Attitudes Towards Computers in an Information-Intense Environment: A Field Study of The Insurance Industry

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Abstract

The topic of human attitudes about computers has been dealt with extensively in both the academic and popular literature, but it remains an issue of importance. The continued relevance was well illustrated by the Soviet chess grandmaster Karpov, who recently remarked that he was not afraid to lose a chess game to a computer, but that people who worked with such computers could lose their soul to the machines (Hooper, 1990). The beliefs which people hold toward computers will affect their computer interaction and their willingness to adapt to automated systems: therefore the issue is of great practical importance. This paper reports on a replication of an early IBM study with the intent of assessing contemporary attitudes towards computers and the changes in attitudes over the last 25 years.

Introduction

Computers are more than tools: they have become a symbol of power, knowledge, and speed for a large group of users. The marketers have helped create this aura while they achieved a tremendous market penetration. Although computers are pervasive throughout our society, there is a segment of the population which resists their implementation and use. These persons hold beliefs such as: 'computers are prone to error', 'more intelligent than humans','an encroachment upon man's humanity' (they may be running our lives), and 'a cause of unemployment'. There may well be a third group which gives the outward appearance of liking, accepting, and using computers while inwardly feeling uncomfortable with the innovation, and covertly resisting its use (or failing to utilize the full potential).

Attitudes towards computers is an area worthy of study because of the tremendous importance of computers, and because of the possibility of learning both positive and negatives aspects about this assimilation of technology, which may be generalized to others. Also there is evidence that despite widespread diffusion of computers, a large number of negative and unrealistic attitudes exists.

Brief Review of Prior Research

The classic study on computer attitudes was conducted in the mid 1960's by Robert Lee of IBM, who investigated attitudes towards the "electronic thinking machine" (Lee, 1970). Lee developed a 20 item attitude scale which showed two independent attitudes about computers: the first viewed computers as useful tools for space exploration, industry, science, etc., and the second saw the machines as relatively autonomous entities which could perform the functions of human thinking. He concluded that computers were a complex and ambiguous stimuli to which persons reacted differently, depending, in large part, upon social class.

Lee's (1970) study was replicated by Morrison (1983) who found different factors, with the largest amount of variance being explained by the negative factor. This was opposed to Lee's largest factor which was the "Beneficial Tool of Man" (Morrison, 1983). Another early study revealed no effect upon performance whether a subject believed that he was interacting with a computer or another person. However, the subjects perceived a "computer" opponent as more powerful and more depersonalizing than a human opponents (Orcutt & Anderson, 1974).

Hirschman (1980), a marketing researcher, proposed a behavioral - attitude theory of consumer behavior, applying the constructs of role accumulation, innovativeness,

creativity, and novelty seeking to the decision to purchase a home computer. The cognitive needs of computer users and their requirements for user-friendly software was also identified as important (Fried, 1982). A later study provided support for Fried's (1982) idea as subjects tested with human-response type software scored higher on tests than those using the mechanistic program (Quintanar, Crowell, & Pryor, 1982).

Danko and MacLachlon (1983) studied computer adopters with respect to predictor variables, including attitudes. They found that attitudes about computers controlling people, were negatively correlated with computer ownership. These findings were supported by Dickerson and Gentry, (1983), who linked attitudes to the decision to purchase a home computer.

The dangers of a systems-oriented specialist dealing with employees who are not systems oriented was elucidated as a basis of fear of computerization (Gross, 1983). Human-oriented implementation has been linked with relieving those anxieties (Gardner, Render, Ruth, & Ross, 1985). Landry (1985) described the implementation of computer technology without a systems approach and concluded that the automation process could turn a job into "piece rate" work. Hill, Smith, and Mann (1987), found that beliefs of efficacy towards computers were influential on the decision to use computers, and that prior experience was directly related to efficacy beliefs.

Sex (Popovich, Hyde, & Zakrajsek, 1987), peer pressure (Ely, 1985), and race (Greenly, 1988) have been linked to negative computer attitudes. Computer technology has been found to result in negative attitudes as workers fear their inability to learn to use the machine (Anderson, 1983; Chamberlain, 1985; Wagenaar, 1985), develop a fear of the computer, per se, or perceive upgrading or downgrading of jobs, and shifts in informal power (Crunkleton & Granger, 1987; Carr, 1988; Buchanan and Boddy, 1983).

