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Abstract

Anecdotal reports and recent reviews assert that expert systems are potentially useful decision aids in human resource management. This study examines the effects of an expert system designed to aid employees when they make their choices in a flexible benefit program. A four group quasi-field experimental design is used to examine the relative effects of the expert system compared to a conventional spreadsheet decision aid. Eighty employees at an NCR-AT&T facility were randomly selected and assigned to the groups. Employees using the expert system expressed greater benefits satisfaction compared to those using the spreadsheet aid. The spreadsheet did not have any effect on employees' decisions. When the benefit choices recommended by the expert system differed from the employees' current choices, employees are more likely to change their choices. Consequently, the expert system is likely to affect employees' decisions. Implications are discussed and future research needs are suggested.

Keywords

effect, benefit, expert system, employee, decision, satisfaction, flexible benefit, human resource, management, study, program

Comments

Suggested Citation

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**THE EFFECTS OF A FLEXIBLE BENEFITS EXPERT SYSTEM
ON EMPLOYEE DECISIONS AND SATISFACTION**

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This paper has not undergone formal review or approval of the faculty of the ILR School. It is intended to make results of Center Research, conferences, and projects available to others interested in human resource management in preliminary form to encourage discussion and suggestions.

ABSTRACT

Anecdotal reports and recent reviews assert that expert systems are potentially useful decision aids in human resource management. This study examines the effects of an expert system designed to aid employees when they make their choices in a flexible benefit program. A four group quasi-field experimental design is used to examine the relative effects of the expert system compared to a conventional spreadsheet decision aid. Eighty employees at an NCR-AT&T facility were randomly selected and assigned to the groups. Employees using the expert system expressed greater benefits satisfaction compared to those using the spreadsheet aid. The spreadsheet did not have any effect on employees' decisions. When the benefit choices recommended by the expert system differed from the employees' current choices, employees are more likely to change their choices. Consequently, the expert system is likely to affect employees' decisions. Implications are discussed and future research needs are suggested.

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Expert systems are gaining increased attention as potential decision aids in human resource management. Anecdotal accounts describe expert system applications (Kirrane & Kirrane, 1990) ranging from employee selection (Mau & Smeltzer, 1989) job analysis (Green, 1987), employee scheduling (McMillan, 1989), to performance appraisal and pay decisions (Robert, 1988). In a recent personnel research review, Lawler (1992) described expert systems and the more inclusive concept, artificial intelligence. He notes that expert system are deductive artificial intelligence applications which model the decision making of individuals designated as experts with specialized knowledge. Recently, a special issue of O B H D P was also devoted to expert systems research, although the articles were primarily directed at understanding how experts think and decide rather than focusing on the behavioral aspects of system design or analyzing the systems' effects on human behavior (Shanteau & Stewart, 1992). Topics ranged from a weather forecasting applications to questions directed specifically at understanding expertise.

Much of the attention in the computer and decision science literature is devoted to research on managerial expert systems. This work focuses on expert system feasibility (Goul & Tong, 1987), case studies describing applications (Sviokla, 1990), issues related to user interfaces (Lamberti & Wallace, 1990), and the evaluation of alternative methods of knowledge acquisition and representation (Lenk & Floyd, 1988; Liang, 1992; Mendel & Sheridan, 1989; Tou, 1985; Wright & Ayton, 1987).

Very little has been reported about the effects of expert systems on the individuals using them. Our study explores the answers to two questions about expert system effects. Do expert systems affect individuals' decisions? And are the attitudes of individuals using expert systems affected?

Expert Systems, Problem Solving and Decisions

Expert systems, as a form of artificial intelligence, are programs which model experts' knowledge into logical structures and translate their reasoning heuristics into formal rules (Al Attar, 1990; Bylander & Chandrasekaran, 1987; Rich & Knight, 1991; Stefik, 1990). In essence, expert systems model experts' problem solving processes and decisions.

The literature on managerial expert systems appears to be remarkably uninformed of relevant behavioral theory and research. For example there has been relatively little connection with research on individual decision making (see Bazerman, 1990 for a review), cognitive processes (Motowidlo, 1986) or expert judgment (Camerer & Johnson, 1991). A noteworthy exception is the O B H D P issue already cited. While our study's objectives are rather more focused and applied, other research has begun to apply psychological knowledge such as validation strategies to expert system design and development (Sturman & Milkovich, 1993).

We do know that people reportedly react adversely to the introduction of computer-based decision aids and support systems (Peterson & Peterson, 1988). Hauser and Hebert (1992) argue that the introduction of expert systems may be considered threatening to managerial autonomy, status and even job security. Kotteaman and Davis (1991) report that subjects often avoid computer based decision aids in favor of less accurate, easier to use approaches. There is even some evidence that easier to use approaches may be perceived as more useful or in some sense better than more complex, albeit more accurate, decision aids (Davis et. al. 1989). Presumably the individual's autonomy and control needs make a person reluctant to relinquish control over the decision to others or to a decision aid. Conversely, Aldag and Power

(1986) report that individuals derive more satisfaction from using computers in the decision process, and prefer the choices they arrive at using computers. Supporting this evidence, Miceli & Lane (1991) suggest that individuals' need for control may affect benefit preferences.

