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The effect of system feedback and decision context on value-based decision-making behavior

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Abstract

Relatively few studies in MIS research have examined systems to support value-based decision-making behavior. The increasing complexity of the decision environment necessitates more reliance on personal values by decision-makers, thus making it an important component to study when considering the design of systems to aid decision-making. This paper describes an exploratory experiment that was conducted to determine how individual value-based decision-making behavior can be influenced by an information system through the use of value specific feedback. It also examines the role of decision context on value-based decisions. The results indicate that value-based decision-making behavior can be influenced and discusses operant theory and reactance theory as useful predictors of decision-maker response to feedback in different decision contexts.

Keywords: Values; Decision support; DSS design; Decision context; System feedback

1. Introduction

Increasingly ambiguous and uncertain problems face decision-makers today. Indeed, decisions are no less complex now than when Decision Support Systems (DSS) were introduced over thirty years ago. Courtney, in his analysis of DSS and Knowledge Management Systems, points out the need to address this ever increasing complexity: "more effective ways must be found to support the vast array of knowledge that will be required in these highly interconnected and wicked situations of the future" [7, p. 36]. Wicked situations, as defined by Rittel and Weber [23], have many characteristics, some of which include: wicked problems may have no definitive problem formulation, solutions to wicked problems are not true or false but are good or bad, and every wicked problem can be a symptom for another wicked problem. Thus, how should systems that provide decision support approach these wicked problems? It may require that the DSS support and consider the individual values of the decision-maker, using them as guidelines in situations where the decision-maker has a lack of information and/or limited knowledge to solve a difficult problem.

Values hold promise as an area of information system research because of the opportunity to incorporate an important stream of social psychology research into decision-making and decision support research. Rokeach, speaking of the centrality of values to individuals, states that, "an adult probably has tens or hundreds of thousands of beliefs, thousands of attitudes, but only dozens of values" [24, p. 124]. Research on individual decision-making has focused on many forms

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of biases [21,27,34,35], but there have been few studies that look at the value bias in decision-making. Rokeach [25] summarizes several studies where feedback targets inconsistencies in an individual's value structure and how the feedback in turn influences the individual's decision on reordering of their values. Yet, this key component of an individual's make-up has only been considered in a few studies in the decision support and information systems research. Value sensitive design [11] has been proposed as a method for developing systems that takes into consideration moral value as part of the system design, for example, by considering issues such as privacy and accessibility. But focusing on moral values may exclude other relevant values that may occur in a decision environment and that need to be addressed by the system designers.

Individual values become very important in decision situations that are labile, where the decision-maker may not know what they want or have an understanding of the problem. Fischoff et al. [10] offer an example of a labile situation where values influence the decision process such as in the case of a decision to build a nuclear power reactor. Such decisions often require the decision-maker (s), for instance a local government official, to understand many things. For example, a decision-maker in this situation must understand the likelihood of miniscule probabilities occurring, such as a reactor exposing a community to radiation and pollution, as well as unfamiliar terminology, such as 'megadeaths'. Thus, decision-makers are left with only their values to guide them through the labile situation for which they have little knowledge. It is often the case with new technologies and new business opportunities where the decision-maker(s) may have little knowledge to aid them in reaching a decision, causing them to rely in part on their individual values to make a choice which may affect the whole organization. Therefore, it is of importance to examine how information systems and specifically DSS can enhance the ability of decision-makers by starting to consider their value preferences and past decision-making behavior as part of the decision process. This research was conducted under the premise that systems provide an opportunity to support decision-makers by considering their value preferences.

This exploratory research seeks to determine if feedback, as a component of DSS design, can target an individual's values and moderate the influence of these values on decision-making behavior. Two differing levels of consequence of the decision context are considered as part of the decision process to determine the effect on value-based decision-making behavior. The results of this exploratory research indicate that feedback can affect value-based decision-making behavior and there may be an interaction effect between feedback and context. Operant theory [31] is introduced as a possible feedback outcome predictor for value-based decision-making behavior. Once feedback is established as an appropriate tool for targeting values, future research can be conducted to examine the improvement on decision-making.

The paper begins with a discussion of the existing literature and theoretical foundations for the study, followed by the research methodology. The results of the study will be presented with a discussion of the findings, ending with possible limitations to the proposed study.