Attitudes may deteriorate as computers are perceived to complicate the lives of some users and intimidate them rather than being a benefit (Penzias, 1982; McNitt, 1984). The importance attached to computers may be generating a negative response (Foegen, 1986): the use of computers by judges in making sentencing decisions and in other decision-making applications has prompted a recent seminar at the Brookings Institute to consider building a conscience in the computer field (Steep, 1990).

Methodology

The Sample

Data for this study was collected from 325 insurance companies employees in the southeastern United States. The insurance industry is a very information- and transaction-intensive industry, and thus has been a leader in the assimilation and use of computers.

The demographics of the subjects' are shown in Table 1.

The Questionnaire

The instrument used in this study was the same 20 item instrument designed by Lee (1970). The only modification was the substitution of the word "computer" for the term "electronic brain machine" which was used in the earlier study. Subjects indicated their agreement with each item on a 7 point scale ranging from 1 (strongly agree) to 7 (strongly disagree). The 20 items are presented in Table 2.

Data Analysis

Questionnaire responses were analyzed by factor analysis of the correlation matrix, using varimax rotation (the procedure used by Lee). Two separate analyses were conducted: first, two factors were extracted to compare with Lee's (1970) two factor results. Second, the data was analyzed without attempting to match Lee, by extracting factors equal to the number of eigenvalues in the principal component analysis with values greater than 1.0, a commonly accepted minimum eigenvalue criteria (Cliff, 1988).

To verify the correctness of the factor groupings, an analysis of the factors' items was conducted with the correlation matrix, which contained the significance levels of the correlations among the 20 items. Analyses were done both for the within and between factor correlations.

Correlation analysis was also employed to identify personal characteristics with a significant relationship with the questionnaire items. Correlations were considered significant at .05.

Results

The results of this study are presented in two parts: a two-factor analysis compared to Lee's (1970) two factors, and results based upon extraction of four factors (with eigenvalues were greater than 1.0).

Contemporary Attitudes Compared to Lee

Factor analysis extracting two factors (to compare with Lee's two factors), provided the results shown in Table 3.

All of the statements in the present study loaded at a value of .40 or greater except item 6, which was classified as a residual item congruent with Lee, who used .40 as the critical factor loading value. The item loadings of both factors in the present study are generally in the same direction and of similar magnitude to those of the prior study. Lee named his factor #I "Beneficial Tool of Man",

TABLE 1
SAMPLE DEMOGRAPHICS

Age	Number	Sex	Number	Education	Number
<25	89	Male	82	High School Graduate	129
26-40	148	Female	239	Some College	99
>41	87			College Graduate	74
				Post Graduate Work	14

Computer Knowledge	Number	Years Worked in Insurance:	
No Knowledge or Experience	41	1 - 3	116
Some Exposure or Courses	138	4 - 10	93
Reasonable Knowledge	97	11 - 20	60
Very Knowledgeable or Experienced	37	> 20	37
Expert in Use and Understanding	11		

Amount of Time Spent Using Electronic Data Processing:		Typing Skill:	
		Cannot Type	25
None	85	Type <20 Words/minute	21
1 - 2 hours/week	83	Type 20-50 Words/minute	113
3 - 8 hours/week	58	Type 50-80 Words/minute	51
> 8 hours/week	94	Type >80 Words/minute	7

TABLE 2
LEE'S COMPUTER ATTITUDE SURVEY ITEMS

1. There's something exciting and fascinating about computers.
2. Computers are kind of strange and frightening.
3. They are so amazing that they stagger your imagination.
4. They sort of make you feel that machines can be smarter than people.
5. They are very important to our man-in-space program.
6. They can be used for evil purposes if they fall into the wrong hands.
7. They will help bring about a better way of life for the average man.
8. With computers, the individual person will not count for very much anymore.
9. They can think like a human being thinks.
10. Computers will free men to do more interesting and imaginative types of work.
11. They are becoming necessary to the efficient operation of large business companies.
12. They can make serious mistakes because they fail to take the human factor into account.
13. Someday in the future, these machines may be running our lives for us.
14. They make it possible to speed up scientific progress and achievements.
15. There is no limit to what these machines can do.
16. They work at lightning speed.
17. Computers help to create unemployment.
18. They are extremely accurate and exact.
19. Computers can make important decisions better than people.
20. They are going too far with computers.