Our study offers individual employees, rather than managers, the use of an expert system. Arguably, rather than threatening, the system could be seen as empowering — offering expert advice without the need of going through managers or the HR function. An expert system, from the employees' perspective, may in a sense offer aid by simplifying a complex problem. Yet its very introduction may be disruptive, particularly if the system's recommendations to the employee differs from what the employee may have decided in the absence of the system.

Flexible Benefits

The behavioral merits of flexible benefits were espoused over twenty years ago by E. Lawler (1971) who argued that allowing individual employees to choose their own benefits heightens their knowledge of benefits and their costs plus it increases the likelihood that benefits coverage fit the individuals needs. From an expectancy theory perspective, flex plans should increase employees' perceived value of benefits received and hence their benefit satisfaction. This rationale should be even more compelling with today's increasingly diverse workforce. Lawler's belief is supported by long standing evidence of significant individual differences in benefit preferences (Davis, Giles & Field 1985,88; Huseman, Hatfield & Robinson, 1978; Nealy, 1963).

Over the past 15 years, there has been a diffusion of flex plans through US employers. In 1981, only 17 major employers offered flex, by 1983 only 99

offered it, and by 1992 over 1400 plans have been implemented (Hewitt Survey 1993). There is also evidence of considerable variation in the design of flex plans (Hewitt Survey 1992). Plans that simply give employees the opportunity to contribute pre-tax income into a reimbursement account (called flexible spending accounts) for uncovered medical and day care expenses as well as those that allow employees to select from among multiple form and levels of coverage, are all considered flexible benefit plans.

There is a well established body of research on benefits satisfaction. Miceli and Lane (1992) offer a review and present a model of benefit satisfaction. Much of the early work on benefits satisfaction examined its facets (H. Heneman & Schwab 1979, 1985; Judge, 1993), the robustness of these facets among employees in different occupations (Scarpello, Huber & Vandenberg, 1988), and the independence of benefits and pay satisfaction (Dreher, Ash, & Bretz, 1988; H. Heneman & Schwab, 1985). Recently increased research attention has been devoted to flex plans. Barber, et. al. (1992) reported that the introduction of a flexible plan was positive related to increased benefit satisfaction. There is also recent evidence that faced with a flex plan, employees choices among different benefit forms and levels of coverage are influenced by employees' characteristics (e.g., age, marital status, age and number of dependents, spousal coverage) as well as the relative costs of the options. (Barringer, Milkovich & Mitchell 1991).

Personal Choice, Choice Maker, and Personal Choice Expert

Personal Choice, the NCR-AT&T approach, is the flex plan used in this study. Through this plan, each NCR employee receives a total amount of benefit credits, generally based on their dependent situation, salary level, and years of NCR service, which they allocate or "spend on" various forms of

benefits each with optional levels of coverage.

Insert Figure 1 About Here

Figure 1 illustrates some of the benefit forms available and the coverage options for a relative simple flex program. Even under this simplified plan, employees face a complex decision task comprised of a number of possible combinations (e.g. as illustrated, 4 health options, 4 long term liability, 4 personal life insurance and 4 spousal life insurance).

Choice Maker, NCR's current software program, is a conventional spreadsheet application with several advanced features such as error checking. Its purpose is to enable an employee to conduct "what if" analysis by altering their benefit decisions. Choice Maker crunches the benefit credit costs of each set of choices and compares them to the total benefit credits available to the employees. It is a convenient calculator, a decision support system (Huber, 1992), but it does not provide any recommendations or comparative information to aid the employee's decision making.

Personal Choice Expert (PCE) is the custom designed expert system which generates specific recommended decisions across the various benefit forms and coverage options offered to employees through Personal Choice. (Hannon, Milkovich & Sturman, 1992). The system, which used the expert system shell, Knowledge Pro (Knowledge Garden, 1992), was designed and developed in accordance with conventional knowledge engineering procedures (Stefik, 1990; Rich & Knight, 1991; Parsaye & Chignell, 1988). PCE is based on NCR benefit managers' expertise supplemented by information provided by its benefit consultants (e.g., booklets, comparative data).

A typical employee session with PCE includes three phases: introduction,

questioning, and recommendation. The introduction phase includes information screens, informs the user about what the program does and how to use it. Figures 2 and 3 illustrate. In the questioning phase, illustrated in Figure 4, employees answer a series of up to 28 questions pertaining to their demographics and personal situation. These questions are the key variables that the benefits' experts used to offer individual employees counsel and aid them in making their selections. These were solicited during the design of the PCE.

Insert Figures 2 and 3 About Here

In the recommendation phase, PCE generates the recommended decisions on a screen and a printout, shown in Figure 5, that mimics the actual benefit enrollment form that employees normally complete.

Insert Figures 4 and 5 About Here

Research Focus & Hypotheses

This study examines whether two distinct computerized decision aids generate differences in attitudes and decisions for those who use them. Although the dearth of directly relevant empirical studies and developed theories makes even the most intuitive hypotheses somewhat tenuous, a few studies do offer some ground to derive exploratory hypotheses.