2. Theoretical foundations and proposed research model

The discussion will present the dependent variable, value-based decision-making behavior, followed by the two independent variables: decision context and feedback. The discussion of feedback will include the theoretical mechanism, operant theory, proposed to explain individual value-based decision-making behavior in response to feedback. The resulting model (see Fig. 1) indicates the proposed effects of values on behavior as moderated by feedback and decision context.

2.1. Value-based decision-making behavior

An individual value is defined by Rokeach as "a type of belief, centrally located within one's total belief system, about how one ought or ought not to behave, or about some end-state of existence worth or not worth attaining" [24, p. 124]. A value-based decision is a decision in which values play a large part. For example, an individual with a particularly strong religious value will make a decision in such a way to support that value and, alternatively, a decision-maker with strong socially minded values would make a decision from a more

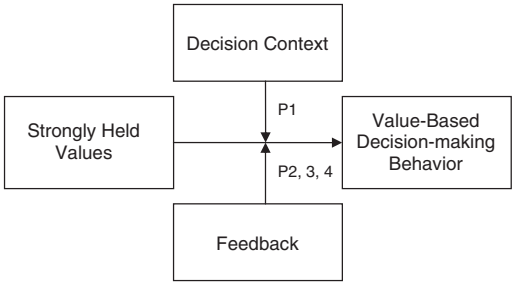

Fig. 1. Conceptual model.

socially-oriented standpoint (the religious and social value dimensions were arbitrarily selected and each is discussed in more detail below). A value-based decision is then expected to follow the principle of value congruence, proposed by Rokeach [25], in which values act as guiding standards with which individual behavior is made congruent. In this study, value-based decisions are expected to be congruent with whichever strongest values apply. Values in this study are assumed to take the form of Spranger's [32] six archetypes: Theoretical, Economic, Aesthetic, Social, Political, and Religious, which are the basis for the Allport–Vernon–Lindzey (AVL) Study of Values [1]. The focus of this study is on attempting to influence a value driven decision using feedback (discussed below), not on providing a philosophical discussion on the subject of human values.

Research on values in decision-making has been seen in the work of Widmeyer [39] and Hall [12]. Widmeyer studied the optimization of aligning a decision-maker's actions and his/her values. Hall found that introducing a component into a DSS based on a Singerian inquirer [5], combined with the value-focused thinking framework proposed by Keeney [16], could influence an individual's behavior. Her system asked questions that required decision-makers to consider perspectives different from their own. She found support for the proposition that behavior related to an individual's weakly held values can be changed through the consideration of alternative perspectives, but was unable to support a behavioral change in strongly held values. This research follows that of Hall in the belief that introducing some new perspective provides a better method of supporting decision-making. However, this study used a different form of decisional guidance to target an individual's strongly held values, thus expanding on Hall's work.

2.2. Decision context

The decision frame or context is an important factor to consider when examining the role of values in decision-making behavior. Tversky and Kahneman [35] discuss the bias associated with how decisions are framed. Specifically, Tversky and Kahneman asked subjects if they would drive across town to purchase the same item if it was $5 less than it was at the store they were currently in. They offer two decision frames coinciding with two items, a jacket at a high price of $125 and a calculator at low price of $15, exchanging the high/low price of the item for half of the subjects (i.e., the calculator is now the high price and the jacket is low) to minimize the effect of preference for a particular item. Most subjects were only willing to save the $5 for the higher priced item, even though the savings and effort expended would be the same when the price was low. Likewise, Pratt et al. [22] found the same effect when offering a constant percent savings (i.e., 10% savings of $5 on $50 and $15 on $150). In this case the decision frame was of a minimal consequence, to save $5 or not.

