Perceived Effort Saved's Influence on Perceptions of Effort and Accuracy

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Abstract

The cost-benefit framework is a well established behavioral decision making theory and has shown remarkable consistency across a wide range of studies. One of the frameworks main tenets is that decision makers want to minimize effort (cost) and maximize accuracy (benefit) when making a decision. Research suggests that decision makers will adapt their decision-making process to the task by trading off these two competing desires. However, attempts to apply the cost-benefit framework within the Information Systems (IS) domain have yielded contradictory findings. Some research suggests that decision makers focus only on effort minimization while other research indicates that decision makers will put forth more effort to gain more accuracy. In this research, a theory was introduced positing that since human effort is largely replaced by decision tool effort in an aided analytic decision environment perceived effort will play a greatly reduced role. While perceived effort's importance is diminished in a computer aided environment, the effort the decision maker saves by using the tool was introduced into the computer aided effort-accuracy framework as a third antecedent to behavioral intention to use a decision tool. The theory was tested in an experiment and results indicated that perceived effort saved accounted for 15.1% of the variance in perceived accuracy. Perceived effort saved and perceived accuracy each explained 19.8% of the variance in behavioral intention, while perceived effort had no significant effect on either perceived accuracy or behavioral intention. The findings of this research suggest that perceived effort saved is an influential construct that has been overlooked in the current research based on the effort-accuracy framework and should be included in future research. Practical implications include the need for practitioners to proactively design and implement decision aids to increase the user's perception of the effort they saved by using the tool.

Keywords: Perceived Effort Saved, Computer-Aided Decision Making, Effort, Accuracy

Introduction

Research has shown that adoption of new technologies can improve productivity. Yet many people are still reluctant to use these technologies. As computer-based decision aides such as search engines, expert systems, decision support systems, and others become more pervasive, the importance of understanding which factors contribute to the acceptance of the technologies becomes increasingly vital. One of the primary methodologies explaining use of decision aids is the computer-aided effort-accuracy framework (Beach and Mitchell, 1978; Payne, 1982; Hogarth, 1987; Payne, Bettman et al., 1993).

The effort-accuracy framework is based upon the cost-benefit framework which is a well established behavioral decision making theory and has shown remarkable consistency across a wide range of studies. One of the cost-benefit framework's main tenets is that decision makers want to minimize effort and maximize accuracy. Research suggests that decision makers will adapt their decision making process to the task by trading off these two competing desires. However, attempts to apply the cost-benefit framework within the Information Systems (IS) domain have yielded contradictory findings. Some research suggests that decision makers focus only on effort minimization while other research indicates that decision makers will put forth more effort to gain more accuracy.

In this study, the goal is to help explain why past research using the effort-accuracy framework has contradicted research using the cost-benefit framework. Perceived effort saved is introduced into the computer aided effort-accuracy framework as a third antecedent to behavioral intention to use a decision tool.

Theory

The cost-benefit framework (Beach and Mitchell, 1978; Payne, 1982; Hogarth, 1987; Payne, Bettman et al., 1993, and others); indicates that decision makers will make a tradeoff between the desired accuracy of a decision and the effort required to make a decision. This tradeoff is made as if there is a general belief that more effort will lead to more accuracy. The incremental cost of a better solution strategy is compared to the incremental benefit derived from using a higher quality solution strategy and the decision maker will generally choose the available choice which best satisfies the user's quality needs at the lowest effort level. Under certain conditions, such as a higher accuracy goal (Creyer, Bettman, & Payne, 1990), the decision maker will put forth more effort to improve the accuracy of their choice. As stated in Payne, Bettman, and Johnson, 1993, "The heart of that framework is the view that strategy selection is the result of a compromise between the desire to make the most accurate decision and the desire to minimize effort." The cost benefit theory is well established in the behavioral decision making research field and has shown excellent reliability across a range of experiments. The traditional cost-benefit framework was developed in an unaided decision environment.

In a series of papers Peter Todd and Izak Benbasat (1991; 1992; 1993; 1994; 1999; 2000) conducted numerous experiments to better understand the role of accuracy and effort in a computer-aided decision-making context. As a result of their extensive research, they developed a central proposition that "if a decision aid makes a strategy that should lead to a more accurate outcome at least as easy to employ as a simpler, but less accurate heuristic, then the use of a decision aid should induce that more accurate strategy and as a consequence improve decision quality" (Todd & Benbasat, 2000).

