# Measuring attitudes towards general technology: Antecedents, hypotheses and scale development

Received (in revised form): 4th August, 2003

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**Abstract** Research on attitudes towards general technology is sparse. In this paper the authors develop and test a new scale to assess attitudes towards general technology and examine factors that may contribute to the acceptance of or resistance to new technologies. Hypotheses of personal factors posited to be antecedents to attitude towards technology are tested. A variety of methods are used in the analysis, including structural equations modelling. A robust and usable scale is developed, and a study involving 605 respondents indicates that individuals who have a positive attitude towards new technologies tend to be younger, to have more complex cognitive processes and to be predisposed to be optimistic. The results suggest a need for further development of scales to measure attitude towards general technology. Implications for marketing are discussed.

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## INTRODUCTION

> 'Technology and technological systems are integral to everything we do and can do.'[1]

It is difficult to overestimate the impact of technology on society and on individuals. Technology drives growth and economic progress, and the pace of innovation is quickening.[2] For example, the high-tech sector accounted for 27 per cent of the growth in the US gross domestic product from 1993 to 1996, compared to 4 per cent for the automobile industry.[3] The biotechnology industry reported 2002 revenues of US$28.5bn, up 300 per cent from 1992.[4] Worldwide semiconductor shipments rose from US$22bn in 1985 to US$140bn in 2002.[5] According to the US Patent Office, in 1981 a total of about 60,000 inventions were granted patents in the USA; over 160,000 inventions were patented in 2001.[6]

Technology affects everyone as it changes the fabric of society. As consumers, workers, family members and citizens, everyone individually faces decisions involving the development or use of technology.[7] Consumers' attitudes towards technology affect the way they purchase, what they buy, when they purchase and even how they pay for purchases.[8] Americans vote (directly or indirectly) on increasingly complex technical issues, such as cloning, environmental protection and the use of alternative fuels. Advances in areas such as healthcare, genetic engineering and energy production raise ethical issues that require an understanding of technology in order to make informed decisions. Even language and culture are changing as products are introduced and become increasingly complex.[9]

While technology increasingly affects everyone, not all individuals view this trend as positive. Some individuals are uncomfortable with technological change, do not enjoy the uncertainty and are reticent to embrace these tools and ideas. Others welcome technological change and the resultant uncertainty and enjoy the challenge. The information technology, psychology, education and marketing literatures provide a basis for hypothesising the existence of a range or distribution of response to technology, and for connecting this distribution with the concept of attitude towards technology in general. This allows a departure from previous technology research and development of a better understanding of the personal factors contributing to behaviours such as technology adoption or resistance.

## LITERATURE REVIEW

### Models of adoption

Adoption of innovation research (and models) can be categorised as either theories of communication and group behaviour, or theories of information and individuals' behaviour. The first group of models and research looks at adoption from a social process perspective, investigating the factors (with a focus on communication) affecting the rate or degree of acceptance of an innovation by a population (of individuals;[10–11] or by organisations[12]). This category of research essentially looks at the diffusion or spread of adoption over time, and is typically applied to issues such as sales forecasting.

The second approach is from an information-processing perspective, which looks at factors affecting an individual's response to an innovation. This category includes the Theory of Reasoned Action (TRA),[13] and the further refined Theory of Planned Behaviour,[14] both of which posit that behaviours are the results of intentions, which result from attitudes towards the behaviour. The Technology Acceptance Model,[15] a modified TRA, is widely used in the investigation of the adoption of information technology.[16] These models, at their core, include attitudes predicting intentions and assume a rational ('reasoned', or 'planned') process.

The present research develops a measure of general, rather than specific, attitude towards technology and investigates several psychological factors thought to be antecedent to this attitude.

### Attitude towards technology

Given the ubiquity and importance of technology, and the recognition that there is a relatively universal response to technology,[17] it is surprising that there has not been more research in this area. Most of the investigations into attitudes towards technology specifically involve computers and information technology (IT), not technology in general. While many people today view IT as a specific tool or set of tools that may help them, technology in general is more ambiguous and amorphous. The connection with personal utility is more difficult to make. The following is a review of the relatively sparse research related to attitude towards general technology.

In an early study of general technology, Goldman *et al.*[18] noted the lack of studies regarding attitude towards technology. Their study investigated the relationship of attitude towards general technology with college majors and developed a suite of scales to measure attitude including scale items such as 'I would prefer reading popular mechanics to reading life'.[19] Included in the suite are five sets of scale items, measuring: 'global mechanism' (positive or negative global attitudes towards technology); 'mechanical curiosity' (machine competence and curiosity in machines); 'preference for handmade goods'; 'alienation' (reflects societal unconcern with the individual); and 'spiritual benefits of technology' (*deus ex machina*). They conclude from their analysis that 'the differences between groups (science majors vs non-science majors) are largely defined by mechanical curiosity and, to a lesser extent, by a preference for handmade goods'. Ray *et al.*,[20] commenting on an earlier computer-related study by Lee,[21] noted that Lee's conclusion that the main factor leading to technology use was 'beneficial tool attitude', and extended this finding to 'all forms of technology'. A more recent investigation of technology attitudes developed a suite of scales with which to measure the 'technological readiness' of individuals and firms.[22] Included in the suite are four sets of scale items, including: 'optimism' (a positive view of technology); 'innovativeness' (tendency to be a technology pioneer); 'discomfort' (perceived lack of control over technology); and 'insecurity' (distrust of technology). Forrester Research conducted the largest study of technology adoption in North America, involving over 250,000 North American consumers.[23] In their study, they focused on three factors: (1) attitude, (2) income and (3) motivation. They found that attitude towards technology is a key factor influencing the adoption of a wide range of digital technologies, including computers, mobile phones and digital television. They contend that among the factors determining whether a person embraces the internet, 'demographic factors such as age, race, and gender don't matter as much as the consumer's *attitude toward technology*' (italics in original). Similarly, 'because consumers behave differently when they buy technology, marketers must go beyond demographics.[24] According to Modahl,[25] technology is a polarising factor. People either like technology or they do not. They characterise individuals with an affinity for technology as 'technology optimists', and those that have an aversion to technology as 'technology pessimists'. They conclude that about 50 per cent of Americans are technology pessimists. Two of these three studies are primarily focused on information technology, with only Goldman and Kaplan[26] investigating general technology attitudes.