Researchers report limited support for the assertion that people enjoy using computerized decision aids (Bronner & De Hoog, 1983), yet they are more satisfied with such a process and prefer the choices they ultimately arrive at to those they make unaided (Aldag & Power, 1986). An alternative perspective suggests that the need for autonomy and control, especially over

valued outcomes such as employee benefits, makes a person reluctant to relinquish control over the decision to other people, (benefits managers or the company) or decision aids (Miceli & Lane, 1992; Northcraft & Neale, 1990).

Based on these two perspectives, the first hypotheses is

H1: For employees using the expert system, there is a positive relationship between satisfaction with benefit outcomes and the propensity of the employee to relinquish control over their benefits decisions, while no such relationship exists for the spread-sheet group.

Second, in her discussion of information systems design, Lovata (1990) suggested that minimizing extraneous information provided to the decision maker, in accordance with the garbage can model which deals with ill defined problems, is likely to result in greater satisfaction. Consequently, the structural aspects of an expert system may generate increased satisfaction. In expert systems, the information search is prescribed, the alternative responses defined, costs specified, and the outcomes weighted and recommended. Hence using an expert system is more likely to favorably dispose employees toward their benefits compared to alternative processes which offer only information about benefit alternatives and/or costs of each but omit guidance, advice or recommendations based on which alternatives best suit the person. Accordingly, the second hypothesis is:

H2: Employees using the expert system will be more satisfied with their existing benefit, post hoc, relative to other support systems.

Finally we can tease out some hypotheses about employees propensity to change their benefit selections after using the decision aids. Drawing from behavioral decision theory, the notions of anchoring (see Bazerman, 1990) and cognitive dissonance suggest that decision makers faced with recent

recommendations from a decision aid that contradicts their own will be more likely to modify their decisions than if the recommendation agreed. For employees using the spreadsheet program, Choice Maker, no recommendation is made. It's value to the user is ease of calculation and improved search through increased information about alternatives. Users simply input their alternative decisions. The program then computes each alternatives benefit costs in terms of benefit credits and the total cost, but does not provide any recommendations. Because the program contains all the necessary price information, it speeds the benefit selection process, and it may permit the employee to search through additional alternatives (what if's) compared to employees without such a computational aid. Comparatively, the expert system, PCE, offers all this plus recommendations from experts.

Thus we hypothesize:

H3: The propensity of employees to change their benefit decisions after using the spreadsheet program will be no more likely than prior to using it.

We also hypothesize that employees using PC Expert are more likely to change their benefit decisions. However this effect depends on whether PC Expert agrees with and therefore reinforces the employee's prior benefit selections. If PC Expert recommendations differs from the employees' prior benefit selections, then negative reinforcement or dissonance is likely.

Therefore, we hypothesize:

H4: Employees propensity to change their minds after using the expert system when the system generated recommendations disagree with the employees prior selection decision will be greater than for employees whose prior decisions agree with the expert systems recommendations.

METHOD

Design

The research design utilized represents a conventional four-group design. This design controls for most threats to internal and external validity (Cook, Campbell & Peracchio, 1990). It represents one of the few quasi-experimental field study of the effects of expert systems on user attitudes and behaviors and the first study in which employees are the subjects. The groups consisted of (A) a group that received pre-test, use of PC Expert and Post-tests; (B) a group that used PC Expert and post-tests only; (C) a group that received a pre-test; used of Choice Maker, the spreadsheet program and post-test; and (D), a group that used the spreadsheet Choice Maker and completed a post-test. Since the basic research hypothesis concerned the comparative effects of a spreadsheet decision support, relative to an expert system, we judged the most appropriate control was the spreadsheet group rather than a non-treatment group. A non-treatment group, while permitting us to examine the absolute affects of both computerized decision was not feasible.

Subjects

Subjects were a representative sample of the exempt managerial, professional, technical NCR employees at the facility who were covered by the flex plan. They were mostly male (71%), mostly married (76%), with a mean age of 38.5 years, and 1 child (ranged from 0-3). These employees earned an average of \$41,000 in 1992, their reported spousal income averaged \$12,500. They reported an average savings level of \$19,000. All were high school graduates, most were college graduates (65%) and almost half (49%) possessed a technical (engineering, computer-science) degree. Their education level and

technical emphasis coupled with the high tech manufacturing processes in the facility, it supplied computer components and printers to NCR, suggests a reasonable level of computer literacy among these subjects. In fact, casual observations by the research team suggested none of the subject experienced any hesitation in our difficulties in using either computerized aid. Group size, determined through power analysis, called for 40 subjects per group. However, because of work scheduling difficulties, vacations and other realities typical of field research, the actual number of subjects was 80: 20 were randomly assigned to each group.

Measures

To examine the relative effects of the expert system on employee attitudes and their benefit decisions, we used measures of five variables, (1) employee benefit satisfaction, (2) employee satisfaction with benefit outcomes, (3) employee satisfaction with pay, (4) employee's attitude toward discharging responsibility for making benefit decisions to computer programs or others and (5) employee's propensity to charge their benefit decisions.

