Do Men and Women Use Feedback

Provided by Their Decision Support Systems (DSS) Differently?

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ABSTRACT

This study investigates the effect gender has on the use of computer-based feedback and the impact that this feedback has on mood. The decision making process of men and women are investigated via a laboratory experiment using a previously validated Decision Support System (DSS) and a commonly used and negatively framed feedback. Grounded in human computer interaction theories highlighting the strong social component of computers and social feedback theories showing that men and women react to negative feedback differently, we argue that the commonly used outcome feedback in DSS studies will influence both the decision accuracy of male and female users and their moods differently. The results, which support our basic theoretical argument, indicate that outcome feedback (in particular the more

negative outcome feedback) improved the decision accuracy of the female users compared to their male counterparts. The results also indicate that the outcome feedback affect the overall mood of men and women differently as well. The overall moods of the female subjects were significantly less positive before and after completing the task (receiving this commonly used negative form of feedback), the moods of the male subjects before and after completing the task (receiving the same negative feedback) did not change. These results not only extend prior DSS feedback studies but also highlight the need and provide support for examining gender differences in such investigations.

Keywords

Decision Support Systems, DSS, Gender, Feedback, Decision Making, Feedback Utilization, Decision Accuracy, HCI, Uncertainty, Mood

1. Introduction

Over the past sixty years, there has been a significant change in the workforce profile in organizations. Female employees, who made up only 29 percent of the workforce in the 1950s, form almost half of the workforce (46.59 percent) today [77]. Moreover, female employees are no longer limited to secretarial work in offices and now hold a variety of organizational positions. For example, a relatively large percentage of working women hold management, professional, and related occupations [77].

Motivated in part by this change in the workforce profile, a growing number of studies have recognized the need to examine the impact of gender differences on decisions made in the workplace. For example, several decision-based studies have focused on gender differences in various situations, such as acceptance and adoption of new technologies [e.g., 47], involvement with a decision aid [26], ethically sensitive decisions [54], the escalation of early investment decisions [5], and the presentation of information to assist manager's in decision making [68]. While Morris et al. [47] did not find gender differences in the acceptance of technology for people under 40, Hess et al. [26] found that women, more than men, were engaged when working with a decision aid. In Radtke's [54] study of ethical decision making women were not found to be more ethical than men. Bateman [5] and So and Smith [68],

however, found significant differences between men and women's decision making prowess. For example, men, in a sequential investment decision making task, were more apt to invest more money when they felt threatened after a successful investment decision. Unlike their male counterpart's, women were more likely, under such circumstances, to decrease their investment [5]. In a study of various presentation formats for management decision making, women demonstrated higher levels of decision quality than did men [68]. Though these studies reveal some existence of gender differences, they do not consider the implications of negative feedback, such as rejection [42], criticism [65], and/or performance feedback [61]. The performance feedback is of particular interest in this study since outcome feedback, feedback regarding one's deviation from a normative strategy (i.e., a form of performance feedback) is often used in the DSS research [e.g., 41].

Decision making studies that do include the use of negative feedback support the idea that men and women respond differently to negative feedback. Women attach a greater emotional value to rejection [42], tend to take on both a competitive and collaborative strategy of conflict resolution when receiving criticism [65] and are less threatened by the prospect of failure than men are [61]. Though these decision making studies investigate gender differences in response to negative feedback, they do not examine gender differences in response to DSS feedback, nor do they examine the effects on decision accuracy when using a DSS due to gender differences.

While DSS feedback studies successfully refine our understanding of feedback utilization and its effect on decision accuracy, they do not include users' gender and its potential impact on responding to feedback in their investigations. Including gender in DSS feedback models is particularly important since the media equation theory [50] indicates that the interaction between humans and their computers has a strong social component. Further social feedback theories [62] assert that men and women respond to negative feedback differently. Hence to extend the DSS feedback literature, this study examines whether gender can impact how the negative feedback provided by a DSS is utilized, that is, whether negative feedback can affect the decision accuracy of men and women differently. Moreover, we examine male and female

users' reactions to feedback by examining their moods. To do so we use negatively framed outcome feedback, which is often used in DSS feedback studies [25]. We test gender effects on utilizing this type of feedback under two feedback treatments: one with more negative information and one with less negative information. Figure 1 provides a visual representation of previous work and how our work extends this previous research. The details of the previous research illustrated in Figure 1 are provided in sections 2.1 and 2.2 of this paper.
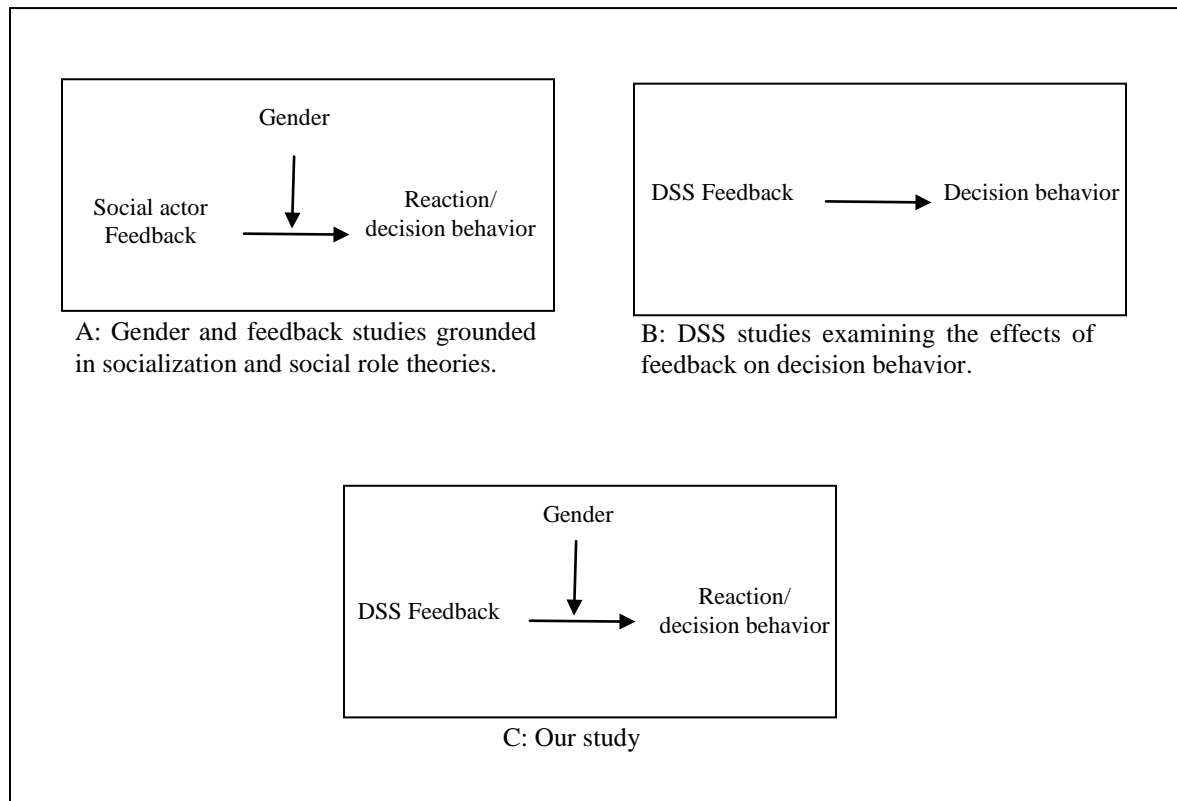