A two-year study by the Committee on Technological Literacy, under the auspices of the National Research Council,[27] investigated the role of general technology in society, and understanding of technological literacy. The results were not encouraging. The committee found that technological literacy was 'poorly understood and significantly undervalued'. The narrow, public conception of technology as computers and the internet was found to be part of the problem. They adopted a broad definition of technology that:

> 'encompasses both the tangible artifacts of the human-designed world (e.g., bridges, automobiles, computers, satellites, medical imaging devices, drugs, genetically engineered plants) and the systems of which these artifacts are a part (e.g., transportation, communications, health care, food production), as well as the people, infrastructure, and processes required to design, manufacture, operate, and repair the artifacts'.[28]

It is on this more general conception of technology that this research focuses. The following addresses the approach and the purpose of the research.

## RESEARCH OBJECTIVES

### Framework for testing construct validity

The primary focus of this study was to refine and test a scale with which to measure and validate the latent construct 'affinity' (to technology). Construct validity refers to the extent to which the scale (instrument) measures what it is supposed to measure.[29,30] To do this convergent, discriminant and nomological validity were tested for. Convergent validity refers to the degree to which different measurements measure the same construct (ie are positively correlated).[31] Discriminant validity is a measure of the divergence between measures of the focal construct and another, related construct. Nomological validity is approached by including other theoretically-related constructs, and refers to whether measures are related to other constructs in theoretically meaningful ways.

### Purpose and process

To better understand and predict behaviour in relation to high-tech products or processes requires an investigation into the role of attitudes towards general technology (of which IT is just a part). The purpose of this research is twofold: first, to develop a scale to measure attitude towards technology, and secondly, to investigate potential antecedents to attitude towards technology. Following Churchill[32] the theoretical framework used to define and operationalise the constructs is introduced first (see Appendix, Table 1 for details). Then, scales measuring attitudes towards technology (affinity) and of hypothesised antecedents to affinity are developed. The scales are then tested for reliability and validity. Next, data are collected and the hypotheses are tested. The following sections (1) describe the variables and (2) develop the hypotheses (see Figure 1 for model).

## ATTITUDE AND PSYCHOLOGICAL VARIABLES

### Attitude towards technology (affinity)

Attitude has been a central construct in social psychology for decades, applied to consistencies and differences in behaviour. An attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour.[33] Ajzen and Fishbein[34] see attitude as an index of the strength of how much a person likes or dislikes something or their own behaviour concerning that thing. Ajzen[35] noted that there is agreement that attitudes are summary evaluations of a psychological object in dimensions such as good–bad, harmful–beneficial, pleasant–unpleasant and likeable–dislikeable. For this study, affinity (considered an attitude) is defined as positive affect towards technology (in general). The key evaluation of this research is the verification of the affinity scale. It is predicted that:

$H_1$: All appropriate scale items will load significantly on affinity.

### Tolerance for ambiguity

Tolerance for ambiguity (TFA) is 'the tendency to perceive ambiguous situations as desirable', and intolerance for ambiguity 'may be defined as the tendency to perceive (ie interpret) ambiguous situations as sources of threat'.[36] Studies indicate that TFA is correlated (among a variety of issues) with conventionality, belief in a divine power, authoritarianism, career choice, decision making, negotiation processes and ethical behaviour.[37–39] Ambiguity may arise from situations that are hard to categorise or label, situations that may be interpreted in multiple ways and situations where there are explicit contradictions. Perception of ambiguity by some individuals may cause them anxiety, diminishing their efforts to think about and to learn new concepts. New technology is often complex, contradictory and ambiguous. Thus, it is predicted that:

$H_2$: Individuals with a higher tolerance for ambiguity will have a greater affinity for technology.

### Dispositional optimism (DOPT)

Optimism has been studied in a variety of contexts, including: test anxiety,[40] computer or IT aversion,[41,42] health and medicine,[43,44] and generalised or global technology.[45,46] 'Optimists are people who tend to hold positive expectations for their futures'[47] and who have ways of coping with outside threats and pressures that differ from those of pessimists. An optimistic person may experience less anxiety associated with new technology and the concomitant lack of information and certainty, and be more likely to get involved with or invest time in new technology as a result of 'optimistic' expectations concerning their personal ability to be successful in their task. Thus, it is hypothesised that:

$H_3$: Individuals with increased scores on the optimism scale (DOPT) will have higher scores on the affinity for technology scale.

### Locus of control

Introduced into the psychological literature by Rotter,[48] locus of control (LOC) is thought to be a personality trait that is general, rather than context specific. Locus of control refers to an individual's belief that he or she is in control of their own actions. Locus of control (considered to be a continuum) is anchored at one end by strong external control (the idea that someone or something outside of oneself is in control), and at the other by strong internal control (where an individual feels that outcomes depend on what the individual does). Individuals with high internal control (internals) are more likely to assume that they will be successful and to seek information more actively than are those with high external control (externals). Externals perceive more risk in their environment than do internals, while internals ascribe effects to be the result of their own actions and perceive less risk than do externals.[49] New technology would seem to the external to be less controllable (and less predictable), and may therefore be more threatening than it would seem to an internal. Thus, it is predicted that:

$H_4$: Individuals with higher scores on the LOC scale (externals) will have lower affinity for technology.