To support their central proposition, they studied how the use of a decision aid varied as the amount of effort required for two different strategies, Additive Compensatory (AC) and Elimination by Aspects (EBA), varied. Since additive compensatory is considered to be a higher quality normative decision-making strategy, it is hypothesized that when it is equally as easy as or easier to use than the elimination by aspects strategy, the additive compensatory strategy will be used. Todd and Benbasat further stated, "We expect the use of the normative strategy to be dominant over simplifying heuristics that are also supported *only when* the effort needed to execute the normative strategy is not greater than that required for the simple choice heuristics". This statement would seem to indicate that the choice of which strategy to use will be made totally without regard to decision quality except when accuracy is a tie-breaker. This argument is in direct conflict with what would be expected if the cost-benefit framework applied to computer aided decision making and also conflicts with research on decision aids conducted by Bettman and Zins (1979); Jarvenpaa (1989); and Chu and Spires (2000) who all found that decision makers seem to be willing to put forth more effort to make a better decision.

In a series of experiments, Bettman and Zins (1979) found strong support that consumers will put forth more effort to keep their accuracy at an acceptable level when changes in the task format make a task more difficult. In their studies participants were asked to complete tasks using particular decision strategies (“lexicographic, conjunctive, differential weighted adding, and a heuristic version of Tversky’s additive difference model”). The participants would complete the tasks with the same accuracy whether information was given in a congruent format or in a less congruent format. However, when participants used data that was in a non-congruent format their time to complete the task increased significantly. It should be noted that their tasks were not done on a computer and was focused on consumer decision making. However, the information that was given to the participants was given on sheets that were stapled together so only one sheet could be viewed at a time and were thus similar to a monitor display. This technique has been used in research on computer-aided decision making to provide a simulated computer environment.

Jarvenpaa (1989) conducted a choice experiment using a restaurant site location task. She examined how the graphical format affects the decision maker’s acquisition of information, evaluation of information, and performance. Her results suggest that how decision makers acquire information is influenced by the way the information is displayed. If the information is displayed by alternatives, then the information acquisition will be alternative based; if the information is displayed by attributes, then information acquisition will be attribute based. However, information evaluation will be subject to task demands. When the information was given in a format that was not consistent with the task, participants tried to evaluate the data consistent with the task instead of solving the problem according to the graphical format. Finally, and most relevant to the current paper, decision makers were willing to put forth more effort (as measured by decision time) in order to keep accuracy at an acceptable level.

Chu and Spires (2000) examined the effects of effort-reduction in the use of computerized decision aids and found that by itself effort reduction is not sufficient for inducing changes in decision strategy. In fact, they found that by making a higher accuracy process easier to use overall, users could be induced to use more effort than they would have for a lower accuracy strategy. They developed a model that predicts effort and accuracy tradeoff effects based upon the cost-benefit model. According to the expanded model that Chu and Spires introduce in their article, their expanded model better fits the Todd and Benbasat (1994) data than the model Todd and Benbasat used and indicated that decision quality plays more than a minimum standard role. "Quality is not simply (or only) a floor that must be met or exceeded, but rather is considered in a tradeoff relationship with effort" (Chu & Spires, 2000).

One characteristic of the experiments conducted by Todd and Benbasat which differs from the other experiments described above is that the decision tasks given to the subjects were tasks which could be solved using either a compensatory strategy or a noncompensatory strategy. The participants were given a task, such as the selection of an apartment, and they were given instructions to choose the best alternative available to them. In order to do this they were told they "…were to treat the problem as if they were making a selection for themselves." (Todd & Benbasat, 1991). The subjects then had to choose which alternative they thought was best according to their own preference. However, Todd and Benbasat compared the participant's choice to the weighted additive solution and were able to make inferences about quality based upon how closely the participant's solution conformed to an alternative based solution.

This measure of accuracy would seem to be inappropriate in the absence of instructions that cue the participant to perform the task in a certain way. Results of research experiments conducted by Wright (1975) found that compensatory strategies were not perceived as being a particularly effective optimizing strategy. Of the decision strategies used in Wright's studies there was a "perception of CONJ (conjunctive) as a more likely optimizer than the other strategies…" Todd and Benbasat considered the alternative based solution as the most accurate and used conformation to this strategy as a measure of accuracy. However, these results suggest that at least some of the participants in their experiments could easily have been using the attribute based decision strategy because they perceived it to be both easier and more accurate. This would result in behavior by participants that was accuracy seeking as well as being effort avoiding and would explain their findings.