Figure 1: Visual representation of previous gender and social feedback studies, DSS studies as well as our study extending these previous studies.

The remainder of the paper is organized as follows. First, we discuss the relevant literature. We then present our hypotheses followed by our methods for testing these hypotheses. Results are then presented and discussed. Future areas of research expansion are outlined along with limitations to the current study. Finally, we present our conclusions and highlight the implications of our findings.

2. Theoretical Lens

It is often assumed that conventional computer feedback fails to capture users' attention [41]. To improve the utilization of such feedback, many studies have focused on examining different types of information (e.g., feedback about accuracy of a decision [25], structure of the task [56], users' cognitive strategy, etc. [2,41]) that are helpful to users. However, little work has been done to examine users' fundamental characteristics, such as gender, that can impact feedback utilization. Experimental studies in psychology provide compelling evidence that gender may play a significant role in how effectively computerized feedback is utilized. This literature suggests that although men and women are both affected by feedback received from others, they respond to it differently [1,62,63]. While people are aware that computers are not "real" social actors they often treat their computers as such [48,50,80]. Thus, it is likely that receiving feedback from a computer, even in its simplest form, can affect men and women differently.

2.1. Computerized Feedback

Many important business decisions involve predictions about a future event. For example, managers often need to estimate the workload [7,39], completion time, and budget for a project [14] and asses its likelihood to achieve profitability [55,76]. Since today's business environment is global and uncertain [8,66], accuracy, timeliness, and cost efficiency of such business judgments are highly valued. Consequently, most organizations provide their employees with computerized decision aids to help them make good decisions [53]. Making good business decisions, however, requires employees and managers to utilize these decision aids effectively and consider their feedback when such feedback is available. Since feedback can help users improve their decision strategies [17,25], investigating factors that can improve feedback utilization are particularly important to DSS research.

The simplest form of computerized feedback is outcome feedback, which informs the user of the actual outcome of the event and the "correctness" of the user's judgment for each decision made [11]. The information regarding decisions accuracy, such as the percentage of the deviation of subject's decision

from the optimal decision, is often labeled as "percent error" [e.g., 41,56]. As the name "percent error" suggests, this commonly provided information is negatively framed feedback.

In addition to being simple to develop, outcome feedback has the virtue that it is easily understood by decision makers [25]. Consequently, this feedback is often included in decision making studies [e.g., 25,41]. Hence, we employed this commonly used feedback to examine the impact of gender on feedback utilization. To be consistent with prior research, we labeled the information regarding the subjects' "correctness" of decisions as "percent error." Thus, consistent with many prior DSS studies [e.g., 41,56], the outcome feedback in our study was framed negatively. Moreover, we refined our investigations by examining the effect of gender on utilization of outcome feedback under two treatments. We manipulated the task in a way so that in one of the treatments making accurate decisions was significantly harder than in the other treatment (see section 4 Method of this paper for more details and a full description of the task). Consequently, in the treatment in which making accurate decisions was harder, the information regarding one's performance was more negative (i.e., percent errors of decisions were significantly larger). Thus, the feedback in one of the treatments was more negative (larger percent errors) and the feedback in the other treatment was less negative (smaller percent errors).

2.2. Gender and Evaluative Feedback

Control theory [6] states that an individual's feedback utilization is influenced by the desire to minimize the disparity between one's accepted goals and standards and one's actual behavior. It is expected that effort will remain stable when feedback indicates that a goal has been met (or exceeded), however, effort often increases when feedback indicates otherwise [46]. That is to say, when people notice that their behavior is not successful, they change their strategies to adapt to the feedback [74].

While literature suggests that feedback can impact an individual's behavior, particularly their effort, it also shows that performance feedback by others can impact men and women differently. For instance women have been found to be more responsive to this type of evaluative feedback than men. In particular, women were found to incorporate more feedback received by others into their own self-evaluations of

achievement than men did thus indicating the different significance each group placed on the informational value of evaluations from others [62].

Furthermore, women tend to incorporate both positive and negative feedback into their decision making, whereas men are more apt to incorporate positive feedback and less so negative feedback into their decision making [62,64]. This indicates that men may be more likely to view evaluative achievement feedback as a competitive challenge and thus assume a self-protective posture and discount the value of others' evaluations. Women, on-the-other-hand, tend to approach such evaluative feedback as an informative opportunity to learn more about their skills.

Baldwin, Granzberg, and Prichard [1] showed that evaluative feedback even when presented as a subtle and indirect cue can affect men and women's self-evaluations (esteem) and moods differently. To show such an effect they [1] first conditioned their subjects to associate a seemingly unrelated noise due to reprogramming a computer in the room with a rejection, acceptance, or control feedback. Then at a later time when subjects were performing a different task they exposed their subjects to such indirect feedback cues (computer noise). The results showed that women's feelings of self-esteem decreased significantly when they were exposed to the indirect rejection feedback cue (hearing the computer tone associated with rejection). Interestingly, however, men hearing the same indirect rejection feedback cue (computerized tone) had a significant increase in their feelings of self-esteem. In terms of changes to mood, the mood of women who received the indirect rejection feedback cue decreased more than the mood of their female control counterparts. In contrast, the moods of men who received the indirect rejection feedback cue were less negative than the moods of their male control counterparts. These results support previous findings that suggest women perceive negative feedback as more negative than men [42], and hence are affected by negative feedback more than men [65].

The results of the study by Baldwin et al. [1] also showed that women's perception of their task performance was significantly worse when they were exposed to the indirect rejection feedback cue. Under the same conditions, contrary to their female counterparts men exhibited significantly more

confidence in their performance. This again supports the idea that men may take on a more defensive, coping mechanism to deal with negative criticism similar to Rhodewalt and Hill's [61] findings.