### Need for cognition

Cacioppo *et al.*[50] developed the need for cognition (NFC) scale to measure the degree to which a person tends to engage in and enjoy effortful information processing (thinking). They find support for their contention that individuals differ in their need for cognition, and that those individuals classified as high in need for cognition find simple tasks more unpleasant than complex ones. Correspondingly, they found that individuals scoring low in NFC found complex problems more unpleasant than simple ones. Verplanken[51] summed up prior research, saying that 'the common theme in these studies is that individuals high in need for cognition are motivated to expend more effort on cognitive tasks than are low-need-for-cognition individuals'.

Understanding technology requires a great deal of information. Individuals who do not enjoy thinking about difficult topics (low NFC) will probably not understand or want to investigate technology to the same degree that will those who enjoy complex and rigorous thinking (high NFC). Based on the literature, it is predicted that:

$H_5$: Lower levels of need for cognition will lead to lower scores on the affinity for technology scale.

### Self-efficacy

Self-efficacy (SEFF) refers to an individual's belief about his or her capability to produce effects and according to Bandura,[52] 'determines how people feel, think, motivate themselves, and behave', along with which goals they set, the effort they expend and their resilience to failures. Gecas[53] suggests that people with high levels of self-worth are less threatened by failure and therefore are more inclined to take risks. Conversely, people who doubt their capabilities avoid difficult tasks that they view as risks.[54] Self-efficacy 'reflects the belief of being able to control challenging environmental demands by means of taking adaptive action', and refers to a sense of 'competence to deal with a variety of stressful situations'.[55] As Bandura[56] put it, 'people who doubt their capabilities shy away from difficult tasks which they view as personal threats'. Low self-efficacy leads to higher resistance to change.[57] A higher level of self-efficacy is seen to have a positive effect on cognitive processing, to enhance self-motivation, to reduce anxiety and to allow an individual the resilience to innovate or persevere in long-term behaviours with ambiguous outcomes.[58] Similarly, Ellen *et al.*[59] suggest that self-efficacy may be a critical influence on decision making involving technology. People with self-esteem deficits are uncertain about their capacity to deal with a new technology and may avoid it. Thus, the following is hypothesised:

$H_6$: Individuals scoring high in self-efficacy will have a greater affinity for technology.

### Personal demographic factors

#### Age

While anecdotal evidence of an inverse relationship between age and affinity for technology (older individuals are generally thought to be more averse to new technology than are younger individuals), the published research regarding age and general technology is negligible. For insights into this relationship it is necessary to look at attitude towards IT for guidance. Studies regarding age and attitude towards computers are mixed. Significant effects

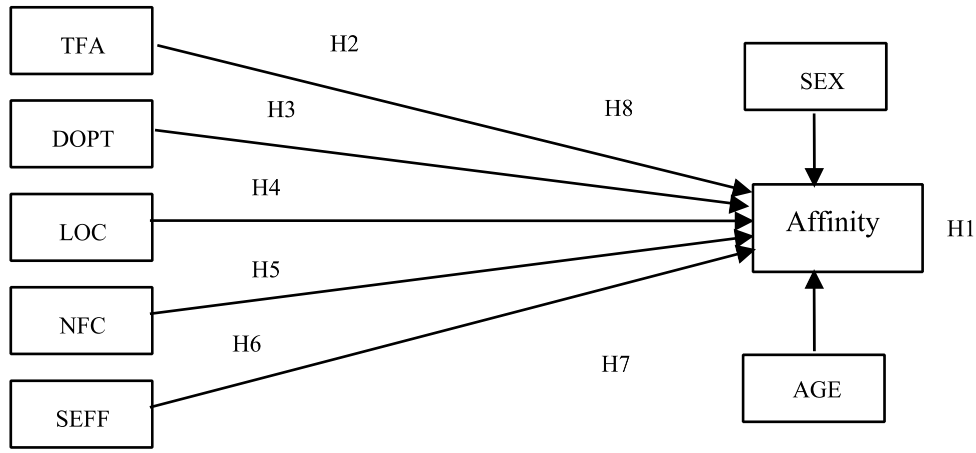


**Figure 1** Model of antecedents and moderators of affinity (to technology)

were reported by Mier and Lambert,[60] and Rosen *et al.*,[61] with older individuals more negative towards computers than younger individuals. Brosnan,[62] on the other hand, reports that a study comparing people 30 years of age and younger with those 55 and older found less aversion towards computers among the older group. Wishart[63] found that increasing age was correlated with internal LOC. Nash and Moroz,[64] investigating the effects of positive attitudes towards computers, found no significant age effect. They do, however, report a correlation between age and experience, and that experience was related to 'computer liking'. It is predicted that:

$H_7$: Older respondents will score lower in affinity for technology.

### Sex

Foote[65] finds in studies of gender and motivation that females have lower expectations for success, under-assessing their own abilities in ambiguous contexts. Men are disproportionately represented in fields such as science and engineering, possibly due to their confidence in their own abilities.[66] Nash and Moroz[67] state that their research found no relationship between sex and computer attitude, supporting past findings in the literature they reviewed. Wishart,[68] however, found a statistically significant correlation between female internals (LOC) and positive attitude towards computers. She states that 'it has been an established finding that females tend to be more externally controlled than males'. She also found that older females were less likely than younger women to be afraid of computers, while older men were more likely than younger men to be afraid. Brosnan[69] reports that findings regarding sex differences in attitude towards computers is mixed. Extrapolating from IT to general technology, the following is hypothesised:

$H_8$: Men will score higher in affinity for technology than women.