The framing of decisions becomes more complex when a decision has a magnitude of consequence associated with it [4,15]. The magnitude of consequence provides a mechanism for interpreting the decision-maker's behavior in a specific decision frame when their values become involved in the decision. Consequences in complex situations will increase the reliance on values as a guideline for making a decision. In this study, subjects are asked to allocate funds in a task (see below) of two different sizes as a manipulation of context. When the dollar amount is high, individuals are expected to perceive little loss (low consequence) in decreasing an allocation according to Tversky and Kahneman's findings and Jones [15] description of magnitude of consequence. On the other hand, individuals are expected to have a higher perception of loss (high consequence) with an equal change in dollar amount in a smaller dollar context (i.e., $1000 out of $10,000 is of higher consequence than $1000 out of $500,000). The perceived strength of the consequence increases as decision-makers are asked to make a choice between competing values because of some limiting factor such as money. The resulting context proposition was examined as part of the conceptual model (see Fig. 1):

P1. *Decision-makers in the high consequence (low dollar amount) context will have a smaller percentage change in allocated funds from Decision 1 and Decision 2 than decision-makers in the low consequence (high dollar amount) context.*

2.3. System feedback

Feedback refers to information presented to the user about the decision-making process to effect a change in the outcome [33]. Feedback in the management literature has focused on positive and corrective (negative) reinforcement [37], as well as on monetary or benefit rewards. Waldersee and Luthans [37] found the control and corrective feedback outperformed the positive feedback in repetitive fast-food industry jobs that had low complexity and high uniformity.

Feedback in a DSS can take many forms ranging from estimated decision outcomes to guidance through the decision process. Silver [29,30] discusses the role of decisional guidance as a tool for aiding decision-

making. Silver defines decisional guidance as "how a DSS enlightens or sways its users as they structure and execute their decision-making processes" [30, p. 107]. Feedback has also been used by Vahidov and Elrod [36] as a critical agent causing users to reconsider their decisions from different perspectives when using a financial planning DSS.

Rokeach [26] studied the effects of computer feedback on individual rankings of values. The feedback was in the form of a computer printout which was given to individuals for consideration. He was able to show that individuals confronted with inconsistencies in their values made the decision to reorder their value ranks. With the advances in computer usage and availability itis important to connect the foundation set by this social psychology study with current DSS research and design.

Operant theory is used in this study to predict the effects of information system feedback on decision-making behavior. Lovata [18] discusses operant theory as a useful tool to be considered in information system design, but it has yet to be used within system design. The theory states that positive reinforcement encourages continued behavior, while punishment will discourage continued behavior [31]. Schneier defines positive reinforcement as "any consequence of behavior that strengthens the probability of the future occurrence of that behavior" [28, p. 531]. In contrast, Schneier defines punishment as "a change in the environment which weakens the probability of future occurrence in the behavior" [28, p. 531]. DSS feedback can be perceived as punishment when acting as a reprimand in the form of exception reporting, highlighting unfavorable performance and discouraging continuation of behavior and decision-making that resulted in the performance [18]. Feedback is thus set to target strongest held values with either a positive, negative, or neutral delivery method. The resulting propositions were examined as part of the conceptual model (see Fig. 1) looking at changes in a decision-maker's behavior subject to the feedback delivery method:

P2. *Positive, value specific feedback will increase fund allocations from Decision 1 to Decision 2, through reinforcement of the value-based decision-making behavior.*

P3. *Negative, value specific feedback will decrease fund allocations from Decision 1 to Decision 2, through punishment of the value-based decision-making behavior.*

P4. *Neutral feedback will not change the value-based decision-making behavior from Decision 1 to Decision 2.*

3. Methodology

A laboratory experiment was chosen as the research method for this exploratory study because it allows experimenter control to examine the question of how feedback affects individual values. This experimental design introduces opposite direction treatments, in this case positive and negative feedback. A control treatment (neutral feedback) is used to measure the potential Hawthorne effect by providing a baseline for the study to compare the experimental treatments (i.e., it will fall in between the positive and negative). To implement this design, a DSS supporting an allocation task was modified to provide the appropriate feedback treatment based on the subject's strongly held values. A full factorial 2×3 experiment was conducted (see Table 1). The research of this DSS artifact followed the software engineering model as a research method guideline as proposed by Hevner et al. [13]. The components of the experiment are discussed as follows: system, subjects, task, system feedback, posttest, data gathering and setting.

3.1. System

To conduct design science research there must be an artifact [13]. The DSS artifact in this study is a web-based system for a fund allocation task offering appropriate value specific feedback. The system (an example of which is available from the author) is coded in Cold Fusion, a web development language. It administers a survey instrument and supports the execution of the task and treatment (described below). The system also collects the data from the subjects and stores the information in a database.