Some researchers attribute gender dissimilarities to differences in socialization. According to the social role theory, gender differences are a consequence of individuals acting in accordance with their social norms [16]. Similarly, the early socialization model [43] points out that men and women encounter different socialization events that teach them different gender-appropriate patterns of behavior. Studies have shown that typically in boy peer groups there are higher levels of negative feedback than in girl groups. Boys' interactions tend to include components of dominance and a struggle for power [45]. Since boys' interactions include threats, refusals, and demands much more than girls' interactions do, boys may over time pay less attention to negative feedback. Roberts [62], in accordance with the social role theory, suggests that men are less likely to respond to criticism (negative evaluations) under instances of evaluative achievement situations. Women on the other hand, are more likely "to approach such situations as opportunities to gain information about their abilities" [62, p. 397].

In short, the literature reviewed in this section suggests that gender can impact how evaluative feedback is interpreted and used. In particular, the literature suggests that men and women are influenced by and respond to negative evaluative feedback received from others differently. Figure 1, A provides a visual representation for the results of these studies.

2.3. DSS as a Social Actor

It is commonly believed that computers are perceived as tools and thus the confusion between the computer-mediated and real life is rare [50,67]. Such confusion is assumed to be related to being young and inexperienced or mistakes caused by distraction [50]. Literature, however, suggests that "confusing" computers with social actors is neither rare nor a product of age, education, or distraction [49,50,80]. According to media equation theory [50] people treat their computers the way they treat other human beings. For example, when users were asked what they thought about a computer (computer A) by that computer (Computer A), their responses were more positive than when another computer (Computer B)

asked users what they thought about that computer (Computer A) [50]. When praised by a computer, users not only like the praise but also the computer that provides that praise [50]. It is argued that people treat "simulations of social actors and natural objects as if they were in fact social and natural" because "for nearly all of the 200,000 years in which Homo sapiens have existed, anything that acted socially really was a person."[50, p. 12]. In other words, the human brain, which has evolved over a long period of time in an environment where all perceived objects were actually real, has not yet evolved to the technology of this millennium. Consequently our brain automatically responds to communicating tools, such as computers, in a similar way as it would respond to another human being.

Since users exhibit a social behavior when interacting with their computers [50,67], it is reasonable to expect that subjects in this study will behave socially when using a DSS. That is, it is likely that subjects will treat their DSS as a social actor and thus will react to its negative feedback the same way they would react to negative feedback from a person.

3. Hypotheses

Grounded in the previous research discussed in section 2 (Theoretical lens), we develop several hypotheses. These hypotheses assert that male and female users will respond to negative evaluative feedback provided by a DSS differently. We argue that the DSS outcome feedback affects the mood as well as decision accuracy of male and female users differently.

3.1. The Impact of Outcome Feedback on Male and Female Users' Mood

The term mood refers to one's global feeling state such as every day mild experiences of feeling good or feeling bad [32]. In this section we argue that negative feedback can affect male's and female's mood differently. Our argument is based on the media equation theory [50] and social theories such as research on evaluative achievement studies [1,63] and children peer-group socialization [45]. The former suggests that people treat their computers as social actors an the latter indicates that woman attach a greater emotional value to evaluative feedback received from others [62].

Women compared to men, tend to perceive negative feedback as more negative and hence experience a greater degree of negative affect [42]. Women tend to be affected by negative feedback even when such feedback is prompted indirectly and subtly such as the presence of a background computerized tone, which was seemingly unrelated to the evaluation received during a previous task [1]. While such indirect feedback cues can impact the mood of women negatively they do not have the same effect on men [1].

Computerized outcome feedback, such as the one used in this study, provides information regarding one's accuracy of decisions, hence it is evaluative by nature. Since people treat their computers as social actors [e.g., 50,80] and since women, compared to men, tend to experience a greater degree of negative affect when received negative evaluative feedback from others [42], it is likely that outcome feedback in our study will impact the mood of female subjects more negatively than the mood of the male subjects. In particular, we argue that there will be a significant change in the overall mood of the female subjects before and after receiving negative feedback (their overall mood will be significantly less positive) but no significant difference in the overall mood of the male subjects before and after receiving negative feedback.

> H1a) *Negative outcome feedback will have a significant effect on the overall mood of female subjects, i.e., the mood score of female subjects after completing the task will be significantly lower than their mood scores before starting the task.*

> H1b) *Negative outcome feedback will not have a significant effect on the overall mood of male subjects, i.e., there will be no significant change in the mood scores of the male subjects before and after completing the task.*

3.2. The Impact of Outcome Feedback on Male and Female Users' Decision Accuracy

The DSS feedback in this study, as in prior studies [e.g., 41,56], includes information regarding the accuracy of decisions labeled as "percent error" in both feedback treatments. As the name "percent error" suggests, this feedback is framed negatively. Compared to men, women not only are more likely to respond to negative feedback [64] but also are more likely to treat such feedback as an opportunity to learn [62]. Negative feedback signals the need for changing strategies [74], hence, it requires an increase

in effort to adapt to the feedback [46]. Since women experience negative feedback as more negative [42], it is likely that female subjects, compared to their male counterparts, will try harder to adjust their strategies to adapt to the feedback. Such an increase in effort, as predicted by control theory, will in turn lead to a higher level of subsequent task performance. Since increased effort in feedback utilization will be evident in the accuracy of decisions [41], it is reasonable to argue that compared to their male counterparts, female subjects will make more accurate decisions. Moreover, the effect of gender on feedback utilization will be specifically more pronounced in the treatment where subjects receive more negative feedback:

H2a)   Decision accuracy is affected by the interaction between gender and feedback treatment.

H2b)   Women's decisions will be more accurate than men's particularly under the more negative feedback treatment.

4. Method

The study was carried out in an experimental setting. This allowed for the control (manipulation) of percent errors (feedback) given to subjects (i.e., that the percent errors in the two treatment were not only different but also significantly so). None of the subjects had prior experience with the task nor had they used the DSS that embedded the task. In order to ensure all subjects had a baseline understanding of the system, a 15-minute training session was conducted prior to the actual experiment. The training familiarized subjects with both the task and the DSS.

4.1. Participants and Design

Sixty-three business undergrad students (25 female and 38 male) from a senior business course in a major university were recruited to participate in this study. The participants were randomly assigned to two feedback treatments. The treatments were designed in a way so that their provided percent errors (outcome feedback) were significantly different. This was achieved by making it significantly harder to make accurate decisions in one of the treatments (see section 2.1 of this paper for greater details). Since

percent error is negatively framed, the feedback in the treatment with larger percent errors was more negative than the feedback in the treatment with smaller percent errors. Thus the experiment was a 2 X 2 factorial design with two levels for gender (male and female) and two levels for feedback (more negative feedback through larger percent errors and less negative feedback through smaller percent errors).