In contrast, most cost-benefit model research uses either Monte-Carlo simulations or tasks with given decision weights. Monte-Carlo simulations apply decision strategies to different preferential choice problems and the results of the simulations are used to calculate the effort and accuracy of each strategy (Johnson & Payne, 1985; Payne, Bettman, & Johnson, 1993; Thorngate, 1980). For tasks with given decision weights the decision makers were given a task and the decision weights to be used were supplied so that there is an objective measurement of accuracy (Creyer, Bettman, & Payne, 1990; Fennema & Kleinmuntz, 1995; Jarvenpaa, 1989; Payne, 1976 and others). Under this condition, where the decision maker is told to use a particular strategy or the use of a particular strategy is dictated by the task, as was done by the immediately preceding authors, the establishment of an accuracy standard based upon conformity to a particular strategy is consistent. Unfortunately, in most previous results in the aided cost-benefit framework area objective standards of accuracy were used for what were essentially subjective tasks.

Effort of others

Research in the classical effort-accuracy area has consistently shown that people want to maximize their accuracy, minimize their effort, and they tradeoff these two competing desires to arrive at an effective decision strategy (Beach and Mitchell, 1978; Payne, 1982; Hogarth, 1987; Payne, et al., 1993, and others). Individuals will value a product more when they have put forth greater effort to get it. One reason forwarded by Kruger, Wirtz, Boven, and Altermatt (2004) for why effort is used as a cue for quality is that it is often correct. Generally speaking, more effort will lead to better results. But does the effort heuristic hold true when people are judging the quality of someone else's effort?

While people are "cognitive misers" who want to conserve their own effort, (Shugan, 1980) they want others who are making choices for them (medical, financial, or career advice) to spend more effort on the decision and make the best choice possible (Kahn and Baron, 1995). According to research by Mohr and Bitner (2004) people rate service experiences higher when they feel the employee is putting forth a lot of effort, even controlling for outcome.

Perceived Effort Saved

As reviewed earlier in this paper, most past research using the effort accuracy framework to study computer aided decision making used highly artificial decision tools. Tools were designed to mimic an unaided decision process which resulted in the tools being hard to use and forced the decision makers to make decisions in a way that required more effort than would be needed in a business environment (for examples see; Todd and Benbasat, 1991; 1992; 1993; 1994; 1999; 2000). In addition, the tasks as given don't always specify what constitutes an accurate decision yet the decision maker's accuracy is judged by how closely their answers conform to a compensatory decision strategy. This is in spite of the fact that research by Wright (1975) indicates that compensatory strategies are not perceived as being a particularly effective optimizing strategy. In a series of experiments, Wilson and Schooler (1991) found that when participants in their studies were encouraged to use an analytical process their performances on judgment tasks (jam and art) were hindered. Lee and Geistfeld (1998) analyzed consumer's preferred choice strategies using conjoint analysis and found that 64 percent of their subjects preferred noncompensatory choice strategies. Phillips (2002) found that participants will adjust their decision criteria to justify selecting their preferred alternative, in which case they are actually using more effort to get the same results as would be achieved with less effort in a noncompensatory strategy!

A trend that has been neglected in the considerations of effort and accuracy is that correctly designed decision tools have an equalizing effect on the amount of effort (as measured by key strokes, clicks, or units of thought) required for most decision strategies. One effect of this shift of effort has been a strong series of research integrating conflict into the cost-benefit research stream and alternative measures of effort such as the NASA task load index (Hart and Staveland, 1988) which try to factor in more cognitive effort. Research in these areas is likely to continue and to help researchers better understand the cognitive tradeoffs made as part of the decision making process.

An area that has received scant attention is the role of the computer in processing information for the decision maker. It has been established from previous research that people prefer others to do work for them, but does that apply to work done by computers? A review of the information systems literature failed to find any existing literature that takes into account the user's perception of the effort put forth by the decision tool. Broadening the scope of the review to other research domains, there is existing research in communications (Fogg & Nass, 1997) and marketing (Nasr Bechwati & Xia, 2003) indicating computer users do not think of computers as putting forth effort.

However, research by Fogg and Nass (2003) found that computer users appear to value work done by a computer. Participants in their experiment completed a task with the assistance of a computer aid. Participants in the high support group were more likely than participants in the low support group to work harder, perform better, and feel happier about performing a screen color calibration task that was perceived as beneficial to the computer.