3.2. Subjects

Twenty-eight student subjects from different sections of two MIS courses participated in the experiment. Student subjects are acceptable because the only requirement of the subjects is that they have some set of values. The subjects' values were measured using the AVL instrument, a two part 45 question instrument

Table 1
Proposed experimental design (actual number of subjects included)

		System feedback		
		Positive	Negative	Neutral
Decision context	High	3	4	3
	Low	7	6	5

which has been used to measure values in Allport et al. [1], Lubinski et al. [19], and Watson et al. [38] among others. Subjects took the AVL as a pretest to determine their highest score of the six value components measured by the instrument. This value became the strongly held value targeted by the study and the system. In the case of a tie the first high score was selected. Subject demographics such as age, gender, class, and major were collected as part of the pretest. Students were offered extra credit for their participation in this study.

3.3. Task and decision context

Since value-based behavior is of interest in this study, rather than specific decision-making ability, the 'Foundation' task [38] was chosen because it requires no previous experience and has been proven to work with students. The task has been successfully used in both individual and group decision-making environments [6,12,38]. The task requires decision-makers to allocate a monetary trust for a deceased relative among six possible groups vying for the funds. Each request for funds corresponds with one value component of the AVL instrument. If money is increased for one group then another group suffers because the funds available decrease. In this study, individuals completed the task, received the feedback treatment (discussed below), and then completed the task again. The change in behavior with regard to the subject's strongly held values was then measured. There are two decision points: one before and one after the treatment. In each decision, the subject completed the 'Foundation' task. In each case the same amount of funds was available though the charities changed from Decision 1 to Decision 2. In both cases, however, the charities still corresponded to the six value types tested by the AVL instrument. The screenshot in Fig. 2 provides an example of the systems implementation of decision task.

The role of context is operationalized by the amount of funds available for allocation. Two levels of fund allocations were used to provide two decision frames: a low context of $10,000 and a high context of $500,000. A higher consequence was assigned to having limited funds, in this case $10,000, because there is less money to distribute the focus will be to help organizations most aligned with the decision-maker's interests. A lower consequence is associated with the $500,000 because there are more funds to go around, so the more interests can be supported. Context will be compared using the percent of the total allocation given to the charity that coincides with the targeted strong value. This enables the two different dollar contexts to be compared.