Decision tasks such as the one used in this experiment consist of several trials [11]. Subjects can improve their judgments by utilizing the provided feedback after each trial [e.g., 41,56]. Since our subjects had no prior experience with the task and thus could not rely on their expertise, they had to rely on the feedback to improve their decisions. Using senior business students with no knowledge of the task as subjects was appropriate for separating the effects of feedback from the possible effect of experience [11].

Subjects were told that the researchers were investigating the processes by which users make and improve their decisions when using a decision aid. To provide a relevant and realistic context for the experiment relevant to students, subjects were told that the decision aid used in this study was developed to help business students practice managerial decisions and that this software was being considered to be used as a training tool in the business courses.

Subjects were informed that utilizing feedback is an essential factor in making good decisions [25] and that without using the feedback a user who is not experienced in the task (such as the participants in this study) had no reasonable chance of improving his or her judgment [41]. Subjects were informed that the task consisted of 35 trials and that their task was to do their best to improve their judgments by using the outcome feedback that was provided by the DSS after each judgment.

4.2. Task Description

The task used in this study was based on Holt, Modigliani, Muth, and Simon's production-scheduling problem [27]. This problem was chosen for its cognitive complexity and managerially relevance, and for the fact that it has been used in many previous decision making experiments [e.g., 13,57,60], including a prior study examining feedback utilization [41]. In addition, actual data from a glass company was used to

calibrate the task [28]. Similar to prior studies, this task consisted of several trials and provided outcome feedback after each trial [e.g., 41,56].

The task required subjects to play the role of a plant manager. Given an uncertain future demand, the knowledge of the current work force size and productivity, subjects had to decide how many units to produce. Consistent with decision making studies that are designed to measure judgment improvement due to feedback (not due to experience or knowledge of the task) [e.g., 25,76], we used subjects who were not familiar with the task and provided them with feedback regarding their performance. This feedback consisted of the subject's decision, the optimal decision (the best decision that a subject could have made given the provided information) and the deviation of the subject's decision from the optimal decision (percent error). Subjects were instructed to use this feedback to improve their remaining decisions.

The equation modeling the production-scheduling decision used in the task was:

$$\text{Production Decision} = \beta_{02} + \beta_{12} * (\text{work force last month}) - \beta_{22} * (\text{inventory on hand}) + \beta_{32} * (\text{the current month's demand}) + \beta_{42} * (\text{the demand for next month}) + \beta_{52} * (\text{the demand for two months ahead}).$$ (1)

The coefficients (β_{ij}) in the above equation were estimated for the production-scheduling decision at Pittsburgh Plate Glass by Holt, Modigliani, and Muth [27, p. 163]. The values for these coefficients were β_{02}=148.5, β_{12}=1.005, β_{22}=0.464, β_{32}=0.464, β_{42}=0.239, and β_{52}=0.113.

Unlike the real world, the decision rule in Equation 1 represents a perfect world with no uncertainties. To mimic the real world in an experimental setting, the above equation is modified to have an embedded error term (e):

$$\text{Production Decision} = \beta_{02} + \beta_{12} * (\text{work force last month}) - \beta_{22} * (\text{inventory on hand}) + \beta_{32} * (\text{the current month's demand}) + \beta_{42} * (\text{the demand for next month}) + \beta_{52} * (\text{the demand for two months ahead}) + e.$$ (2)

The production scheduling task embedded in the DSS provided subjects with scheduling information (e.g., demand, inventory, etc.). After making their production decision, subjects entered their production scheduling decision by adjusting a slider or using a scrollbar to set their desired value. During this process, subjects were reminded to do their best through a message displayed in a small window on the bottom right corner of the screen. The participants submitted their judgments by clicking the button "I am satisfied with my current decision." Once subjects pushed this button a short history of their five most recent decisions (the production values entered by them), the five most recent optimal decisions (the production values generated by the model in Equation 2), and the five most recent percent errors of their decision were displayed. At the same time, the window that displayed the message reminding subjects to do their best was replaced by another window displaying the value of the optimal decision (the production value generated by the model in Equation 2) in a large font. This window contained a button labeled "OK to Continue", which was used to start a new set of randomly determined and statistically independent production information values. Figure 2 and 3 are screenshots of the actual system.
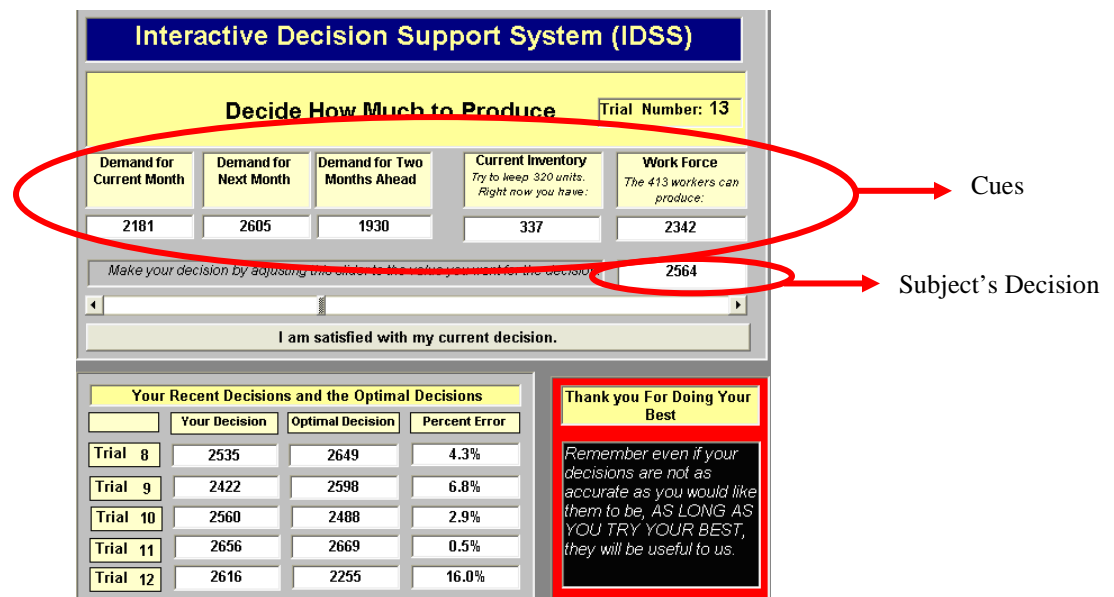

