, V. T. (1984). Reliability and factorial validity of the computer attitude scale. Educational and Psychological Measurement, 44 (1), 501–505.

Martin, C. D. (1993). The myth of the awesome thinking machine. Communications of the ACM, 36 (4), 120–133.

Moore, C. (1994). Attitudes towards computers: the influence of sex stereotypes, experience, ownership and mathematics. Unisa Psychologia, 21 (1), 20–27.

Moston, S. (1996). Consumer attitudes and new technologies. http//pluto.lbs.ac.uk:81/future/attitude.htm.

Okebukola, P. A., Sumampouw, W. & Jegede, O. J. (1992). The experience factor in computer anxiety and interest. Journal of Educational Technology Systems, 20 (3), 221–229.

Ray, N. M. & Minch, R. P. (1990). Computer anxiety and alienation: toward a definitive and parsimonious measure. Human Factors, 32 (4), 477–491.

Rosen, L. D., Sears, D. C & Weil, M. M. (1987). Computerphobia. Behavior Research Methods, Instruments & Computers, 19 (2), 167–179.

Rosen, L. D., Sears, D. C. & Weil, M. M. (1992). Treating technophobia: a longitudinal evaluation of the computerphobia reduction program. Computers in Human Behavior, 9, 27–50.

Rosen, L. D. & Maguire, P. (1990). Myths and realities of computerphobia: a meta-analysis. Anxiety Research, 3, 175–191.

Rosen, L. D. & Weil, M. M. (1992). Measuring Technophobia Manual. Unpublished. Available from LRosen@dhvx20.csudh.edu.

Rosen, L. D. & Weil, M. M. (1995). Adult and teenage use of consumer, business, and entertainment technology: potholes on the information superhighway? Journal of Consumer Affairs, 29 (1), 55–84, http://www.csudh.edu/psych/jca.html.

Rosnow, R. L. & Rosenthal, R. (1996). Beginning Behavioral Research: A Conceptual Primer. NJ: Prentice Hall.

Sanders, I. & Galpin, V. (1994). A survey of attitudes to computing at the University of Witwatersrand. South Africa: University of Witwatersrand.

South African Institute of Race Relations (1998). South African Survey.

Sternberg, R. J. (1995). In search of the human mind. Fort Worth, TX: Harcourt Brace.

Todman, J. & Lawrenson H. (1992). Computer anxiety in primary school children and university students. British Educational Research Journal, 18 (1), 63–72.

Weil, M. M. & Rosen, L. D. (1995). The psychological impact of technology from a global perspective: a study of sophistication and technophobia in university student from twenty-three countries. Computers in Human Behavior, 11 (1), 95–133.

Weil, M. M. & Rosen, L. D. (1997). TechnoStress: Coping with technology @home @work @play. NY: John Wiley & Sons, Inc.