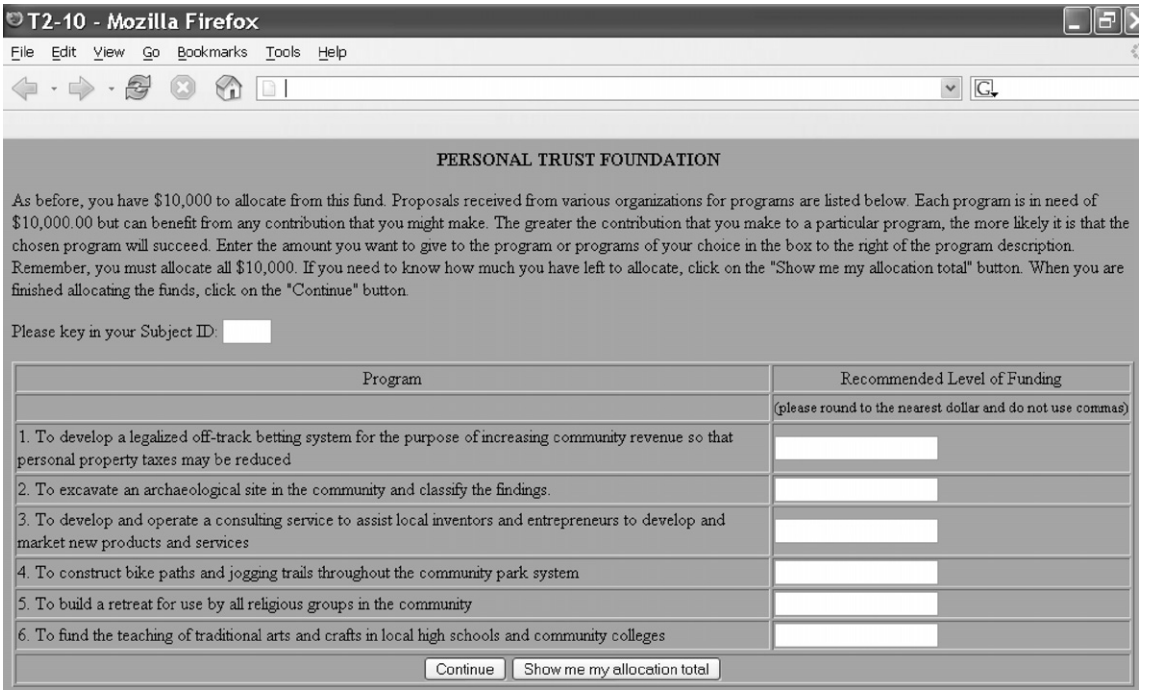

Fig. 2. Decision task screenshot.

3.4. System feedback treatment

The decisional guidance in this study was value-specific feedback, operationalized as deliberate and suggestive guidance to aid in the execution of the decision-making process using Silver's [30] categorization. Feedback in this study focused on two forms-positive and negative. Under operant theory, positive feedback was reinforcing to encourage subjects in this treatment to focus on and increase support for one's strongly held values. Negative feedback is intended to be perceived as a punishment under operant theory and was designed to cause individuals to reconsider their value positions in favor of other value positions, thus decreasing support for one's strongly held values.

Subjects were randomly selected into treatments as they entered the experimental environment. The feedback was tested statically to determine the effect of a positive or negative delivery, so subjects were placed in a positive, neutral, or negative treatment group. The feedback followed the subject's first execution of the distribution task and corresponded to their strongly held values as measured by the AVL pretest. An example of negative feedback for an individual with a high AVL Social score is:

> TRY AGAIN!¯Your initial survey score indicates you are interested in socially oriented endeavors, such as volunteering for community projects or working to improve the situation for all individuals. Research has shown individuals like you perform poorly on allocation tasks like the one you just completed, primarily because you focus too heavily on the social concerns that are most important to you without considering other perspectives. With this in mind, you will be provided with an opportunity to attempt another fund allocation. Please continue.

Positive feedback for the same individual type takes the form of:

> GOOD JOB!¯Your initial survey score indicates you are interested in socially oriented endeavors, such as volunteering for community projects or working to improve the situation for all individuals. Research has shown individuals like you perform well on allocation tasks like the one you just completed, primarily because you focus on the social concerns that are most important to you. With this in mind, your talents are needed for one more fund distribution. Please continue.

The control contained a neutral message asking the participant to continue to the next allocation task. Feedback of similar structure has been used successfully in Wolford and Goodwin [40]. The screenshot in Fig. 3 is an example of the feedback implementation by the system. Because strongly held values are central to individual behavior, an individual's strongly held values were targeted to determine the effect of feedback on value-based decision-making behavior. Feedback was measured using the percent of the total allocation given to the charity that coincides with the targeted strong value. This enabled the two different dollar contexts to be combined so that all feedback may be grouped by treatments and compared for Decision 1 and Decision 2.

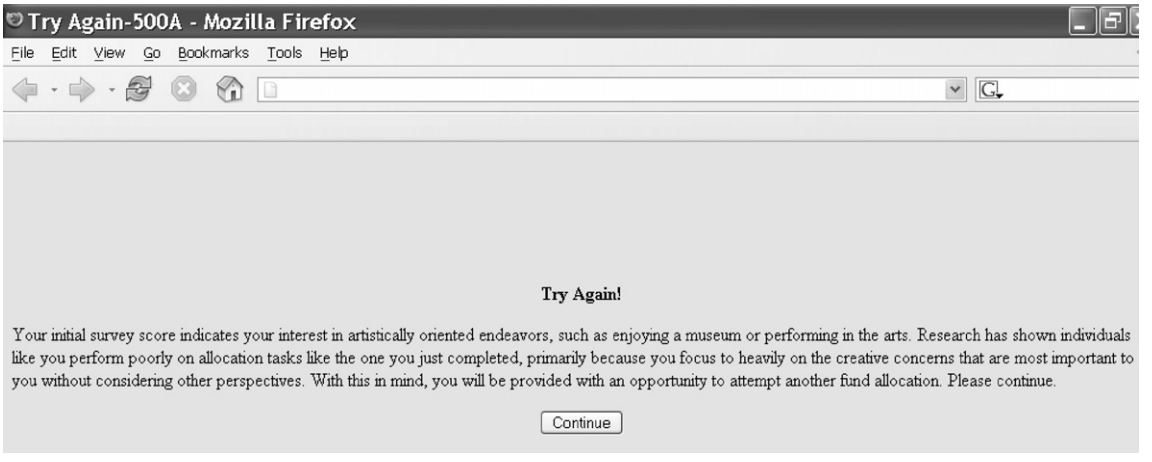

Fig. 3. Negative aesthetic feedback screenshot.