Figure 2: Sample decision screen before pressing the button "I am satisfied with my current decision"
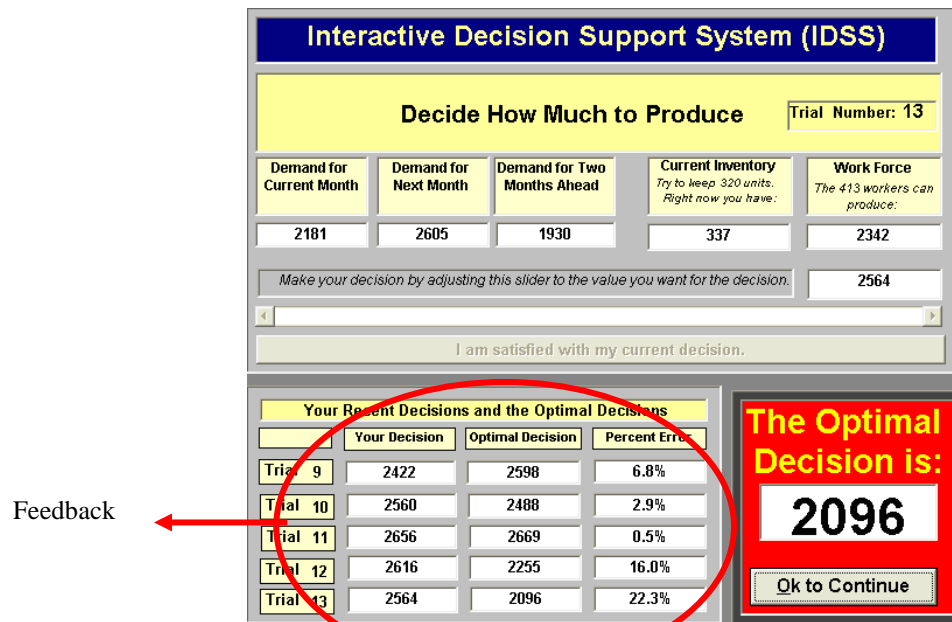
Figure 3: Sample decision screen after pressing the button "I am satisfied with my current decision"

The production scheduling task in this study consisted of 35 trials. To achieve statistically stable results the lower threshold for the number of judgments in a task with uncorrelated cues is calculated by providing five trials for each cue in the task [10,71]. Since the cues in our task were statistically independent, we used the above "5 to 1" rule to determine the minimum number of trials required in our decision making task (25 trials in our case: five trials per five cues). Many studies add extra trials to the minimum number of trials required [e.g., 59]. Similarly, we added 10 extra trials to the required minimum to bring the total to 35 trials. The upper limit for the number of trials in a decision making task is often bounded by the time available for the experiment [10,71]. Since all of our subjects completed their task within the allocated time, the selected number of trials (35) in our study proved to be a reasonable upper limit.

4.3. Treatments

As mentioned earlier, we generated two treatments by making the percent errors in one of the treatments significantly larger than the other treatment. Percent errors are negatively related to decision accuracy (i.e., larger values of percent errors signify less accurate decisions). Accuracy of a decision, on the other

hand, is positively related to predictability of a task (i.e., the more unpredictable the task the more likely to have less accurate decisions) [70,72]. Thus, one way to control the percent errors in a task is by manipulating its predictability, which is determined by the error term e added to the task equation [e.g., 40,41].

To control percent errors through error terms added to the task, we used a simulation study that generated an extensive set of error terms and their corresponding predictably levels. From this set, we chose the error term e=100 for our first treatment since this error term was used in many previous studies [e.g., 40,57-59]. This error term set the task predictability in our first treatment to 0.75. We selected the predictability level of 0.55 for our second treatment by adding the error term e=188 to its task equation. Research has shown that accuracy of decisions drop significantly when the task predictability is decreased by 0.2 points [51]. Thus, by choosing predictability levels that were 0.2 points apart, not only would our treatments have different percent errors, but also the difference in percent errors in these two treatments would more likely be significant. We verified this assumption through a pretest.

Forty-three subjects were recruited for this pretest. These subjects were randomly assigned to either the treatment with the predictability level of 0.75 or to the treatment with the predictability level of 0.55. We compared the mean of percent errors (MAPE) of subjects' decisions in the two treatments. This mean (MAPE) was determined by calculating the mean of percentages of absolute differences between subjects' decisions (decision values entered into the computerized decision aid by the subjects) from the optimal decisions (production decisions calculated by the linear model in Equation 2). The results of the t-test showed that the MAPE in the treatment with the predictability level of 0.75 (MAPE= 5.2%) was significantly smaller (df= 41, t= 4.36, p<0.001) than the MAPE in the treatment with the predictability level of 0.55 (MAPE = 8.4%). Thus, these results showed that percent errors were significantly different in these treatments (i.e., when compared to the percent errors in the more predictable task, the percent errors in the less predictable task were significantly larger). The results of the pretest also showed that subjects were able to complete the task (all 35 trials) within the one hour of allocated time.

4.4. Decision Accuracy Measurement

Decision accuracy is often measured as the deviation of a decision from a normative strategy [75]. Thus, consistent with prior research [e.g., 41,75]**,** we measured accuracy by calculating the mean of absolute differences between a subject's decision (the decision entered by the subject into the system) and the optimal decision (the value calculated by Equation 2). This mean, i.e., the mean absolute error of judgments, for a subject was obtained by calculating the mean of subject's absolute deviation from the optimal judgment for all the 35 trials in the task. It is important to note that this method of performance evaluation is often used by managers as well [44].

4.5. Feedback Measurement

As in prior decision making studies [e.g., 41,56], the outcome feedback provided in our study include, the subject's decision, the optimal decision, and the percent error of the subject's decision. The percent error of a decision is measured by calculating the percentage of the absolute deviation of a subject's decision from the optimal judgment. The feedback was provided in a numerical format (see Figure 2).

4.6. Mood Measurement

Mood is often measured using self-report surveys [19,31,35]. The mood literature suggests that positive and negative mood can coexist at the same time and that stimuli do not necessarily influence one's positive and negative mood in opposite directions [29,32,37]. Consequently, changes in mood are best captured using a bivariate space along the positive and negative subscales [37]. Such bivariate space not only allows for capturing changes in opposite directions (e.g., when a stimulus increases positive mood and decreases negative mood or visa versa), but also for other modes of activations (e.g., when a stimulus impacts either positive or negative mood but not both).