Nasr Bechwati and Xia (2003) examined the role of the consumer's perception of effort saved by using an electronic decision aid upon the user's satisfaction with the decision process. In one experiment a simulated search task was used with a three-group design. The participants were randomly assigned to a no-aid, human aid, or electronic aid group. Results from this study indicated that participants in the no-aid condition had a higher perceived effort than participants in the other two conditions. Participants in the human-aid and computer aid groups did not have significantly different levels of perceived work. The amount of effort put forth by others was significantly higher for the human-aid group, but the difference between the no-aid group and the electronic aid group was not statistically different. The amount of effort participants perceived they saved was significantly less for the no-aid group when compared to the human aid and electronic aid groups. There was no significant difference in perceived effort saved between the human aid and the electronic aid groups. These results indicate that decision makers do not feel a decision tool exerts effort on their behalf and decision makers do perceive the decision tools as saving them effort.

Both Fogg and Nass' and Nasr Bechwati and Xia's research results support the contention that people value work done on their behalf by an electronic aid. In the case of Fogg and Nass there is even evidence indicating that when the aid does not provide the help the decision maker expects, then retaliatory behavior might be elicited. In light of these findings, it is worthwhile to further explore the role of the user's perceptions of the effort saved by using an electronic aid.

Since people value effort put forth on their behalf, increasing the decision maker's perception of the amount of effort saved by using a decision tool should increase the perceived accuracy of the decision tool. This increase is hypothesized to occur even when the decision tool itself is held constant and in the absence of significant variance in the actual effort or accuracy of the decision tool. Based on literature review, the hypotheses for this research model are as follows:

H1: Perceived accuracy will have a positive effect on behavioral intention.

H2: Perceived effort will have a negative effect on behavioral intention.

H3: Perceived effort saved will have a positive effect on behavioral intention.

H4: Perceived effort will have a positive effect on perceived accuracy.

In addition to the model hypotheses specified above there are an additional five hypotheses that serve as manipulation checks. The fifth hypothesis is: since both groups receive the same instructions regarding the function of the decision tool and its use, the groups' actual accuracy should not differ.

H5: The accuracy for both the high and low PES groups will be the same.

The sixth hypothesis is that the manipulation was successful and that the participants in the treatment group (PES_{high}) will have a higher perception of PES than participants in the control group (PES_{low}).

H6: Participants in the PES_{high} group will have a higher mean perception of effort saved than the participants in the PES_{low} group.

Participants in both groups will be using the same interface with the exception of the message displayed on the pop-up feedback box that gives feedback. It is therefore expected that it should take the same amount of effort, as measured by time on task, to complete the task for both groups. The seventh hypothesis is that:

H7: The treatment group should not be significantly correlated with the amount of time the participants take to complete the task.

Since the users wait time is the same, they should perceive the wait to be the same. The eighth hypothesis is that:

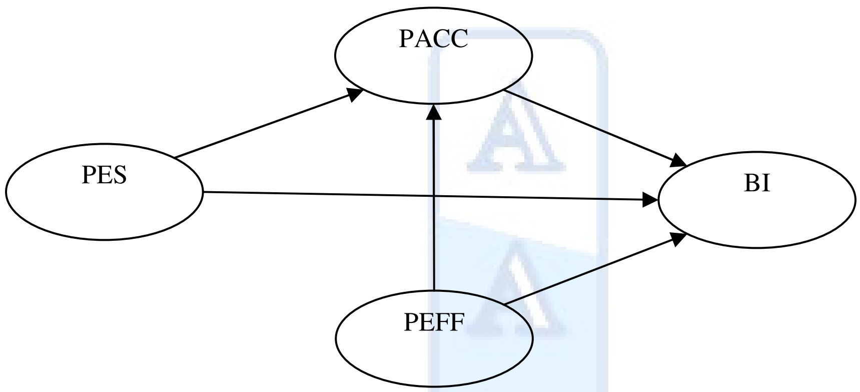
H8: Perceived wait time will be the same for both groups.

Since the users wait time is the same they should perceive the effort they put forth to be the same. The ninth hypothesis is that:

H9: Perceived effort will be the same for both groups.

A graphic representation of the proposed model is shown in Figure 1.

Figure 1



METHOD

Participants

A study was conducted at a large Southern university. The participants were recruited from students enrolled in courses in the College of Business. Participants were recruited from marketing and information systems courses. There were seventy-five participants. Three questionnaires had to be discarded because of incompleteness leaving a sample size of seventy-two. The experiments were conducted by class. All classes were upper division and the marketing and information systems classes each had one class complete the PES_{high} and one class complete the PES_{low} treatment to reduce demographic differences between the groups. Eleven percent of the participants were juniors, eighty-seven percent were seniors, and two percent were graduate students. Sixty percent of the respondents listing a gender replied male and the remaining forty percent replied female. While the samples were not purely random, they were counterbalanced to randomize them to the extent possible by having alternating marketing classes and information systems classes into each group. Forty students were in the PES_{high} group and thirty-four were in the PES_{low} group. The students received bonus points for participating in the experiment. Two students elected not to participate. There were two students who were enrolled in both classes. They received points for both classes but only completed the experiment one time.