Benefits Satisfaction. Heneman and Schwab's (1985) four-item benefits satisfaction scale, extracted from the Pay Satisfaction Questionnaire, was used to measure employee attitudes toward their benefits. The four items in this scale (1 = Strongly Disagree to 7 = Strongly Agree) are: (Alpha = 0.93)

I am satisfied with:

- *my benefits package*
- *the amount the company pays toward my benefits*
- *the value of my benefits*
- *the number of benefits I receive*

Satisfaction with Benefit Outcomes. This study uses a measure, satisfaction with benefit outcomes, to ascertain the employees satisfaction

with the benefits derived through the process they used. A three-item scale (1 = Strongly Disagree to 7 = Strongly Agree) was used to estimate this construct.

The actual items are as follows (Alpha = 0.62):

- *The benefit choices from this process are best*
- *The benefit choices from this process are fair and equitable*
- *Another process could have yielded better benefit choices*

Note that the third item was reversely scored. Thus, the values to this answer were converted so that all items would be scaled similarly.

Satisfaction with Pay. Because of the potential interrelationship between pay and benefits satisfaction (H. Heneman & Schwab, 1985; Judge, 1993), Heneman and Schwab's (1985) Pay Satisfaction Questionnaire was used. The specific items for measuring pay satisfaction were as follows: (Alpha = 0.97)

I am satisfied with:

- *my take-home pay*
- *my current salary*
- *my overall pay level*
- *the size of my current salary*

Discharging Responsibility for Benefits Decisions. To gauge employee attitudes towards the idea of other people or software packages conceivable making their benefits choices for them, five Likert-type questions (1 = Strongly Disagree to 7 = Strongly Agree) were used to develop a scale. These items are: (Alpha = 0.83)

If I provided information about my personal situation and preferences, I would not mind if:

- *a computer made my benefit choices*
- *an expert system made my benefit choices*
- *a benefit analyst made my benefit choices*
- *a human resource generalist made my benefit choices*
- *my manager made my benefit choices*

Likelihood of Changing Benefits Choices. To assess how likely employees are to change their existing benefits after using a decision aid, a measure of

the degree of agreement between current and revised benefits choices was computed. The following illustrates questions used to calculate this measure.

For the following questions please indicate your current benefit choices. If you could change your choice right now, enter the new choice you would make on the new benefit choice line. If you would not make a change, put "NC" on this line.

Health Care

Current Benefit Choice _____

New Benefit Choice _____

Choices

1. High
2. Medium
3. Low

Special Dependent Health Care

Current Benefit Choice _____

New Benefit Choice _____

Choices

1. 1 dependent
2. 2 dependents
3. 3 dependents

Dental

Current Benefit Choice _____

New Benefit Choice _____

Choices

1. No benefits
2. Dental benefits for all those in your dependent category
3. Dental benefits for all those in your dependent category plus all your special dependents

Employee Life Insurance

Current Benefit Choice _____

New Benefit Choice _____

Choices

1. \$10,000
2. 1 times annual base pay
3. 1-1/2 times annual base pay

In short, to measure each person's propensity to change, they were asked, in both the pre- and post-tests, to state their current benefit selections and to indicate any revision they would make if they could.

Procedure

Employees were randomly assigned to the research design groups. Participation was voluntary and all were given the opportunity to withdraw at anytime. No one did. Employees were notified via e-mail of the time and place of the study and followed up with personal calls and inter office mail as reminders. To minimize researcher effects, research assistants were trained to introduce the study, the computerized aids and the measurements. Pattern instruction guides were also used by the researchers.

Employees were brought into a conference room where they heard a scripted introduction speech thanking them for their participation. If the group was designated to receive a pre-test, the questionnaire was administered at this time. After the introduction or introduction and pre-test, the group was brought to a second conference room which contained computers with the appropriate software already running. Here, employees received scripted instructions regarding how to use the software to make benefits decisions.

After the computer session, which lasted about 30 minutes for both the expert system and spread-sheet groups, employees were brought to the third conference room where the post-test was administered. After completing the post-test, the subjects were thanked for participating in the study and excused.

Analysis

Analysis of variance (ANOVA) was used to examine any differences between the expert system and spread-sheet groups for the demographic variables (i.e. gender, marital status, age, number of children, pay, spouse's pay, and savings). ANOVA's were also run to determine if attitudinal differences between the two pre-test groups existed. These variables include satisfaction with benefits, satisfaction with benefit outcomes, satisfaction with pay, propensity to discharge benefits decision making responsibility, and number of desired benefit changes.

Correlations were computed to show the relationship between the attitudinal variables across groups, with particular attention being paid to the relationship between benefits satisfaction and propensity to discharge responsibility for benefits decision making for the expert system and spread-sheet groups. These correlations were tested to determine both if they differ from zero (p-value) and if they significantly differ from each other (a one-tailed t-test to determine if the correlation of the expert system group was higher than the correlation of the spread-sheet group).