## RESEARCH METHOD

### Survey instrument

For compatibility with previous research, scales developed in prior published studies were used when appropriate.

Items for these scales can be found in the appropriate references and in the Appendix. All construct measurement scales are Likert-type with five-point format, anchoring at '1' — Strongly disagree and '5' — Strongly agree. A paper instrument was created, incorporating the scale items and pertinent demographic items. To reduce the likelihood of responses being based on information technology, care was taken to introduce the respondents to the broad range of generalised technology, giving a number of examples, including fibre optics, gene splicing, mobile phones and DVDs.

## SCALE DEVELOPMENT

### Item generation

The procedure described by Churchill[70] was used to develop and purify the scales to measure the focal variable, attitude towards technology and the five psychological factors (see Table 1, in the Appendix, for details) in several stages. The following discusses first the 'pilot' study, and then the 'main study'. The purpose of the pilot study was to develop a reduced and refined set of items measuring affinity. The main study focused on the verification of the affinity scale and on possible antecedents to affinity.

### Pilot study

A pilot study was conducted to develop a short scale to measure affinity towards technology (Table 1, P1). It was performed in three stages with a total of 212 students. A pool of items was generated for the pilot study, starting with the definition of affinity as the positive affect for general technology (Table 1, P2). The initial item candidates were adapted and adopted from several sources including Rosen *et al.*,[71] Heinssen *et al.*,[72] Parasuraman,[73] Simpson and Troost[74] and Brosnan.[75] The list was reviewed for content validity to make certain that each of the items captured an aspect of affinity. A questionnaire was constructed and administered to 35 junior and senior business majors (Table 1, P3). On the basis of the results from this first instrument, the results of exploratory and confirmatory factor analysis, and from a review by several faculty members, a second instrument was developed (Table 1, P4). As part of the second stage of this process an additional construct was included in the instrument to assess nomological validity. The full, 20-item personal involvement inventory (PII) developed by Zaichkowsky[76] was included to capture the individual's involvement with high-tech products. It is reasonable to expect a positive relationship between involvement (with high-tech products) and affinity towards technology. With this second instrument, two rounds of data collection were conducted in the purification process, incrementally increasing the internal consistency of the scale, maximising the reliability and demonstrating validity (see Table 1).[77] The redrawn instrument was administered to a convenience sample of 65 junior, senior and MBA students during a regular class period (Table 1, P5), yielding 63.

To further validate the resultant scale, a fresh set of data for cross-validation was gathered and analysed.[78] For this third stage of the pilot study the revised instrument was administered to 116 graduate and undergraduate students (yielding 114 usable questionnaires) in a Southern metropolitan university (Table 1, P6). This was sufficient for a small measurement model to be tested using structural equations modelling (SEM).[79] Confirmatory factor analysis (CFA) using the AMOS SEM program was then used to determine scale unidimensionality (Table 1, P7).[80]

A measurement model was created with the two latent constructs, affinity and involvement, included with their respective multiple indicators. All scale items loaded as theorised (significant at the $p < 0.001$ level), demonstrating adequate convergent validity. The affinity scale items exhibited acceptable reliability (given the small *n*) as evidenced by individual squared multiple correlations (SMCs) of 0.445 to 0.763.[81] Model fit was found to be adequate (see Appendix, Table 4) and an analysis of the modification indices found only small parameter change estimates, supporting the unidimensionality of the scales.[82]

The sample contained 56 men and 58 women, ranging in age from 18 to 48 years of age. The mean age of respondents was 24 years of age, with a median of 23.5. The predicted correlation between affinity and involvement was supported ($r = 0.349$, $p < 0.0002$), further demonstrating consistency and reliability (Table 1, P8).

## Main study

The primary purpose of this study was to verify and further develop a scale with which to measure affinity (attitude towards technology) and to investigate relationships between affinity and several potential antecedents, including the factors need for cognition, locus of control, tolerance for ambiguity, self-efficacy and dispositional optimism. Additionally, the authors explore whether affinity may be differentially distributed with respect to age and sex (Table 1, M9-10).

Data were gathered from grade-school and high-school educators, college administrators and junior, senior and graduate students in a Southern metropolitan university (Table 1, M11). In addition to the purified affinity scale and demographic items carried over from the pilot study, the questionnaire measured potential antecedents (to affinity), including dispositional optimism, need for cognition, tolerance for ambiguity, locus of control and self-efficacy. Investigation of each of the constructs was undertaken. Results of various analyses indicated that the affinity scale items exhibited acceptable reliability as evidenced by individual SMCs of 0.419 to 0.734, and had acceptable internal consistency, with a standardised Cronbach's alpha of 0.892, and an item-to-item correlation of 0.66 ($p = 0.001$) (Table 1, M12).[83]

The data were gathered from a convenience sample. A total of 605 usable questionnaires were used of the 609 administered (four were found to be improperly completed). Of the 605 respondents, 340 indicated that they were female and 256 indicated that they were male (nine did not specify sex). A wide range of ages was captured, with respondents averaging 27 years (ranging from 18 to 65). There were 224 respondents over the age of 25 and 395 respondents under the age of 25. Work experience averaged 6.4 years, with 371 indicating one year or less full-time work experience and 222 indicating five or more years of full-time work experience. About 50 per cent of the respondents had between four and ten years of full-time work experience. In educational background, the sample was also varied. While 367 (66 per cent) individuals were undergraduates, 80 (14.4 per cent) had achieved a four-year degree, 55 (10 per cent) were pursuing Masters degrees, 21 (3.8 per cent) were pursuing law degrees, and 21 had achieved Masters degrees. The students tended to be non-traditional, being older (with a mean age of 26), and having more work experience (57 per cent had over four years of full-time work experience).