Task

The task and tool for the experiment were based upon a task and tool developed by Speier and Morris (2003). Speier and Morris used a 2 x 2 x 2 design to examine the effect of the design of a query interface on the decision maker's performance. Their independent variables of interest were query interface (visual versus text based), task complexity (low versus high), and spatial visualization ability (low versus high). The dependent variables were subjective mental workload, decision time, and decision accuracy.

A home finding task was used to simulate a real estate acquisition decision, and the interface was designed to support an elimination-by-aspects (EBA) decision strategy. "…Subjects were told to identify the five homes (out of approximately 1,100 homes for sale) that best fit the criteria provided in a vignette" (Speier and Morris, 2003). Since the subjects were given explicit criteria to consider in making their choice of the top five homes, an objective measure of accuracy was used. Accuracy was defined as the percentage of the top five homes that were correctly identified. The high complexity, text based interface task proved to be difficult for the subjects as evidenced by the mean percentage of correct answers of 13. The subjects fared much better on the low complexity task with a mean percentage of 80.

Participants in Speier and Morris' experiment were told they would be evaluated based upon both the accuracy of their decision and by their speed. However, no specific information was given to the participants regarding specifics of how their performance would be evaluated. There were no tangible incentives given.

A proximate recreation of the text-based decision tool used by Speier and Morris was designed. A picture of the interface and output that appeared in the Speier and Morris (2003) article was used as a guide. A dataset similar to the description of the dataset used in the Speier and Morris experiment was also developed. The text based query interface with a high complexity task was used because the high complexity task should require the most effort and is most likely to yield a difference in the perceived effort saved between the two groups.

The primary independent variable of interest was perceived effort saved. A between-subjects design was used. In order to manipulate PES the control group (PES_{low}) completed the task with no emphasis on the level of PES. The PES_{high} group received priming and feedback that was hypothesized to make them more aware of the amount of effort that would have been required if they would have had to perform the task manually instead of having much of the task demands performed by the decision tool. The manipulation is explained in more detail below. The dependent variables of interest were perceived accuracy and behavioral intention. Control variables of interest were accuracy, effort, and perceived wait time.

Procedure

The experiment was designed so that the control and treatment groups experienced the experiment in the same way for the majority of the steps involved. The steps in the experiment are listed below with areas where the treatment of the groups differ noted as they apply.

1. The informed consent form was read to the potential participants. They either signed the form to participate or they left. None of the students who attended any of the experimental sessions left after the session started.

2. Training was provided on how a compensatory and a noncompensatory decision strategy work in an unaided decision environment. Participants were then shown how the decision tool simplifies the noncompensatory task.
3. The PES_{high} group heard a brief statement that the decision tool would save them a lot of effort. This group was also asked to visualize doing the task without the tool. This manipulation is similar to the procedure used by Nasr Bechwati and Xia (2003) in their first study.
4. Participants were given a vignette describing a real estate selection task similar to the one used by Speier and Morris (2003). Participants were instructed to read the vignette and then to write down the time displayed on the clock at the front of the room. At the end of the task they were to write the time completed on their answer sheet.
5. The decision tool and dataset were the same for both groups. The only difference was that the participants in the PES_{low} group saw a message similar to the one used by Nasr Bechwati and Xia (2003) stating "Please wait." They then waited fifteen seconds for their results. The PES_{high} participants saw a message stating "The search engine is searching for the properties requested. Please wait." They waited 5 seconds and then received a message saying "The search engine has already searched 30% of the database and is now going through the remaining 70%. Please wait." Both groups waited a total of fifteen seconds for their results.
6. After the results were received the participants could either submit their answer or run the query again and repeat the process until they arrived at a satisfactory answer.
7. After submitting their final answer the participants completed a questionnaire.

Measurement

All of the subjective constructs were measured by a questionnaire which used a 7-point Likert type scale. The endpoints were labeled "Strongly Disagree" (1) and "Strongly Agree" (7) while the midpoint was labeled "Neither Agree or Disagree" for all constructs. As the point of the current research in not instrument development, the items for the questionnaire were from instruments that had been previously validated. In order to test the validity of the chosen constructs after they were adapted to the current research task, a list of all items randomly ordered and a list of all constructs randomly ordered were given to faculty members with instructions to match the items to the appropriate construct. Overall, interrater reliability was very high indicating that the measures have good face validity.