As recommended [37] and consistent with prior research [e.g., 19,22,78], we used a self-report survey to capture the mood of our subjects along the negative and positive subscales. Subjects were asked to rate on a seven-point scale (with 1 denoting "strongly disagree", 4 denoting "neutral", and 7 "strongly agree") how each of the words "glad", "annoyed", "frustrated", "happy", "pleased", and "dissatisfied" described

their current mood. The items "glad", "happy", and "pleased" were used to measure positive mood and the items "annoyed", "frustrated", and "dissatisfied" were used to measure negative mood. The same words (e.g., "glad", "annoyed") were used in previous research to measure mood [e.g., 19,34,35] and were reported to be strongly related (alpha= 0.893 for the positive items and alpha=0.892 for the negative items) [19]. We verified previous findings by testing the internal reliability of the positive and negative items on our survey. Our test of reliability also showed a strong relationship among the items on the survey (alpha= 0.89 for the positive items and alpha= 0.90 for negative items).

Similar to previous research [19], the overall or dominant affective state of subjects was determined by subtracting the average of their scores for the negative items on the survey from the average of their scores for the positive items on the survey. This overall mood score was interpreted as positive if its value was larger than zero and negative if its value was smaller than zero [19]. Since this mood score is calculated by incorporating both negative and positive mood subscales, it reflects the overall or the dominant mood of the subjects and serves as a suitable measure to detect possible changes in the overall mood regardless of whether this change is along the positive or the negative subscale.

4.7. Procedure

On the day of the experiment, as each participant arrived, they were handed a card with a randomly assigned seat number typed on it. They were informed again that the experiment would be examining the decision making process. They were further informed that the DSS they would be using was developed to practice business decision making. To motivate the subjects, they were told that this DSS was being considered for adoption in their business courses including the very course that they were attending. Subjects were encouraged to do their best. They were told that by doing their best to make a decision, whether it was accurate or not, it would provide invaluable information to the researchers and help improve the software. After a brief tutorial of the task, the subjects were asked to go to their randomly assigned computers in the lab and begin the study. Half of the subjects were randomly assigned to the

treatment with the less negative feedback (smaller percent errors) and the other half to the treatment with the more negative feedback (larger percent errors).

In the computer lab, subjects launched the DSS that embedded two practice trials, two mood surveys, and the actual task. The software was designed in a way so that participants had to complete a mood survey followed by two practice trials before they could start the actual task. After completing the task, the system presented subjects with a second mood survey. The total time to complete the experiment did not exceed one hour.

5. Results

This experiment was designed to be consistent with prior research. Hence, we used a task that had been used in many previous studies examining decision making and/or feedback utilization [41,56-58]. While the context of our experiment is similar to these prior studies, our point of view is different. Similar to these previous studies we also examine the effect of feedback on decision accuracy [e.g., 41,56], however, we extend these previous findings by including the gender of DSS users in our investigation. In other words, where previous studies examine whether feedback affects decision accuracy, we investigate whether feedback affects the decision accuracy of male and female users differently.

Before testing the hypotheses of this study we verified that the outcome feedback (percent errors) provided in the two treatments were significantly different. We compared the mean of absolute percent errors (MAPE) provided in the two treatments. The results of the t-test showed that the MAPE of the subjects in the treatment with the less negative feedback (smaller percent errors) was significantly lower than the MAPE of the subjects in the treatment with the more negative feedback (larger percent errors). Thus, consistent with the results of the pretest, these results confirmed that the feedback provided in these two treatments were significantly different (see Table1). To make good decisions users must utilize the provided cues and feedback [41]. Since decisions with 10% or less MAPEs for the task used in this study are considered to be good [41], the results displayed in Table 1 shows that subjects in our study made

good decisions. In other words, these results provide support that subjects took the time to review and utilize the provided information to make their decisions.

Table 1: Treatment Manipulation Check

	MAPE	
Treatment	Mean	Std. Dev.
Less negative feedback (smaller percent errors)	5%	0.0001
More negative feedback (larger percent errors)	8%	0.0002

df= 61, t Stat= 6.82, p<0.0001

Next we tested the hypotheses of this study. Hypothesis one (H1a and H1b) asserts that the dominant or overall mood of the female subjects will be significantly less positive after receiving negative outcome feedback (completing the task) while there will be no significant difference in the mood of the male subjects before and after receiving the negative outcome feedback. The results of the paired t-test showed that the overall mood of the female subjects after completing the task was significantly different from their overall mood before starting the task. The mood of female subjects became significantly less positive after completing the task. Our effect size analysis [9] showed that the outcome feedback had a moderate influence (d=0.46) on the overall mood of female subjects. The results of the paired t-test for the male subjects showed no significant difference between their overall mood scores before and after completing the task. These results, which support hypotheses H1a and H1b, are displayed in Table 2.

Table 2: Results of the paired t-test for the overall mood of the male and female subjects

	Female		Male	
Mood scores	Mean	Std. Dev.	Mean	Std. Dev.
Before completing the task	2.57	2.12	1.68	2.33
After completing the task	1.75	1.79	1.67	2.32

df= 24, t Stat= 2.22, p=0.04   *df= 37, t Stat= 1.52, p=0.14*

Hypothesis 2 asserts that the interaction between gender and feedback treatments affects the decision accuracy of male and female users (H2a). This hypothesis also predicts that female subjects, compared to

their male counterparts, make more accurate judgments and that the gap between the judgment accuracy of male and female subjects is greater in the more negative feedback treatment (H2b).

As recommended [4], we used ANOVA to test for the possible interaction between feedback treatments and gender (H2a). The results of the ANOVA showed significant interaction (f= 5.85, p=0.02, Adj R^2 = 0.48) between gender and feedback treatments, thus, supporting H2a. Since feedback utilization is evident by decision quality [41], as recommended [4], we conducted two more tests that compared the decision accuracy of male and female subjects for each treatment separately. The first t-test compared the decision accuracy of the male and female subjects in the less negative feedback treatment. The second t-test compared the decision accuracy of the male and female subjects in the more negative feedback treatment. Contrary to what was expected, the results of our first t-test did not show a significant difference between the accuracy of the judgments of male and female subjects in the less negative feedback treatment. However, the results of our second t-test showed that female subjects made more accurate decisions than male subjects in the more negative feedback treatment. These results showed that the more negative feedback had large effect (d=0.89) on the decision accuracies of male and female subjects [9, p. 26]. These results, which supported H2b partially, are displayed in Table 3.

As in prior research [41,75], accuracy of the decisions was measured as the mean absolute of the judgments. To determine decision accuracy for a subject, first the absolute difference between the optimal decision (derived from Equation 2) and the value of the judgment made by the subject (the decision value entered into the DSS by the subject) for each single decision was calculated. Then, the mean of these absolute differences for all the trials in the task (35 decisions) were computed. Since accuracy measures the mean of absolute deviations from the optimal decision, the smaller its value the more accurate the judgment.