## ANALYSIS

### Measurement validation

In preparing the affinity scale and the five psychological scales, exploratory factor analysis was conducted using the maximum likelihood method (see Table 1, M12). The number of factors extracted was decided by using an eigenfactor of 1. Items that demonstrated adequate loadings on the first factor extracted were retained. Next, Pearson correlations were run, yielding acceptable Cronbach's alphas for each set of items (see Appendix, Table 2). Affinity was then compared with a global item (asking the respondent to indicate the degree to which he or she is 'technophobic') for nomological validity purposes, with a high correlation indicating high reliability.[84] The predicted relationship with the global item was supported with a correlation of 0.513 ($p < 0.0001$). No correlation of factors was relatively close to one (from 0.116 to 0.454), providing evidence of discriminant validity.

Confirmatory factor analysis (CFA) using the AMOS structural equations modelling program was then performed to test unidimensionality.[85] A measurement model was created including the latent constructs (affinity, TFM, NFC, SEFF, DOPT and LOC) with their respective (and reflective) indicators. All items loaded as theorised and were significant at the $p < 0.001$ level. Model evaluation was based on a number of criteria, including convergent and discriminant validity, unidimensionality and reliability.[86] Model fit was found to be adequate (see Table 2).[87–89] Finally, the modification indices were small, supporting the proposed unidimensionality of the scales.

### Data analysis

Measures were captured in two formats. First, for correlations, regressions, and two-sample *t*-tests of means, specified items were linearly summed. Additionally, items from the measurement model exhibiting the highest SMCs were selected for each construct, with higher SMCs indicating higher reliability.[90] Regressions using structural equations modeling were performed using these items (Table 1, M13).

Hypothesis 1, examining the affinity scale itself, was tested using confirmatory factor analysis. Scale items should load on the affinity construct, and should not cross-load on the other constructs in the model. Hypotheses 2–7 were tested comparing Pearson product moment coefficients of correlation. Hypothesis 8 was tested using two-sample *t*-test for means. Although no hypothesis was proposed, a multiple linear regression analysis (including the independent variables NFC, DOPT, SEFF, LOC and TFA, and the dependent variable, affinity) was performed using structural equations modelling.[91]

## RESULTS AND DISCUSSION

First, results of the hypothesis testing are reported. Of the eight hypotheses, six hypotheses were supported and two were not supported (see Appendix, Table 2).

The first hypothesis, that the scale items for affinity would load correctly, was supported with statistically significant individual SMCs ranging from 0.419 to 0.734 (see Appendix, Table 3).

Optimism as a trait (or disposition) has been associated with increased effort expended, motivation, success and reduced anxiety. The results of this study supported the hypothesis that individuals with higher optimism scores would also have a higher affinity for technology ($H_3$). As shown in Table 4, a correlation of affinity with optimism (DOPT) shows an $r = 0.288$, with $p < 0.0001$.

The need for cognition scale measures the degree to which a person tends to engage in and enjoy effortful information processing (thinking). Individuals differ in their need for cognition, and those individuals classified as high in need for cognition have reported that for them simple tasks are more unpleasant than complex ones. Conversely, individuals scoring low in NFC find complex problems more unpleasant than simple ones. A common theme in past NFC studies is that individuals high in need for cognition expend more effort on cognitive tasks than do low-need-for-cognition individuals. Understanding technology requires a great deal of information. The hypothesis that individuals with lower scores on the need for cognition scale would also exhibit lower scores on the affinity for technology scale ($H_5$) was supported, with a correlation of 0.404 ($p < 0.0001$).

A person who doubts his or her capability is more threatened by failure, and is less likely to take risk. Higher levels of self-efficacy are thought to reduce anxiety, to lead to more cognitive processing and to increase self-motivation. The hypothesis that those individuals with higher levels of self-efficacy will exhibit higher levels of affinity ($H_6$) was supported, with a correlation of 0.210 ($p < 0.0001$).

While there was little in the literature upon which to develop hypotheses concerning the effect of age on attitude towards general technology, there is considerable anecdotal support for the premise that younger individuals embrace technology to a greater degree than do older individuals. The hypothesis that older individuals will have lower affinity scores than will younger respondents ($H_7$) was supported. A Pearson's moment correlation finds a slight but statistically significant correlation of $-0.108$ ($p = 0.0086$). The inverse correlation would suggest that older respondents have less affinity for technology than do younger individuals. From the literature, and the anecdotal evidence, it was hypothesised that males would score higher in affinity than would females ($H_8$). The hypothesis was supported, with means of 26.73 and 25.22 for males and females respectively. A two-sample *t*-test found the difference between means to be significant ($p = 0.0004$), suggesting that males in this sample had higher affinity for technology than did females.

The following hypotheses were not supported.

Tolerance for ambiguity is thought to be a trait that affects an individual's ability to deal effectively with ambiguous situations. Higher levels of tolerance are associated with lower levels of anxiety and higher levels of cognitive complexity in the presence of contradictory or ambiguous information. No support was found for the hypothesis that those respondents with higher scores on the TFA scale will score lower on the affinity scale ($H_2$) (non-significant correlation, $p = 0.201$).