Perceived Effort Saved

The items for perceived effort saved were adapted from Nasr Bechwati and Xia (2003) and were as follows: Using the decision tool to analyze data using this decision process saved me a lot of effort; If it were not for the decision tool, I would have had to work much harder to analyze the data; There was a lot of data manipulation that had to be done, either by me or by the decision tool.

Perceived Accuracy

Perceived accuracy was measured using three items adapted from Wixom and Todd (2005). The items were: The decision tool produces correct information; There are few errors in the information I obtained from the decision tool; and The information provided by the decision tool is accurate.

Perceived Effort

The items for perceived effort were adapted from Wixom and Todd (2005) and were as follows: I put a lot of effort into selecting the best properties to show; I worked hard looking for the best properties to show; and Finding the best properties to show required me to put forth a great deal of effort.

Behavioral Intention

The items for behavioral intention were based upon previous research by Davis (1989). The items adapted for use were: If I were a Real Estate Professional I would use this decision tool over the next year; If I were a Real Estate Professional I would increase my use of a tool such as this one over the next year; If I were a Real Estate Professional I would intend to use a tool such as this one over the next year, and If I were a Real Estate Professional I would plan to use this decision tool in the next 12 months.

Perceived Wait Time

The amount of time the participants perceived the tool to take was also measured as a manipulation check. The items were adapted from Wixom and Todd (2005) and were as follows: It takes too long for the decision tool to respond to my requests. (RC); The decision tool provides information in a timely fashion; and The decision tool returns answers to my requests quickly.

Actual Accuracy

To get a more refined view of actual accuracy the number of query parameters that were correctly specified by each participant was used as a measure of actual accuracy. This method of calculating accuracy has the advantage of more accurately reflecting the quality of the decision process. When number of correct answers is used as a measure of accuracy, one parameter specified incorrectly can lead to an accuracy score of zero. By examining all 13 parameters on the decision tools query page the researcher can determine if a set of wrong answers represents a fundamental lack of knowledge and/or execution on the part of the participant or if one error led to the poor results.

Results

The participants appeared to take the task seriously. The average number of queries submitted was 8.9 and the average time on task was 5 minutes and 6 seconds. The minimum and maximum number of queries submitted were 3 and 27. The minimum and maximum amount of time on task were 103 seconds and 1,003 seconds.

Each construct was tested for validity and reliability by examining the correlations of the variables and by calculating the Cronbach's alpha (Cronbach, 1951). Inspection of the correlation matrix indicated that the questionnaire items clustered together sufficiently well to justify the appropriateness of the use of factor analysis. There were no items that loaded higher on an item for another factor than the lowest item loads on the common factor. This is further supported by a Kaiser-Meyer-Olkin Measure of Sampling Adequacy value of .808, which indicates that the data is likely to be conducive to factor analysis and is well above the minimum .500 score (Hair, Anderson, Tatham, & Black, 1998). Bartlett's Test of Sphericity has an approximate chi-square of 980 with 78 degrees of freedom and is significant at the < .000 level. It is generally recommended that there be a minimum of 5 observations per variable for factor analysis to be used and a size of 10 is more generally accepted (Aiken & West, 1991; Frazier, Tix, & Barron, 2004; Kraemer & Blasey, 2004). The current number of observations per item is therefore adequate for factor analysis.

The number of factors to extract is known a priori to be four. There are four items with eigenvalues greater than one which is the lower limit of the number of factors that are recommended to be extracted. The four factor model accounts for 89.1 of the variance and is shown as Table One.

Table 1
Total Variance Explained

Factor	Initial Eigenvalues	% of Variance	Cumulative %
1	5.9	45.6	45.6
2	2.8	21.9	67.5
3	1.6	12.5	80.0
4	1.2	9.2	89.1
5	0.4	3.0	92.2

Extraction Method: Maximum Likelihood.

When constructs are expected to be correlated, maximum likelihood estimation is recommended as is oblique rotation (Preacher & MacCallum, 2003). Maximum likelihood analysis with Promax rotation was used. As shown in Table Two, all constructs show good discriminant validity with values in excess of 0.65 as recommended by Hair et al. (1998) for a sample size of 70. There were no significant cross-loadings on the rotated factors. The Cronbach's alpha for each factor is also shown. All factors had Cronbach's alpha values exceeding 0.70 as recommended by Nunnally (1978). Based on the results of the correlation analysis, factor analysis, and reliability test good convergent, discriminant, and internal validity are shown.