Ordinary least squares (OLS) regression was used to examine the relative effects of the computer interventions. Two dummy variables were created. The first variable was set to 1 for the expert system group and to 0 for the spread-sheet group. To determine if the pre-test had an effect, the other dummy variable was created and set to 1 if the group received a pre-test. Benefits satisfaction was regressed on the expert system or spreadsheet, pre-test or not, satisfaction with pay, satisfaction with benefit outcomes, and number of changes made.

To examine the effect the expert system's recommendations had on the

employees' decision-making behaviors, a logistical regression was performed, with the dependent variable being the individual decision for each benefit category to change or not (0 equalling no change; 1 equalling a desire to change). This analysis was performed for all benefit decisions for each individual, thus the sample size was 1320 and not 120 because there are 11 benefit categories within the plan. In addition to the independent variables mentioned for the other regression, another dummy variable was created which equalled 1 if the expert system recommended the individual change their benefit selection. This dummy variable equalled 0 if the expert system agreed with the employee's decision or if the employee did not use the expert system.

Results

The ANOVA results indicate that the expert system and spread-sheet groups were similar in most regards. No significant differences were found for gender ($F = 0.07$; $p = 0.7898$), number of children ($F = 0.42$; $p = 0.5187$), pay ($F = 0.83$; $p = 0.3645$), spouse's salary ($F = 0.13$; $p = 0.7195$), and savings ($F = 0.71$; $p = 0.4034$). Additionally, there were no significant attitudinal differences across the pre-test groups for satisfaction with benefits ($F = 1.24$; $p = 0.2732$), satisfaction with benefit outcomes ($F = 0.01$; $p = 0.9073$), satisfaction with pay ($F = 0.93$; $p = 0.3374$), propensity to discharge the benefits decision making responsibility ($F = 0.01$; $p = 0.9351$), and number of desired benefit changes ($F = 2.37$; $p = 0.1323$).

Two differences between the expert system groups and the spread-sheet groups were evident: age and marital status. The expert system group's mean age was 40, compared to a mean of 35 years in the spread-sheet group (F

= 10.65; $p = 0.0016$). In the expert system group, 78% were married, compared to 60% in the spread-sheet groups. This was not significant at $\alpha = 0.05$ ($F = 3.44$, $p = 0.0673$). These differences may be attributable to the sample size being somewhat less than ideal and temper our conclusions. Nevertheless, because there were no differences across the attitudinal variables, as well as most of the demographic variables, we argue that the results possess reasonable generalizability.

Correlations of the attitudinal variables are shown in Tables 1, 2, and 3. Table 1 shows these values for the pre-test group, table 2 for the spread-sheet group, and table 3 for the expert system group. The correlation between satisfaction with benefits and satisfaction with pay is significant for all three groups (p (pre-test) = 0.0001 p (spreadsheet) = 0.0093; p (expert system) = 0.0001). There are also strong relationships between benefits satisfaction and satisfaction with benefit outcomes (p 's = 0.0002, 0.0031, 0.0262). Not all correlations, though, are similar across all three groups. One aspect of these differences offers support for the first hypothesis.

Insert Tables 1, 2 and 3 Here

The correlation analysis suggest that satisfaction with benefits outcomes for employees using the expert system is positively related to the employee's propensity to transfer benefits decision-making responsibility. Although a t -test reveals no difference between the mean level of this propensity between the expert system group and the spread-sheet group ($p = 0.9351$), the correlation between propensity to change benefits decision-making responsibility and benefits satisfaction for the expert system group was significant ($r = 0.38$; $p = 0.0155$), while not significant for the spreadsheet group ($r = 0.18$; $p = 0.2584$). A one-tailed significance test reveals that the correlations

for the ES group was significantly higher than that for the spreadsheet group at $\alpha < 0.05$.

Results of the regression, shown in table 4, lend support for the second hypothesis, that the use of the expert system increases benefits satisfaction. After controlling for pay satisfaction, satisfaction with benefit outcomes, number of desired changes, and possible pre-test effects, using the expert system still had a significant effect on benefits satisfaction (Beta = 0.79; $p = 0.0015$).

Insert Table 4 Here

Note that the number of desired changes had a significant negative effect on benefits satisfaction (Beta = -0.14; $p = 0.0214$). Results of the logistical regression, shown in table 5, reveal that being in the expert system group (Beta = 0.8797; $p \leq 0.0001$) and receiving advice from the expert system to change a benefits selection (Beta = 0.7200; $p \leq 0.001$) are both related positively to the propensity of an individual to desire a change in a given benefit.

Insert Table 5 Here

Conclusions

The principal conclusions to be drawn from these findings are that expert systems clearly have the potential to influence employee attitudes and decisions. The results of this study seem to indicate that, although changing benefits decisions is negatively related to benefits satisfaction and people in the expert system group were more likely to say they wanted to make changes to their benefits selections, there was still an increase in the level of benefits

satisfaction for the expert system groups, large enough to yield a net increase in benefits satisfaction for those using the expert system. On the other hand, we found no evidence to suggest that a spreadsheet decision aid had any effect on employees' decisions or satisfaction. It appears that reinforcement of a decision or the lack thereof from the expert system influences the decision maker.