3.5. Posttest questionnaire

A questionnaire was used at the end of the study to check the feedback manipulation. Questions were aimed at determining what knowledge the subject had of the experiment's goals and whether they received positive or negative feedback. Finally, subjects were asked if the feedback affected their decision process.

3.6. Pilot study

A pilot study was used to "check out procedures, tasks, and measures" [8, p. 164]. In this case a pilot study using five graduate students was executed to assess the system. Based on the findings of the pilot study, the screen format, data validation, and text errors were revised.

3.7. Data gathering and setting

Data was gathered at five points for the treatment groups. Data was collected from the demographics form, the AVL instrument, the first fund distribution task, the second fund distribution task, and the posttest survey. Data was collected electronically for a given subject and stored in the system's database. The setting took place in a computer lab with subjects assigned to a treatment as they arrived for the experiment. Because of the short length of the experiment, the computer lab minimized the effect of the setting on the experiment. Each subject had the same type of computer system to access the application. Also, the environment allowed subjects to be monitored and removed the ability to collaborate on answers that would have been possible if they were allowed to freely access the application.

4. Analysis

Change in decision behavior was calculated as the proportion change from Decision 1 to Decision 2. This measure was analyzed by using a Mann–Whitney nonparametric comparison test to examine the treatment effects. Nonparametric procedures are robust, distribution-free techniques that are particularly useful when the N is small, as in this case where there are only 28 subjects. There are many additional advantages to using nonparametric procedures, such as minimal assumptions concerning the underlying populations, insensitivity to outliers, and the ability to analyze an unequal number of observations in experimental cells [14]. The Mann–Whitney statistic compares the median values for two samples to determine if there is a significant difference, simultaneously generating the W test statistic, confidence interval, and the exact p-value. This nonparametric procedure has been successfully used to analyze data in previous feedback studies [33]. Because this study is exploratory, an $\alpha = .10$ was used as the test for significance because two-tailed analysis was used to analyze the data and the author did not want miss potential effects that may not fall within the preferred significance level of $\alpha = .10$. The data was analyzed using Minitab 14 for all tests. First, the preliminary analyses are presented, followed by the feedback effect on behavior and the decision context. Finally the interaction effect of the two treatments will be discussed.

4.1. Preliminary analyses

Table 2 indicates the number of decisions per treatment that followed the hypothesized classification. For example, six out of seven subjects in the positive/$10,000 treatment increased the funds allocated which coincided with the hypothesized behavior. On the other hand, only one out of six in the negative/$10,000 experimental cell decreased funds contrary to the hypothesized behavior. There was no significant difference when percent allocations were compared for strongly held values in Decision 1 compared to Decision 2 (Mann–Whitney $W = 766.5$, $p = .6074$).

To test for prior knowledge of the experimental treatments, post test questions were qualitatively analyzed indicating that subjects had no prior knowledge of the goals of the research. Most subjects indicated that feedback had little effect on their decisions, but in contrast to the subjects' expressed opinion there is some indication of significant effects on behavior. This result seems to indicate at least a partially successful manipulation where the subject was not aware of the treatment effect.

4.2. Decision context

The Mann–Whitney test indicates there is a difference between the percent changes of fund allocations between the two decision contexts (see Table 3). The test

Table 2
Classification of decision behavior with hypothesized behavior

		Positive	Negative		Neutral	
$10 k	Correct	6 out of 7	1 out of 6	$10 k	Inc	3 out of 5
	Incorrect	0 out of 7	4 out of 6		Dec	1 out of 5
	NoDiff	1 out of 7	1 out of 6		NoDiff	1 out of 5
$500 k	Correct	2 out of 3	4 out of 4	$500 k	Inc	2 out of 3
	Incorrect	1 out of 3	0 out of 4		Dec	1 out of 3
	NoDiff	0 out of 3	0 out of 4		NoDiff	0 out of 3

Table 3
Comparison of the percent change between contexts

	W	p-value
$10 k–$500 k	300.0	.0640*

*Significant at the $p<.10$ level.

indicates that decision context significantly affects value-based decision-making behavior, providing support for Proposition 1.