Table 2
Maximum Likelihood Extraction with Promax rotation

	Behavioral Intention	Perceived Effort	Perceived Effort Saved	Perceived Accuracy
BI2	**0.955**	-0.016	-0.011	-0.006
BI3	**0.948**	0.017	0.018	-0.015
BI1	**0.947**	0.033	-0.010	0.012
BI4	**0.924**	-0.017	0.020	0.054
PEFF2	-0.008	**0.946**	-0.056	0.033
PEFF1	0.048	**0.926**	-0.003	0.011
PEFF3	-0.022	**0.882**	0.045	-0.059
PES2	0.004	0.001	**0.959**	-0.015
PES3	0.113	-0.053	**0.828**	-0.061
PES1	-0.079	0.031	**0.762**	0.069
PACC3	0.017	-0.037	-0.149	**1.042**
PACC1	0.123	-0.030	0.005	**0.828**
PACC2	-0.078	0.072	0.266	**0.756**
Cronbach's α	0.97	0.94	0.89	0.93

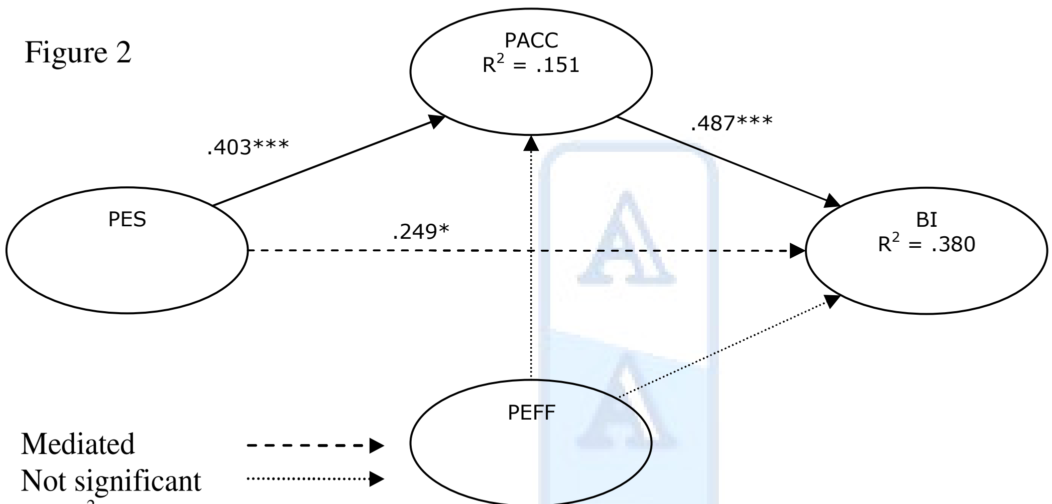
In order to test the proposed model, linear regression analysis was used. As recommended by many researchers (Aiken & West, 1991; Frazier, Tix, & Barron, 2004; Kraemer & Blasey, 2004) the raw scores were centered. Centering was based on the mean. The centered score for the interaction terms were also standardized as recommended by (Aiken & West, 1991). The results, as shown in Figure 2 and Table 3, indicate the proposed model was generally acceptable.

Table 3 - Model Hypotheses

	Variables Dependent	Independent	R^2/R^2 Adj.	Beta (p-value)	Comments
H1	BI	PACC	.346/.336	.588 (.000)	Supported
H2	BI	PEFF	.000/-.014	-.017 (.889)	Not supported
H3	BI	PES	.198/.187	.446*** (.000)	Supported
H4	PACC	PEFF	.016 / .002	.127 (.293)	Not supported
Mediation	BI	PACC	.397/.380	.487 (.000)	
		PES		.249 (.018)	
		PACC x PES			Not Significant, drop
Mediation supported		Aroian version of Sobel test: p = .004			
Manipulation Checks					
H5	Accuracy	Group	.052/.038	.227 (.057)	Supported

H6	PES	Group	.146/.133	.382** (.001)	Supported
H7	Effort, Time	Group	.000/-.014	.011 (.927)	Supported
	Effort, Queries	Group	.000/-.014	-.017 (.890)	Supported
H8	Perceived Wait	Group	.029 / .015	.170 (.160)	Supported
H9	Perceived Effort	Group	.012/-.003	-.107 (.372)	Supported