These findings have a variety of implications. As previously noted, the expert system and computer based decision aid literature is particularly uninformed about behavioral research. Little is known about the signals these decision aids send to the users, whether manager or employees. Equally unknown is how these computer based aids affect the cognitive processes used by decision makers. Much of the behavioral research has been in the tradition of understanding expertise and expert judgment. The relative efficiency of various linear and non-linear models is also well studied. Virtually ignored is the role played by such aids in the decision process itself.

It is also apparent that employers may be able to affect employee decisions by introducing expert systems. These decision aids may be biased, legitimate or otherwise, towards one particular alternative or away from others. For instance, in an attempt to reduce health care insurance costs, employers may introduce a benefits decision aid which usually selects the least expensive plan from the employer's perspective. This decision aid could cause employees, as a whole, to choose the less expensive plan more often and, thus, reduce company expenditures. The ethics and fairness of such actions is open for discussion. It is important, however, to note the potential attractiveness of such a strategy, regardless of who is advantaged through it.

Experience suggests that benefits counselors are typically trained to avoid

recommending specific selections to employees for fear of legal liabilities. Concerns for such liability can be mitigated by offering users a choice in their selection of experts. Employees could be given a choice among different experts in the system itself. Rather than an employer's representative, experts could be a panel of benefit providers, benefit consultants and/or even employees who have experience with the benefits.

Despite the recent attention to computer based aids, employers have raised two major concerns regarding their use in managing benefits. In a recent Conference Board Report (1993) companies raised concerns over development and implementation costs. Some also questioned the return on investment of developing such computer software when employees may not have access to needed hardware. "During our transition to flex," noted 3M's benefits manager, "we produced and distributed a computer disk to help employees model and map out their decision (i.e., a spreadsheet based approach). It was great for some, like our engineers, who work with computers regularly. However, for a significant percentage of our workforce, the cost/value of the tool was not apparent (Conference Board, 1993, pg. 35)." Lawler (1992) echoes this cost/value concern. He suggests that they conserve expertise and if little time is devoted to a decision task, or others less expensive option, (i.e., training) exist, then expert systems may not be justified. Ours was not a utility study of expert systems (Boudreau, 1991). However, we can report that the expert shell, Knowledge Pro, costs \$895.00, we spent about 240 hours in design and testing plus 32 hours of expert time. Overall, we estimated under \$7000 devoted to the expert system. On the value side, benefits satisfaction increased markedly for those using the system. Other value added factors such as improved knowledge, cost of options

selected and the like, need to be considered. However, an increase of 20% in benefits satisfaction for a \$7000 investment suggests that employers and others may be well advised to explore the relative value added of such systems in addition to considering only the costs.