Source: Lee, 1970

and his factor #II, "Awesome Thinking Machine" (Lee, 1970).

Only three items are different between the first factors in the two studies: item 1, a residual in the Lee study, would be included in factor I (the "Beneficial Tool...") in the current study. Items 3 & 15, which were included in Lee's "Awesome Thinking Machine", (factor II) would be included in the "Beneficial Tool..." category in this study. The "Beneficial Tool..." factor accounted for 30.4% of the variance in the current data.

Items 20 and 12, which were residuals in Lee's study loaded into our factor 2 producing an "Awesome Thinking Machine" factor in the present study which accounted for 15.2% of the variance. The two factors combined provided 45.4% of the variance in the data: the Lee study did not report the factor variance.

Examination of the correlation matrix supports the study's factors: correlations within the factors are positive and high, and between the factors, negative and high.

TABLE 3
STUDY RESULTS VERSUS LEE'S (1970) TWO FACTORS

	Factor Loading			
	Lee		Present Study	
ITEMS	I	II	I	II
I. Beneficial Tool of Man				
14. They make it possible to speed up scientific progress and achievements.	.59	.02	.70	.08
5. They are very important to our man in space program.	.56	.02	.59	.05
11. They are becoming necessary to the efficient operation of large business.	.55	.10	.69	-.03
7. They will help bring about a better way of life for the average man.	.53	-.03	.76	.02
18. They are extremely accurate and exact.	.52	-.04	.64	.06
16. They work at lightening speed.	.49	.21	.66	.10
10. Computers will free men to do more interesting and imaginative types of work.	.40	-.04	.63	.14
II. Awesome Thinking Machine				
9. They can think like a human being thinks.	.10	.62	.34	.67
8. With computers the individual person will not count for very much anymore.	-.09	.60	.01	.77
4. They sort of make you feel that machines can be smarter than people.	.13	.57	.32	.58
13. Someday in the future, these machines may be running our lives for us.	.02	.56	.19	.72
15. There is no limit to what these machines can do.	.17	.50	.54	.29
19. Computers can make important decisions better than people.	.21	.46	.38	.59
2. Computers are kind of strange and frightening.	-.15	.44	.22	.62
3. They are so amazing that they stagger your imagination.	.13	.42	.46	.30
17. Computers help create unemployment.	-.12	.39	-.09	.78
Residual Items				
20. They are going to far with computers.	-.33	.50	-.10	.76
6. They can be used for evil purposes if they fall into the wrong hands.	.10	.25	.28	.37
12. They can make serious mistakes since they fail to take the human factor into account.	-.13	.17	-.02	.60
1. There's something exciting and fascinating about computers.	.30	.28	.58	.13
Percent variance			30.4	15.2

Current Attitudes

Factor analysis

Factor analysis of the correlation matrix of the current data produced four factors with eigenvalues greater then 1. Table 4 shows the loadings for each factor.

The extraction of four factors from this data provides a more detailed analysis of attitudes. The items in the factor named positive supertool are the same as in Lee's (1970) "Beneficial Tool..." (factor I). The "Awesome Thinking Machine" (Lee's factor II), was divided among three new factors: negative, awesome, and science fiction. Each of the 20 items loaded into the factors with a value greater than .40, and these factors together account for 57.3 % of the variance in the data.

TABLE 4
PRESENT ATTITUDES TOWARDS COMPUTERS

		Factor Loadings			
		Positive Supertool	Negative		
5.	They are very important to our space program.	.70			
7.	They will help bring about a better way of life for the average man.	.62			
10.	Computers will free men to do more interesting and imaginative work.	.51			
11.	They are becoming necessary for efficient operation of big business.	.71			
14.	They speed up scientific progress	.76			
16.	They work at lightening speed.	.59			
18.	They are extremely accurate.	.55			
2.	Computers are kind of strange and frightening.		.53		
6.	They can be used for evil purposes in the wrong hands.		.57		
8.	With computers, the individual will not count for very much.		.66		
12.	They can make serious mistakes because they fail to take the human factor into account.		.68		
13.	Someday these machines may run our lives.		.59		
17.	Computers help create unemployment.		.75		
20.	They are going too far with computers.		.78		
	Variance	30.4	15.2		
		Awesome	Science Fiction		
4.	They make you feel that machines can be smarter than people.	.50			
9.	They can think like a human.	.70			
15.	There is no limit to what these machines can do.	.52			
19.	Computers can make important decisions better than people.	.71			
1.	There is something exciting and fascinating about computers.		.50		
2.	Computers are kind of strange and frightening		.49		
3.	They are so amazing that they stagger your imagination.		.81		
4.	They make you feel that machines can be smarter than people.		.52		
	% Variance	6.4	5.4		

Examination of the four factors reveals very different attitudes being described by the factors, although they can be collapsed to fit Lee's two factor results (see Table 3).