Figure 2



All R^2 values are adjusted

As put forth in hypotheses one and three, perceived effort saved and perceived accuracy act together to influence a user's behavioral intention and account for 38.0% of the variance in intention. Hypotheses two and four were not supported. This result indicates that perceived effort did not have a significant effect on either perceived accuracy or behavioral intention. One possible reason for this could be suppression of variance since the same decision tool was used by both groups and no effort manipulation took place. Levene's Test for Equality of Variances indicates that equal variance can be assumed (p=.824). The t-test for equality of means with equal variance assumed indicates there is no significant difference between the means of the two groups (p = .372). However, while there was not significant difference between the means the variance within each group was quite robust. PES_{high} had a mean of 3.27 and a standard deviation or 1.74 while PES_{low} has a mean of 3.64 and a standard deviation of 1.62. This indicates that while the variability between groups was consistent the within group variability was quite high which would suggest suppression of variance is not an explanation for the lack to predictive ability of perceived effort.

A Sobel test was conducted to determine mediational effects. The Aroian version of the Sobel test made available online by Preacher and Leonardelli (2003) was used. Perceived accuracy was found to partially mediate perceived effort saved's relationship with process satisfaction (p < .004).

Hypotheses five through nine served as manipulation checks. As predicted, there were no significant differences between the groups actual accuracy, effort as measured by time, effort as measured by numbers of queries run, perceived wait time, or perceived effort, as hypothesized in H5, H7, H8, and H9 respectively. Hypothesis six was that the perceived effort saved for the PES_{high} group would be significantly higher than for the PES_{low} group. This hypothesis was supported (p = .001).

Conclusion

The results support the contention that in a computer aided decision environment the role of perceived effort saved is crucial to understanding users' perceptions of accuracy and behavioral intention. The findings have expanded upon previous work by introducing accuracy into the effort-accuracy model thus advancing the understanding of how the user's perceptions of accuracy and effort saved are related to behavioral intention to use a decision aid. The results for this research support the hypothesis that making the user aware of the amount of processing put forth by the decision aid increases the user's perception of the accuracy and increases the user's behavioral intention.

Research to date paints a potentially incomplete picture by failing to incorporate the user's perception of the amount of effort saved by using the decision tool. One area of interest for future research is expanded exploration of the effect of perceived effort saved upon usage intention. One of the leading models predicting usage intention is the technology acceptance model (TAM). However, the technology acceptance model has somewhat limited explanatory power (Venkatesh, 1998). Venkatesh (2003) notes that "Very little research exists on understanding the determinants of perceived usefulness and perceived ease of use, and further work would help us better understand and even foster acceptance". Given the strong effect of perceived effort saved upon accuracy and behavioral intention, it would seem worthwhile to examine whether its effect upon intention has a main effect or if it is completely mediated by ease of use and usefulness.

The current research has shown that the joint effect of feedback from the tool interface and priming by the trainer can have a significant effect. Future research should also consider what factors have the most influence upon the user's perceptions of the amount of effort saved by using the decision tool. By better understanding the underlying mechanisms, strategies can be formed to improve user perceptions of accuracy and satisfaction which should lead to increased behavioral intention to use a decision tool.

Theoretical Implications

The theoretical implication of the results of this research is that perceived effort saved has emerged as a key psychological construct that has the potential to add substantial explanatory power to the effort accuracy framework. Perceived effort saved explained the same amount of variance in behavioral intention as perceived accuracy (19.8% each, unadjusted). Perceived effort had no explanatory power, which would tend to support the findings of Jarvenpaa (1989), Creyer, et al., (1990), and others, who have found that users will put forth more effort to obtain a better result.

Practical Implications

The findings of this research have important ramifications on decision aid design, implementation, and training. Decision aids should be designed to increase the user's perception of the effort they saved by using the tool. One such design change is the use of feedback informing the user about the work being done for them. It is not hard to imagine other design features that could raise awareness of the effort saved although further research will be needed to test the effect of such changes.

Entities implementing new decision aids can emphasize the role of the decision aid in allowing the decision maker to accomplish more, or the same amount of, work with less effort than would otherwise have been required. By framing the introduction of the decision tool as an effort saving device, users should be more receptive to the introduction of a new process.

When users are trained to use a decision aid, emphasis should be placed on how the process would be accomplished in the absence of the tool and how the tool saved the user effort. By increasing the decision maker's perception of effort saved, there should be increases in the perceptions and accuracy and in their intentions to use the decision tool.

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