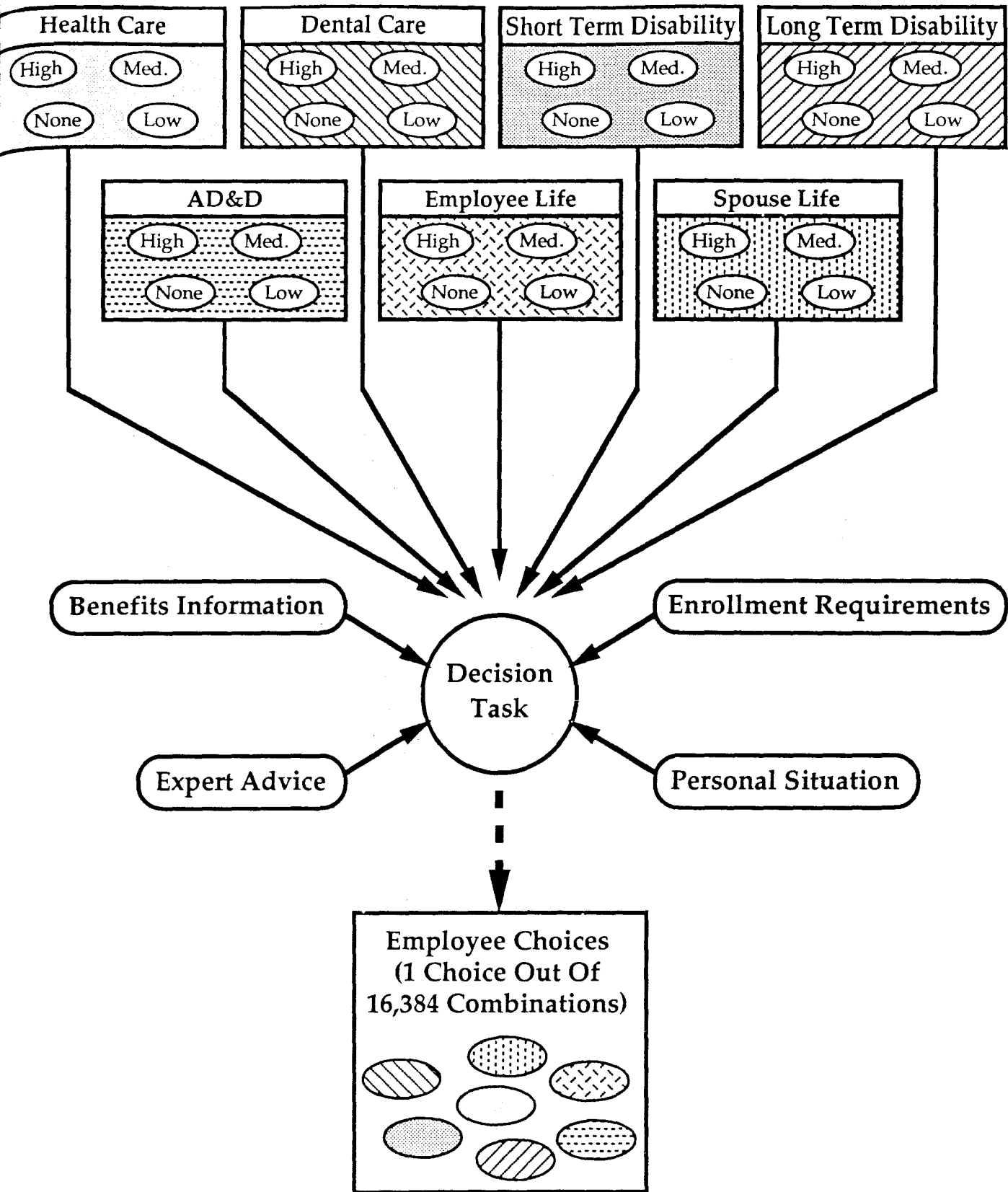


Figure 1: The Flexible Benefits Decision

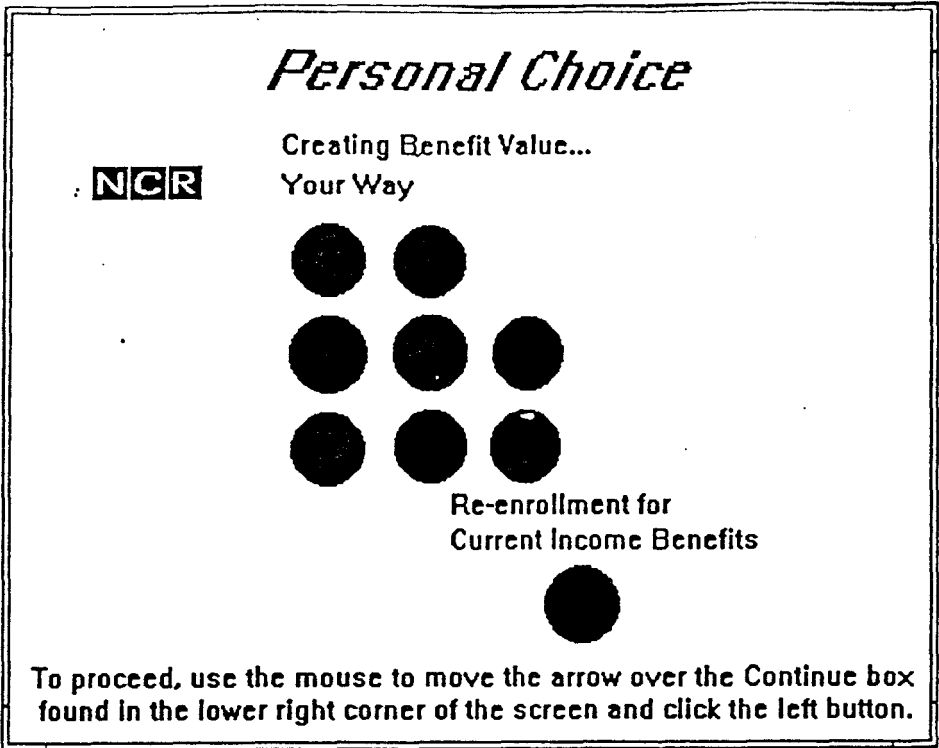


Figure 2: Introductory *Personal Choice* Expert Screen

Personal Choice Expert

Welcome to Personal Choice Expert. This program was developed in consultation with employee benefits experts from NCR. It is designed to help you select an individualized benefits package. With the help of Personal Choice Expert, and based on the information that you provide, you can choose a combination of benefits which best suits your needs. Remember, Personal Choice Expert ONLY PROVIDES GUIDANCE.

All recommendations should be carefully reviewed to ensure the accuracy and appropriateness of the output.

To continue, use the mouse to move the arrow over the Continue box, which is found in the lower right corner of the screen, and click the mouse's left button.

Figure 3: Personal Choice Expert Direction Screen (1 of 3 screens)

User Information

Employee Social Security number :

Age :

Marital Status : Single
 Married

How many legal dependents, other than yourself and your spouse, do you have?

How many Special Dependents do you have?
- children age 19 older you want to protect under your health care plan -

User Information

Annual base pay from NCR. Please do not include bonuses :

Total Income From NCR, including bonuses:

Annual Income beyond that provided by NCR:

Savings - i.e. cash, savings accounts, checking accounts, 401K, etc. - :

User Information

How many flexible benefits credits have been allotted to you?