Correlation Analysis

The correlation matrix reveals a number of significant correlations (see Table 5). Sex was significantly correlated with 5 items (numbers 5, 7, 10, 14, & 16), all of which are in the "Beneficial Tool of Man" factor (in the two-factor analysis) and the "Positive Supertool" factor (in the four-factor analysis).

Age correlated with only two items - numbers 1 & 2. Education was significantly related to eight of the 20 items (numbers 1, 3, 9, 12, 13, 15, 19, & 20). The level of computer knowledge correlated only with item 12; and the time spent using a computer was not significantly related to any of the 20 items.

TABLE 5
CORRELATION ANALYSIS

Questionnaire Item	Age	Sex	Computer Knowledge	Time Using	Education
1.	**.1787**	.1217	-.1301	-.0117	**.1776**
	(.014)	(.098)	(.076)	(.874)	(.015)
2.	**.0157**	-.0182	.0902	-.0090	.0228
	(.031)	(.805)	(.221)	(.903)	(.757)
3.	-.0553	.0286	.0109	-.0204	**.1502**
	(.453)	(.698)	(.882)	(.782)	(.041)
4.	-.0456	.0075	.0414	.0181	.1383
	(.537)	(.918)	(.574)	(.806)	(.059)
5.	-.0931	**-.2397**	.0628	.0339	-.0492
	(.206)	(.001)	(.394)	(.646)	(.301)
6.	-.0624	-.1310	.0544	-.0149	.0762
	(.397)	(.075)	(.461)	(.840)	(.301)
7.	.1042	**-.1696**	-.0188	-.0339	-.0875
	(.157)	(.021)	(.799)	(.646)	(.235)
8.	-.0633	.0310	.0440	.0312	.0862
	(.390)	(.675)	(.551)	(.672)	(.242)
9.	-.0019	.0856	.0441	.0125	**.2390**
	(.979)	(.245)	(.550)	(.866)	(.001)
10.	.1065	**-.1629**	-.1063	-.0408	-.1045
	(.148)	(.026)	(.149)	(.580)	(.155)
11.	.1034	-.0867	-.0241	-.1024	.0323
	(.160)	(.239)	(.744)	(.164)	(.662)
12.	.0276	.1113	**.1842**	.1177	**.1402**
	(.708)	(.130)	(.011)	(.109)	(.056)
13.	-.0366	.0592	.0125	-.0637	**.2260**
	(.620)	(.422)	(.865)	(.387)	(.002)
14.	.0256	**-.2143**	-.0944	-.0112	-.0566
	(.729)	(.003)	(.200)	(.879)	(.443)
15.	.0195	.1005	.0533	.0047	**.2056**
	(.792)	(.172)	(.469)	(.949)	(.005)
16.	-.1017	**-.2305**	-.0059	.0442	-.0731
	(.167)	(.002)	(.936)	(.548)	(.321)
17.	-.0845	.0453	.1190	.0886	.1110
	(.251)	(.539)	(.106)	(.229)	(.131)
18.	-.0893	-.0575	.0075	.0208	.0015
	(.225)	(.436)	(.918)	(.778)	(.984)
19.	-.0615	-.0243	.0481	-.0513	**.2309**
	(.404)	(.742)	(.514)	(.487)	(.001)
20.	-.0966	.0119	.0485	.0139	**.1884**
	(.189)	(.872)	(.511)	(.850)	(.010)

Note: Significance level in parentheses

Discussion

The results of this study, with the extraction of two factors, reveal remarkable consistency in attitudes between the mid 1960's and the present. When Lee analyzed his data, "two factors emerged" (Lee, 1970, p.54): he did not choose a two factor result as we did for the purpose of comparison. The two factor analysis in this study shows the same general results as Lee's study: the computer is seen as a "Beneficial Tool...", which includes positive, helpful, and necessary beliefs, and it is still viewed as an "Awesome...Machine", which includes negative, awesome, and science fiction attitudes.