Table 3: Results of the t-test for decision accuracy

Treatment	Gender			
	Male		Female	
	Mean	St. Dev.	Mean	St. Dev.
Less negative feedback (smaller percent errors)	127.47	19.52	135.74	33.37
	df=29, t Stat= 0.878, p=0.40			
More negative feedback (larger percent errors)	199.97	41.45	169. 37	26.73
	df=30, t Stat= 2.40, p=0.02			

6. Discussion

The results of this study showed that the overall mood of the female subjects was significantly different before and after completing the task. The results also showed that there was not a significant difference in the overall mood of the male subjects before and after completing the task. These results, which support H1a and H1b, are consistent with the literature discussed in this paper [62,64] and suggest that female subjects were more influenced by the provided outcome feedback than male subjects.

Further, the results showed that the negatively framed outcome feedback was utilized differently by the male and female subjects. This is similar to Rudawsky, et al. [65] which revealed that negative feedback is perceived as more negative by women than men. While our results did not show a significant difference in feedback utilization, measured by the accuracy of decisions, between male and female subjects when the feedback was less negative, they did show a significant difference between female and male subjects when the feedback was more negative.

One way to explain why there was no significant difference in feedback utilization between male and female subjects in the less negative feedback treatment is that the feedback in this treatment, despite its negative framing (percent error), may have been interpreted by our subjects as positive. The percent errors in the less negative feedback treatment were significantly smaller than the percent errors in the more negative feedback treatment. It is possible that the smaller values of percent errors in the less negative feedback treatment were viewed by our subjects as small enough to be interpreted as success hence signaling positive feedback. Since both men and women respond to positive feedback [62,64], it is

reasonable to argue that in the less negative feedback treatment, male and female subjects both utilized the provided feedback in the same way and hence there was no significant difference in their performance. In the more negative feedback treatment, however, the percent errors were significantly larger than in the less negative feedback treatment. Thus, it is reasonable to argue that the negatively framed feedback in this treatment was indeed interpreted as negative by our subjects. Women interpret negative feedback more negatively than men [42]. They are also more receptive to negative feedback than their male counterparts [62]. Thus, it is likely that the outcome feedback in our study captured the attention of our female subjects more than it captured the attention of our male subjects. As a result, female subjects used the DSS feedback significantly more than their male counterparts in the more negative feedback treatment, while they did not use the feedback significantly more than the male subjects in the less negative feedback treatment.

Our results showed that the outcome feedback did not impact the overall mood of male subjects, while it did impact the overall mood of the female subjects. One can argue that these results indicate the possibility that male subjects did not engage in the task as female subjects did. To investigate this issue further, we conducted two post hoc analyses.

In the first post hoc analysis, we compared the feeling states of male and female subjects after completing the task along the positive and negative subscales using two t-tests. The results of the t-test comparing the mood scores of male and female users along the positive subscale after completing the task showed no significant difference between these two groups of users. The t-test comparing the mood of male and female subjects along the negative subscale, however, showed a significant difference between the mood score of male and female users after completing the task. These results are consistent with prior studies that show women have more negative feelings than men after receiving negative feedback [42]. These results are also consistent with the findings of previous research on gender and feedback cues which showed that the mood of men and women was affected differently by the negative feedback cue (rejection cue) along the negative subscale but not affected differently along the positive subscale [1]. It is important

to note that our first post hoc analysis replicated the analysis in previous research on gender and feedback cues [1] by comparing the mood of subjects after completing the task. To further refine this analysis, we conducted a second post hoc analysis. In this analysis we compared the impact of the feedback on the positive and the negative mood subscales of male and female subjects by comparing these mood states before and after completing the task (paired t-test).

In addition to confirming the results of the first post hoc, the second post hoc revealed additional information about the impact of the outcome feedback on subjects' mood along the positive and negative subscale. For example, the results showed that the mood of male subjects before and after completing the task was not significantly different on the positive subscales. The mood of female subjects on the positive subscale, however, was significantly different before and after the task. In other words, the results showed that male subjects did not feel any less glad, happy, and pleased before and after the task. Female subjects, on the other hand, did feel significantly less glad, happy, and pleased after the task.

Moreover, the results showed that the mood of both male and female subjects were affected by the feedback on the negative subscale, i.e., both male and female subjects felt significantly more annoyed, frustrated, and dissatisfied after completing the feedback. It is important to note that our results showed that the overall mood (calculated as the averaged differences between the positive and negative mood) of male subjects was not affected by the DSS feedback. In other words, the change in the negative subscale of the male subjects was not strong enough to affect their overall mood. The DSS feedback, however, not only increased the negative mood of the female subjects (increase along the negative subscale) but also decreased their positive mood (decrease along the positive subscale). The effect of the feedback, in this case, was strong enough to impact the overall mood of the female subjects. These results, once again, confirm prior research suggesting that negative feedback leads to greater negative feelings for women [42]. It is also important to note that the results of the post hoc showed that while feedback (stimulus) changed the positive and negative mood subscales of the female subjects in an opposite way (i.e., increased the negative mood and decreased the positive mood) it did not affect the mood of male subjects

in a similar way (it did not change the mood of male subjects along the positive subscale but it increased their mood along the negative subscale). These results are consistent with the mood literature that suggests positive and negative moods are not necessarily affected by stimuli in opposite symmetrical directions [29,32,37]. Moreover, these results reveal that feedback impacts men and women's moods along positive and negative subscales differently. While the impact on the negative subscale was not enough to change the overall mood of the male subjects, the change in the negative subscale suggests that male subjects did engage in the task.

In short, the results of this study are consistent with the literature discussed earlier and show that men and women respond to and utilize a DSS differently. The results suggest that women are more significantly influenced by the negatively framed outcome feedback than men. They also use the outcome feedback significantly more than men when it is more negative. While effective in capturing women's attention, this feedback impacts the overall mood of female users in a negative way. Although our results show that the outcome feedback does not change the overall mood of the male users, our post hoc analysis provide evidence that outcome feedback can increase the negative mood of the male users. Changes in mood of DSS users have important theoretical and practical implications which will be discussed in the final section of this paper.

7. Limitations and Future Research

As with all experimental studies, the generalizability of our results is limited by the laboratory setting and the task used. Laboratory experiments facilitate more precision in controlling, manipulating, and measuring the desired variables [69,73]. However, care must be taken when generalizing their results. We reduced the possible threats to external validity by designing our experimental setting to capture relevant aspects of real decision tasks. Moreover we calibrated the task by real world data. Nevertheless, future experiments using different tasks are needed to increase the confidence in generalizability of these results.