Locus of control is a personality trait that is used to categorise individuals according to the degree to which they feel in control of events. People who feel that someone or something is in control of their future perceive more risk in their environment than do those who feel more in control. The hypothesis that individuals scoring higher on the locus of control scale will exhibit less affinity for technology ($H_4$) was not supported, with a correlation (approaching significance) of $-0.0733$ ($p = 0.0719$) (see Table 1).

Table 3 (in the Appendix) summarises the results of the analyses. Affinity was found to correlate with three of the five psychological factors: optimism, self-efficacy and need for cognition. Additionally, both sex and age were found to moderate the antecedents-to-affinity relationship. Age correlated with affinity, with younger individuals exhibiting more affinity and the mean affinity score for women was lower than the score for males (statistically significant).

To determine the relative contribution of the psychological factors, a linear regression model with NFC, TFA, SEFF, DOPT, LOC and key demographic factors as independent variables, and with affinity as the dependent variable was performed (see Figure 1 for model). To better account for error and the effects of multicollinearity, SEM using the AMOS SEM program was used.[92,93] This analysis found that only the NFC, DOPT and AGE regression coefficients were statistically significant. The standardised regression weight for DOPT was 0.331 ($p < 0.008$). This finding (that optimism is a factor contributing to a positive attitude towards general technology) would seem to be consistent with Parasuraman's[94] 'optimist' and the 'technology optimist' from the Forrester study.[95] The regression weight (standardised) for AGE was $-0.297$ ($p < 0.0001$). The standardised weight for NFC was 0.758 ($p < 0.0001$). This finding is consistent with Goldman *et al.*,[96] in that the need for cognition would seem to be related to their 'mechanical curiosity'. The overall fit of the model was acceptable, with a Tucker-Lewis index of 0.943, a comparative fit index of 0.957 and an RMSEA of 0.046. Overall, these findings lend support to the original premise that attitude towards technology is influenced by individual factors (most influential of which was NFC). Individuals with an affinity for technology like to think and solve problems, are generally optimistic by nature and tend to be younger.

## CONCLUSIONS AND LIMITATIONS

Researchers have called for 'greater attention to consumer resistance to new products … particularly technological alternatives'.[97] The study reported here identified and examined one factor affecting resistance — attitude towards technology (affinity), and its potential antecedents. A better understanding of the interplay of these factors will aid marketers in efforts to explain and predict (and possibly to accelerate) adoption of technological innovations.

The results of this study support the premise that there is a general attitude towards technology, that this attitude is differentially distributed among the sample population and that there are several personal factors that contribute to this attitude. Some individuals are more positively disposed towards technology than others and the attitudinal distribution may be predicted through the investigation of antecedents to attitude towards affinity.

The data were gathered from a convenience sample which included a significant proportion of undergraduate students. While care was taken to be inclusive in soliciting respondents, generalisability would be enhanced with a randomised data collection approach.

Many of the correlational relationships, although statistically significant, are small (eg AGE to affinity at 0.1075, $p < 0.0086$). In the regression including age, NFC and DOPT as independent variables and affinity as the dependent variable, one quarter of the variance in the dependent variable affinity ($SMC = 0.245$) is accounted for by these three variables. While this is not a large proportion, even relatively small effects may be useful if replicable.[98]

## Implications

Measuring attitudes towards general technology can help marketers better to understand and predict both customer and employee behaviour in relation to high-tech products and processes. The rate of diffusion of an innovation (eg a new product) among customers and the acceptance and use of new technology by employees may be contingent on the composition and distribution of their attitudes towards technology. For example, the more high-tech a product is, the more resistant some individuals are to adopting it.

Understanding the differences between individuals with relatively high affinity for technology and those with lower affinity is helpful in a variety of efforts, including segmentation, targeting, positioning, marketing mix development and employee selection and training. Certainly, segmenting the market based on attitudes towards general technology would generate another useful perspective for marketers. Combined with other segmentation variables (eg demographics, lifestyles), attitudes towards technology would provide a more complete picture of consumers. Affinity for (or aversion to) technology would also help to target more effectively specific consumer segments and position a product or service.

Examples of how considering attitudes towards general technology can aid in developing product strategy include better design of the user interface (eg simplifying the control panel of a multifunction household appliance to appeal to more consumers). Product instructions and technical manuals could be tailored to offer more or less detail and could also be made available on the internet or on CD-ROM. Package design, including technical details, may also be influenced by consumer attitudes.

In terms of promotional strategy, advertising and other promotional messages may be more effectively tailored to different consumer segments. The findings indicate that individuals with positive attitudes towards technology like to read and think, and they are generally more optimistic than those with less positive attitudes. These consumers may be persuaded by more detailed copy, communicated via relatively high-involvement media such as print (eg magazines) and the web. Targeted prospects with lower affinity for technology may desire less technical detail and more symbolic content or image-based appeals. They may be reached through various means, including lower-involvement media (eg television, radio). Testimonials and other assurances may be important to less optimistic individuals.

A positive attitude towards general technology must be considered an employee asset for many companies. Even firms not considered high-tech may use technology in the creation of their products or in dealing with suppliers of technology-intensive products and in selling to customers involved with technology. Understanding the antecedents to a positive attitude towards technology could aid in designing evaluation criteria for hiring (eg test batteries). In some cases, it may not be possible or appropriate to hire only those individuals with an affinity for technology. Still, employee resistance to adoption and use of innovations may be reduced via better training programmes based on a thorough understanding of attitudes towards general technology.