4.3. Feedback

The analysis indicates there is an increase in funds allocated for the positive feedback treatment, but not the negative or neutral treatments. The Mann–Whitney comparison of fund allocation with positive feedback in Decision 1 versus Decision 2 was significant at the .10 level, supporting Proposition 2 (see Table 4). The negative feedback did not significantly differ between allocations even though the difference in allocation was larger than the allocation for the positive treatment. Thus, there is no support for Proposition 3. This result is due to fewer individuals in the negative/$10,000 context experimental cell decreasing funds on the strongly held value dimension from Decision 1 to Decision 2 (in fact, the majority increased their allocation, see Table 2). However, the percent allocation decreased from Decision 1 to Decision 2 with the negative feedback treatment, which may indicate an effect but insufficient power to illustrate significance. The fourth Proposition was tentatively supported, the neutral feedback had no effect, there was no significant change in percent allocation between decisions but care should be taken when accepting a large p-value. Fig. 4 provides a graphical comparison of the data.

4.4. Interaction effect

While no interaction was proposed, post hoc analysis indicates that at least a partial effect was evident in the results. When the low context ($500,000) is combined with positive feedback there is a significant difference in behavior (Mann–Whitney $W=37.0$, $p=.0458$), but there is no difference when the positive feedback is combined with the high context ($10,000). Contrary to the above result, negative feedback significantly affected decision-making behavior in the high context ($10,000) context (Mann–Whitney $W=25.0$, $p=.0591$), but not in the low context ($500,000). The expected cause of this interaction will be discussed in the following section.

Table 4
Percentage of allocation Decision 1 compared to Decision 2

	n	Median
Positive D1	10	0.20
Positive D2	10	0.25
	$W=81.5$	$p=.0719$*
Negative D1	10	0.20
Negative D2	10	0.13
	$W=120.0$	$p=.2689$
Neutral D1	8	0.15
Neutral D2	8	0.20
	$W=64.0$	$p=.7093$

*Significant at the $p<.10$ level.

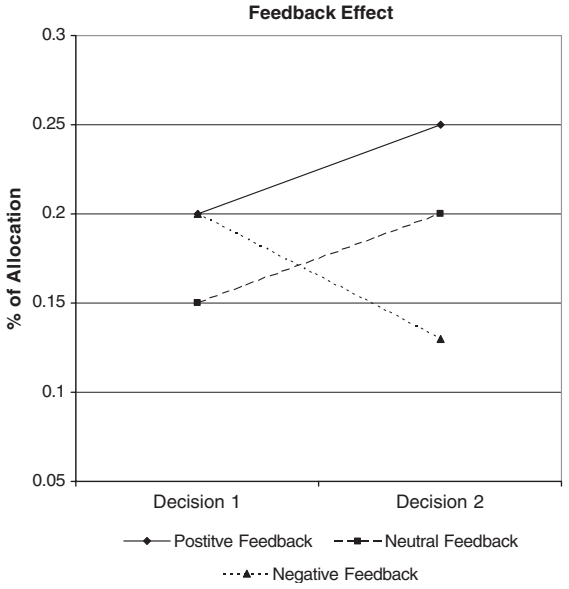

Fig. 4. Feedback effect for both contexts.

5. Discussion

The results from this exploratory experiment are encouraging. The positive feedback was successful in encouraging participants to increase their fund allocations in the second decision for their strongly held values, especially when plenty of money was available for allocation. Most subjects in the positive feedback, regardless of the context treatment, when encouraged to focus on their highest value increased the funds allocated to the organization aligned with their value type. This behavior shift is consistent with that predicted by operant theory as reinforcement increased desired behavior.