The generalizability of our results is also limited by the use of student subjects. Although our subjects were all business students training to become managers, they were not experienced in the task. The

objective of this study was to investigate whether men and women use computerized feedback differently. Subjects, in this study, were required to use the provided feedback (not their experience) in order to improve their decisions. In such situations, students who are not experienced in the task serve as suitable subjects [11,73]. Thus, the results of this study are applicable to decision makers who are not familiar with a task, such as those entering the workforce, learning a new task, or adopting a new DSS. Future studies, however, are needed to examine whether experience can mediate the gender effects on feedback utilization observed in this study.

Another interesting possible future expansion of this research is to investigate the impact of gender on feedback utilization when the feedback contains different characteristics. For example, it is important to investigate whether other types of feedback (such as task feedback or cognitive feedback) [3,41] also impact men and women differently. Moreover, men and women may prefer their feedback in a different format. For example, they may respond differently if the provided feedback is textual-based as oppose to the numerical data presented in this study. Greater insight into the differences in how men and women prefer to receive computerized feedback would be valuable to DSS designers when designing feedback mechanisms. Moreover, users' moods may serve as a useful factor in software process improvement models, such as the capability maturity model [52]. For example, investigating the relationship between maturity, gender, and feedback may provide more detailed guidelines for developing timely and cost effective quality systems [18].

Moreover, future experiments can clarify other factors that may influence the results observed in this study. For example, future experiments can investigate whether the number of trials can weaken or strengthen the results obtained in this study. For example, whether the discrepancies in decision accuracy of male and female subjects persist or dissipate if they are given more opportunities (decisions) to improve their judgments.

The impact of gender on feedback utilization can also be studied in the framework of technology acceptance [12]. Given that negative mood can have a lasting negative impact on acceptance behavior

[79] and given the results of this study showing that negative feedback can affect male and female users' mood differently, it is important to investigate the impact that feedback may have on the acceptance behavior of male and female users.

8. Conclusions and Implications

It is often assumed that conventional computer-based feedback, such as the one provided in this study, is impersonal and thus does not capture users' attention [41]. Our results showed that such conventional computer based feedback affected men and women differently. Our results suggest that female subjects, compared to their male counterparts, under the more negative feedback treatment tried harder to adjust to the feedback and consequently made more accurate decisions. Since effort and accuracy have been the primary measure of DSS usage in the literature [15,75], our results suggest that that feedback may be a factor that can influence how a DSS is used by men and women. Thus, our results provide support for establishing gender as an important variable in existing decision making and feedback models and contribute to the DSS literature by providing the rationale and theoretical direction for examining the role of gender in other types of feedback.

The results of this study have also important implications for DSS interface design. Our results suggest that the utilization of negatively framed outcome feedback is influenced by the gender of users. Thus, these results highlight the importance of personalized feedback mechanisms, which can potentially help users to utilize a DSS more effectively. For example, through personalized feedback functions, such as personalized software agents [36,38], users can specify how they wish to receive their feedback.

The results of our study showed that while the negatively framed DSS feedback captured female users' attention, it caused their overall mood to become less positive. Moreover the post hoc analysis showed that outcome feedback increased the value of self-reported mood scores of both male and female users along the negative subscale. These results are particularly important to DSS research since negative mood is shown to create negative impressions and thus affect the acceptance and usage of a technology negatively [79]. Consequently, paying attention to how feedback influences an individual's mood can

have a significant impact on how a DSS is accepted and used by both male and female users. Since IT is a vital factor in a firm's competitiveness in today's business environments, investing in ways to improve acceptance and effective DSS usage are of great interest to organizations. Our results imply that organization can greatly benefit from the early engagement of users in purchase or design of software applications. Users need to be included in the feedback design and implementation phases of DSS development. In particular, DSS designers may benefit from prototyping the feedback since this method can help them to gather valuable information regarding users' reaction in various stages of development.

The impact of feedback on mood has also broader implications for organizations. Literature suggests that positive mood can influence employees' behavior in the workplace [21,30]. The result of our study showed that the DSS feedback caused our female users to feel less positive after completing the task. Since women will make up about half of the employee population in a near future [77], these results have important implications for organizations. There has been evidence that positive mood improves quality of decisions [69] and enhances one's ability to be both an efficient and thorough decision maker [32]. For example, physicians in a positive mood, when diagnosing cancer on a busy day in a busy hospital, not only were more flexible and open in integrating new information but also were more efficient and thorough than their control counterparts [20]. Positive mood can also enhance productivity and work quality in other ways. For example, positive mood at work is shown to reduce absenteeism [23], and foster pro-social behavior [24]. The cooperativeness fostered by positive mood [33] is particularly important to organizations that rely on teams and require employees to build team based structures. Cooperative and pro-social behavior is also important to human resource departments and to employee and customer direct contact. Finally, literature suggests that employees' positive mood has a spiraling effect that can spread through their organization and foster lasting positive organizational outcome [21]. Consequently, paying attention to factors that can impact employee's positive mood (such as DSS feedback) should be of great interest not only to DSS designers but also to managers.

Our results showed that the outcome feedback affected the mood of male and female users differently. The outcome feedback was also used differently by male and female decision makers. Using profile information which is readily available to managers, organizations can arrange training and other interventions (e.g., policies or reward systems) to encourage that the DSS feedback is appropriately interpreted and used by their users. Targeted trainings that emphasize the different gender-based styles of feedback utilization may help decision makers to become aware of their "gender tendencies" and thus support them in increasing their feedback utilization. Training may also help to reduce the negative impact feedback has on users' moods (the increased levels of negative mood as observed in the post hoc analysis), which in turn have been found to have harmful impact on acceptance and usage of an IT [79]. Targeted trainings that focus on gender differences in feedback utilization may help to avoid building such unfavorable impressions of a DSS and thus help to ensure that the system is well received by its users.

In short, the results of this study contribute to the DSS literature by examining the role of gender in utilizing computerized feedback. These results have important implications for decision making and feedback models since they extend our understanding of the effects of gender on the relationship between feedback and its utilization. These results also contribute to DSS design since they help to better understand how people interact with a DSS. Furthermore, they provide additional support for the importance of user analysis and acceptance in the early stages of the DSS development and implementation process. Moreover, the results provide managers with additional insight that can help to improve effective IT utilization. The results regarding employees' mood are not only highly relevant to DSS design, but also to management practices since mood has been shown to have significant impact on employees' behavior.

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