### Future research

Additional refinement of the affinity scale is needed. Previous research (in an IT context) points to the idea that people may hold both positive and negative affect towards IT. It is reasonable to consider that this may hold true for more general technology as well. The scale used in this research addresses only the positive attitude component. A similar scale may be developed to measure the negative aspects of attitude towards technology (aversion). Also, the antecedents proposed and described in this study only include a few of the factors that may affect attitude towards technology. A broader study incorporating additional factors would be informative.

Future research should also include other age groups and individuals with varying demographic characteristics. While the sample frame in this study included a wide range of ages and occupations, many of the respondents were undergraduate students. A logical next step for research in this area would be to widen the sample frame.

Possibly the most important consideration of attitude towards technology is the effect on an individual's behaviour. The existence of a scale by which to measure this attitude allows questions such as the following to be addressed: is a person's voting behaviour determined in part by her attitude towards technology; are certain individuals' purchasing behaviours affected by their affinity for general technology; are career choices, in part the result of technology attitudes?

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## APPENDIX

**Table 1:** Construct purification steps

| Phase: pilot or main study | Description | Churchill (1979) step |
|---|---|---|
| Pilot 1 | Domain specification: Attitude toward technology | 1 |
| Pilot 2 | General pool of items | 2 |
| Pilot 3 | Collect data ($n$ = 35) | 3 |
| Pilot 4 | Purification | 4 |
| Pilot 5 | Collect data ($n$ = 63) | 5 |
| Pilot 6 | Purification | 4 |
| Pilot 7 | Collect data ($n$ = 63) | 5 |
| Pilot 8 | Analysis | N/A |
| Main 9 | Domain specification: five psychological scales | 1 |
| Main 10 | Generate pool of items | 2 |
| Main 11 | Collect data ($n$ = 605) | 3 |
| Main 12 | Assess reliability, validity | 6 |
| Main 13 | Analyses | N/A |

**Table 2:** SEM model results (pilot and main study)

| Model fit | Chi-square [df] | Goodness-of-fit (GFI) | Adjusted goodness-of-fit (AGFI) | Tucker-Lewis | RMSEA | Comparative Fit Index | |
|---|---|---|---|---|---|---|---|
| Pilot study | 137.2 [122] | 0.874 | 0.826 | 0.937 | 0.049 | 0.949 | |
| Main study | 3.264 [134] | 0.945 | 0.921 | 0.920 | 0.051 | 0.938 | |
| Regression results (main) | | | | | | | |
| Dep variable | LOC | DOPT | SEFF | TFA | AGE | SEX | NFC |
| Affinity | ns | 0.331 ($p<0.008$) | ns | ns | −0.297 ($p<0.0001$) | ns | 0.758 ($p<0.000$) |

**Table 3:** Hypotheses and findings (main study)

| | |
|---|---|
| $H_1$: The scale items will load on affinity | Supported, with SMCs from 0.419 to 0.I734 |
| $H_2$: Individuals with higher tolerance for ambiguity (TFA) will exhibit higher affinity scores | Not supported, with a non-significant correlation of −0.052 ($p<0.201$) |
| $H_3$: Individuals with higher scores on the optimism scale (DOPT) will have higher scores on the affinity scale | Supported, with a correlation of 0.288 ($p<0.0001$) |
| $H_4$: Individuals with lower scores on the locus of control scale (internals) will score higher on affinity scale | Not supported, with a correlation of −0.0733 ($p<0.0719$) |
| $H_5$: Individuals scoring lower on the need for cognition scale will score lower on the affinity scale | Supported, with a correlation between NFC and affinity of 0.404 ($p<0.0001$) |
| $H_6$: Individuals scoring higher in self-efficacy (SEFF) will have a greater affinity for technology | Supported, with a correlation of 0.210 ($p<0.0001$) |
| $H_7$: Older individuals will have lower scores in technology affinity (affinity) than will younger individuals | Supported, correlation of −0.108 ($p<0.0086$) |
| $H_8$: Males will score higher on the technology affinity scale than will females | Supported, with means of 26.73 and 25.22 for males and females respectively ($p<0.001$) |

**Table 4:** Correlation of key constructs (main study)

| | Affinity | NFC | TAM | SEFF | DOPT | LOC | AGE |
|---|---|---|---|---|---|---|---|
| Affinity | 1 | | | | | | |
| NFC | 0.40398<br><0.0001 | 1 | | | | | |
| TAM | −<br>0.05212<br>0.2008 | −0.1874<br><0.0001 | 1 | | | | |
| SEFF | 0.2102<br><0.0001 | 0.3045<br><0.0001 | 0.448<br><0.0001 | 1 | | | |
| DOPT | 0.2875<br><0.0001 | 0.2011<br><0.0001 | 0.0654<br>0.1081 | 0.4199<br><0.0001 | 1 | | |
| LOC | −0.0733<br>0.0719 | −0.2126<br><0.0001 | 0.2946<br><0.0001 | 0.1536<br><0.0001 | | 1 | |
| AGE | −0.1075<br>0.0086 | 0.1540<br>0.0002 | 0.1540<br>0.0002 | −0.0298<br>0.4682 | 0.0378<br>0.3566 | −0.1320<br>0.0012 | 1 |

## Scales

### Affinity for technology

This scale was developed by the authors for a previous, unpublished study. It was adapted and adopted from Parasuraman,[99] Rosen *et al.*,[100] Heinssen *et al.*,[101] Simpson and Troost[102] and Brosnan.[103] The previous unpublished study found a Cronbach's alpha of 0.892. This study found an alpha of 0.88.