The consistency of this study's results with those of Lee (1970) from 25 years previous, and containing a "Negative" factor accounting for 15% of the variance is an indication that education and the general proliferation of computers has not moved the attitudes of a large portion of the population.

Personal Variables and Computer Attitudes

Although many persons use computers as a tool of the trade, with positive thoughts such as may have occurred during the passing from slide rule to calculator, there is a segment of the population which has a totally different set of attitudes, with some beliefs being very negative. We believe, consistent with Lee (1970), that the answer to the issues of computer attitudes lies beyond the machines themselves. People are responding to an ambiguous stimuli which, in this case, happens to be computers. They are unsure of their relative role in the human-machine interaction.

The correlation matrix suggests that familiarity with computers does not have a significant relationship to beliefs about the machines. The level of education appears to be inversely related to negative attitudes and feelings that computers are awesome. This may be partially explained by education increasing the ability to deal with ambiguity and creating an awareness of the limits of the power and ability of computers.

Males appear to have more positive attitudes about computers than females. Each of the five significant item correlations with sex were in the positive factor. Age is also linked to attitudes: increased age corresponds to beliefs that computers are exciting, strange, and frightening.

Even in our highly technologically driven culture, people are not quite sure where the human mind stops and the artificial intelligence or the control by computers begins. The computerized fire-control system of the USS Vincennes was pivotal in the downing of the Iranian jet in 1988, and the Strategic Defense Initiative (Star Wars) could not operate in any scenario in the absence of computers. Judges are using computers which are programmed to forecast how personalities will behave to make sentencing decisions. Viewed against such a background, rather robust factor loadings for such items in the negative factor as "computers are ... strange and frightening", "they are going too far with computers", and "with computers, the individual will not count for very much" are not surprising.

The Unique Symbolism of Computers

The computer has different attributes than any previous technological advance: it can operate alone in different situations without human support, after it has been programmed. The majority of the population knows little about computer technology, artificial intelligence, expert systems, or MIS, even if they use computers. Thus they can be reasonably expected to think of computers as beneficial, but also with awe, and inferior feelings, based upon their limited knowledge and their impressions, right or wrong. The attitudes of the population have been relatively stable over time regarding computers, and Lee's results are still generally valid. As education and the proliferation of computers increases, the ability and power of hardware and software increase at least as fast, thus preserving the ratio of understanding and knowledge to computer capabilities which existed 25 years ago.

In our second analysis, (the four factor) the factors provide a more realistic view of current attitudes, and reveal a maturing and consolidating of beliefs since Lee's study of 25 years ago. Items 6, 12, & 20 which were residuals in the Lee study loaded in the negative factor in the this analysis, indicating more certainty of beliefs or less ambivalence, which is congruent with our assertion of a maturing of attitudes. Item 1, also a residual in the Lee study loaded in the science fiction factor.

Computers are still viewed as beneficial tools and as awesome machines, but attitudes have become more sophisticated as computers have become common and contact with the machines has increased. A practical examination of the factor groupings reveals intuitively acceptable groupings that provide a more in-depth explanation of attitudes than any prior study, and thus can provide a better understanding and basis for any attempts to alter attitudes.

Attitudes and Introduction of Computer Technology

Many persons hold negative attitudes about computers and misconception remains about their power and ability. Recognition and, more importantly, acceptance of the negative and the unrealistic attitudes (factors Negative, Science Fiction, and Awesome) are requisite for successful introduction of new computer technology, or improvement of the human - computer interaction. Also, awareness of the component items of the Positive Supertool factor can

be useful to marketers, managers and others who are attempting to sell or implement computer technology, or to improve existing attitudes.

Perhaps because many computer competent professionals who work to implement computer technology are comfortable with computers, and have realistic beliefs, they do not consider the background, education, and experiences of others relative to computer technology. This is not to suggest that the less education the persons have the more negative their attitudes will be: some very educated workers may view the computer as a device to prevent need achievement, as they perceive the computer to be removing some of their autonomy, decision making, and control. Computers may be viewed as a means by which management controls the workers, monitors them on a constant basis, and in general removes some of the humanism in the work environment. In any case, consideration of the relevant attitudes of employees is vital when designing, selling, or implementing computer technology, and when managing employees who have a significant interface with computers.

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