On the other hand, negative feedback was significant in the $500,000 context, but not in the $10,000 context. There are two possible explanations for why there was no significant change in behavior was in $10,000 context. One possibility is reactance theory [2], which offers an alternative explanation for behavior opposing that predicted by operant theory. Negative feedback could be

perceived by decision-makers as restricting their abilities to best make decisions, causing them to react to the feedback by continuing the behavior targeted for change by the feedback. When they were presented with feedback that they perceived as restricting their ability to exercise their value judgment, they responded by ignoring or increasing the funds distributed to the corresponding strongly held value allocation. Another possibility is the negative feedback was not perceived as a strong enough punishment to elicit the appropriate operant behavior.

The interaction effect seems to indicate that the former may be true; that reactance theory has more explanatory power due to the magnitude of consequence associated with a specific context. Negative feedback was successful when the dollar amount was high. This indicates a possible low perceived magnitude of consequence when more money is available to distribute among competing charities in the task. Subjects in the negative treatment perceived a higher magnitude of consequence when there was only $10,000 because there were limited funds available to allocate. When negative feedback threatened the amount they felt they should be able to distribute, subject to their strongly held values, they rebelled against the feedback. Thus, reactance theory suggests a response contrary to operant theory. If the negative reinforcement or punishment is perceived as constraining in nature, individuals may exhibit the opposite behavior than that desired. For instance, the more a small child is told not to run out into the road, the more attractive that specific behavior becomes because the child resents the imposed limits on his/her freedom. Reactance theory is under used in MIS and decision-making research, but it has been mentioned as a possible explanation of individual adjustment to information driven technologies [20]. Within the management literature, reactance theory has been used in studies of scarce goods [9] and used in studying entrapment [3].

These exploratory findings lay the groundwork for operant theory and reactance theory as two psychological predictors of feedback effect on users making value-based decisions. The results also indicate that the decision context as well as the magnitude of the consequence associated with that decision should be considered when designing a DSS to support complex decision-making. Thus, value-based decision-making behaves as follows: when context is low, creating high consequence, positive feedback operates per operant theory and negative feedback in accord with reactance theory. When context is high, operant theory is the better predictor for both positive and negative feedback. A study will need to be conducted to empirically test the exploratory findings presented here. A critical experiment [17] is needed to determine whether operant and reactance theory adequately predict and explain the feedback effect on individual value-based decision-making in differing contexts. Thus, the critical experiment tests the falsifiability and utility of the theories and enables the designer to have a better understanding of decision-maker behavior in response to feedback.

This study has practical implications for DSS design. DSS that use decisional guidance in the form of feedback need to incorporate the decision context into the decision process it aids. Feedback should be tailored to meet the context keeping in mind that operant theory holds in situations of low consequence but decision-makers may ignore feedback in situations of high consequence. Likewise, system complexity will have to increase to incorporate multiple types of feedback and determine when positive, negative, or no feedback is appropriate. More research will be required to further test these relationships to increase the practical applicability of these theories to DSS design.

6. Limitations and conclusions

There are several general limitations with this study. Additional experiments will be required to further test the theoretical mechanisms affecting feedback across context. While there seems to be some initial support for the idea that value specific feedback and decision context can elicit some change in behavior, there is a question of whether the feedback, particularly the negative feedback, was strong enough to change behavior significantly. Finally, the task did not adequately target the decision-maker's strongly held values as well as it perhaps should. Fund allocations that elicit a much stronger response may be needed to further test the feedback treatment effect.

This study opens many possibilities for future research. Future studies first need to be conducted to examine more dynamic feedback, as well as to confirm the role operant theory and reactance theory play in decision-maker response to feedback. A possible extension to this study would be to extend this research to the group-level to determine the role that values have in group decision-making behavior. Another interesting direction for value-based research is examining the alignment of individual and organizational values. Future studies need to be conducted that introduce more dynamic feedback tested in different decision situations.

In value-based decision-making situations, the values people hold become central to the problem making it necessary to consider values in the process of decision support. This work contributes to information system research by building a foundation for moving DSS into the

realm of supporting decision-maker values for decisions where values matter. It also contributes by providing some useful insight into DSS design by suggesting feedback as a useful aid in targeting decision-maker values and expanding the range of values important to a decision beyond the scope of those called for in value sensitive design. Finally, this experiment increases our knowledge of this field by introducing operant theory and reactance theory as predictors of feedback effect.

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