How much money do you save per year?

How much do you spend per year on non-essentials?

Figure 4: Demographic and Personal Information Screens (3 of 7 screens)

Benefits Enrollment Form

Creating Benefit Value...Your Way

Options

Print Output

Quit

<u>Your Credits</u>	<u>Dependent Category</u>	<u>Choice</u>	<u>Credits</u>
1. From NCR	C		3533
2. From <u>Vacation Selling</u>		6	0
Total Credits			3533

<u>Your Choices</u>	<u>Choice</u>	<u>Price</u>
3. <u>Health Care</u>	3	\$ 2667
* <u>Special Dependent Health Care</u>	6	\$ 0
4. <u>Dental</u>	1	\$ 0
5. <u>Short-Term Disability</u>	3	\$ 175
6. <u>Long-Term Disability</u>	2	\$ 175
7. <u>Employee Life Insurance</u>	1	\$ 9
8. <u>AD&D Insurance</u>	1	\$ 0
9. <u>Spouse Life Insurance</u>	4	\$ 18
10. <u>Child Life Insurance</u>	1	\$ 0
11. <u>Vacation Buying</u>	2	\$ 300
12. <u>Health Care Spending Account Deposit</u>		189
13. <u>Dependent Care Spending Account Deposit</u>		0
Total Cost		\$ 3533
Excess of Total Cost over Total Credits, if any		\$ 0

I have read and understood the explanation of benefits choices. I authorize the choices I have made. I further authorize deductions from my pay – before-tax and/or after-tax – equal to the excess, if any, of Total Cost over Total Credits, as shown above.

The benefits selection plan shown above is a recommendation only. Carefully review any choices before selecting your final plan.

Signature _____

Date _____

Figure 5: Benefits Enrollment Form / Personal Choice Expert Output Screen

TABLE 1
Intercorrelation Matrix: Pre-Test Group

	Satisfaction with Benefits	Satisfaction with Pay	Satisfaction with Benefit Outcomes
Satisfaction with Benefits	(0.93)		
Satisfaction with Pay	0.61****	(0.97)	
Satisfaction with Benefit Outcomes	0.57***	0.39*	(0.62)
Number of Desired Changes	-0.19	-0.19	-0.23

Note: Coefficient alphas are reported in parentheses. N = 40.

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; **** $p \leq 0.0001$

TABLE 2
Intercorrelation Matrix: Spread-Sheet Group

	Satisfaction with Benefits	Satisfaction with Pay	Satisfaction with Benefit Outcomes	Discharge of Decision-Making Responsibility
Satisfaction with Benefits	(0.93)			
Satisfaction with Pay	0.41***	(0.97)		
Satisfaction with Benefit Outcomes	0.46***	0.40*	(0.62)	
Discharge of Decision- Making Responsibility	0.16	0.27	0.18	(0.83)
Number of Desired Changes	-0.23	0.06	-0.21	0.34*

Note: Coefficient alphas are reported in parentheses. N = 40.
 $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; **** $p \leq 0.0001$

TABLE 3
Intercorrelation Matrix: Expert System Group

	Satisfaction with Benefits	Satisfaction with Pay	Satisfaction with Benefit Outcomes	Discharge of Decision-Making Responsibility
Satisfaction with Benefits	(0.93)			
Satisfaction with Pay	0.65****	(0.97)		
Satisfaction with Benefit Outcomes	0.35*	0.13	(0.62)	
Discharge of Decision- Making Responsibility	-0.06	-0.06	0.38*	(0.83)
Number of Desired Changes	-0.37*	-0.25	-0.02	-0.08

Note: Coefficient alphas are reported in parentheses. N = 40.

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; **** $p \leq 0.0001$

TABLE 4
Results of Regression for Benefits Satisfaction

Independent Variables	β	Standard error β	t ratio
Satisfaction with Pay	0.3794	0.0633	5.990****
Satisfaction with Benefit Outcomes	0.4753	0.1269	3.746***
Number of Desired Changes	-0.1388	0.0595	-2.334*
Pre-Test Group	0.2109	0.2308	0.914
Expert System Group	0.7917	0.2429	3.259**
R^2	0.4358		
Adj R^2	0.4109		

N = 120

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; **** $p \leq 0.0001$

TABLE 5

Results of Logistical Regression for Desire to Make Benefit Change

Independent Variables	β	Standard error β	Chi-Square
Satisfaction with Benefits	-0.3750	0.0907	17.15****
Satisfaction with Pay	0.0256	0.0635	0.16
Satisfaction with Benefit Outcomes	0.0200	0.1213	0.04
Pre-Test Group	0.2235	0.2123	1.11
Expert System Group	0.8797	0.2061	18.22****
Expert System Agreement	0.7200	0.1985	13.16***

Note: N = 1320; Model Chi-Square = 56.48 with 6 degrees of freedom; $p \leq 0.0001$

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; **** $p \leq 0.0001$

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