1 Technology is my friend …
2 I enjoy learning new computer programs and hearing about new technologies.
3 People expect me to know about technology and I don't want to let them down.
4 If I am given an assignment that requires that I learn to use a new program or how to use a machine, I usually succeed.
5 *I relate well to technology and machines.
6 **I am comfortable learning new technology.
7 **I know how to deal with technological malfunctions or problems.
8 * Solving a technological problem seems like a fun challenge.
9 * I find most technology easy to learn.
10 **I feel as up-to-date on technology as my peers.

(* indicates items used in summations, ** indicates items also included in SEM)

### Global attitude towards technology measure

This scale was suggested by the literature.

*Technophobia (negative affect towards)*
If 'technophobia' is defined as feeling discomfort about computers or any new technology, which of the following best describes you: [please check only one box below]

[ ] Highly Technophobic
[ ] Moderately Technophobic
[ ] Mildly Technophobic
[ ] Not Technophobic

### Need for cognition

On need for cognition the authors report an alpha of 0.90.[104] The present study found an alpha of 0.760.

1 **I would prefer complex to simple problems.
2 **I like to have the responsibility of handling a situation that requires a lot of thinking.
3 *Thinking is not my idea of fun.
4 I would rather do something that requires little thought than something that is sure to challenge my thinking ability.
5 *I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something.
6 *I find satisfaction in deliberating hard and for long hours.
7 *I only think as hard as I have to.
8 I prefer to think about small daily projects to long-term ones.
9 I like tasks that require little thought once I have learned them.
10 The idea of relying on thought to make my way to the top appeals to me.
11 **I really enjoy a task that involves coming up with new solutions to problems.
12 *Learning new ways to think doesn't excite me very much.
13 I prefer my life to be filled with puzzles that I must solve.
14 The notion of thinking abstractly is appealing to me.
15 I would prefer a task that is

intellectual, difficult, and important to one that is somewhat important but does not require much thought.
16 It's enough for me that something gets the job done: I don't care how or why it works.
17 I usually end up deliberating about issues even when they do not affect me personally.

(* indicates items used in summations, ** indicates items also included in SEM)

### Tolerance for ambiguity

McQuarrie and Mick[105] report an alpha of 0.70. This study found an alpha of 0.705.

1 **I like movies or stories with definite endings.
2 **I always want to know what people are laughing at.
3 *I would like to live in a foreign country for a while.
4 **A good job is one where what is to be done and how it is to be done are always clear.
5 I tend to like obscure or hidden symbolism.
6 *It really disturbs me when I am unable to follow another person's train of thought.
7 **I am tolerant of ambiguous situations.
8 A poem should never contain contradictions.
9 *I don't like to work on a problem unless there is a possibility of coming out with a clear-cut and unambiguous answer.
10 *I like parties where I know most of the people more than ones where all or most of the people are complete strangers.

(* indicates items used in summations, ** indicates items also included in SEM)

### Self-efficacy

Schwarzer and Jerusalem[106] report an alpha in the 'high 0.80s'. The present study found an alpha of 0.946.

1 **I can always manage to solve difficult problems if I try hard enough.
2 *If someone opposes me, I can find the means and ways to get what I want.
3 **It is easy for me to stick to my aims and accomplish my goals.
4 **I am confident that I could deal efficiently with unexpected events.
5 *Thanks to my resourcefulness, I know how to handle unforeseen situations.
6 *I can solve most problems if I invest the necessary effort.
7 *I can remain calm when facing difficulties because I can rely on my coping abilities.
8 *When I am confronted with a problem, I can usually find several solutions.
9 *If I am in trouble, I can usually think of a solution.
10 *I can usually handle whatever comes my way.

(* indicates items used in summations, ** indicates items also included in SEM)

### Dispositional optimism (life orientation test)

The authors record an alpha of 0.82 for the original scale.[107] The present study found an alpha of 0.839.

1 **I'm always optimistic about my future.
2 **In uncertain times, I usually expect the best.
3 **I always look on the bright side of things.
4 If something can go wrong for me, it will.
5 It's easy for me to relax.

6 I hardly ever expect things to go my way.
7 I enjoy my friends a lot.
8 It's important for me to keep busy.
9 I rarely count on good things happening to me.
10 I'm a believer that 'every cloud has a silver lining'.
11 I don't get upset too easily.
12 Things never work out the way I want them to.

(⋆ indicates items used in summations, ⋆⋆ indicates items also included in SEM)

### Locus of control

The authors report an alpha of 0.80.[108] The present study found an alpha of 0.862.

1 ⋆Children get into trouble because their parents punish them too much.
2 ⋆Many of the unhappy things in people's lives are partly due to bad luck.
3 ⋆People's misfortunes result from the mistakes they make.
4 ⋆In the long run people get the respect they deserve in this world.
5 ⋆Unfortunately, an individual's worth often passes unrecognised no matter how hard he or she tries.
6 ⋆⋆Most students don't realise the extent to which their grades are influenced by accidental happenings.
7 ⋆Many times exam questions tend to be so unrelated to course work that studying is really useless.
8 ⋆Getting a good job depends mainly on being in the right place in the right time.
9 ⋆This world is run by the few people in power, and there is not much the little guy can do about it.
10 ⋆It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.
11 ⋆⋆Many times we might just as well decide what to do by flipping a coin.
12 ⋆Who gets to be boss often depends on who was lucky enough to be in the right place first.
13 ⋆As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.
14 ⋆⋆Most people don't realise the extent to which their lives are controlled by accidental happenings.
15 ⋆It is usually best to cover up one's mistakes.
16 ⋆⋆Many times I feel that I have little influence over the things that happen to me.
17 ⋆There's not much use in trying too hard to please people, if they like you, they like you.

(⋆ indicates items used in summations, ⋆⋆ indicates items also included in SEM)

 