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Gender, Feedback, and Decision Making: How Men and Women Differ on the Use of Computerized Feedback?

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ABSTRACT

This study examines the impact of gender on the utilization of computerized feedback. By comparing the decision making process of men and women using a computer-based managerial decision system, the results of this study show that women use the feedback provided by their systems more effectively. This is relevant to HCI's focus on the ways humans interact with information, technologies, and tasks. In particular, this study explores the production decision making process of men and women using a computer-based managerial decision system.

Keywords

Gender, Feedback, Feedback Utilization, Decision Making, HCI, Judgment

INTRODUCTION

Although research has shown that feedback utilization can impact the quality of decisions when using a decision support system (Lim et al., 2005), no work has been done to examine whether gender can influence the utilization of such feedback. Examining the role of gender in utilization of computerized feedback is particularly important since research has shown that men and women respond to feedback differently (Baldwin, Granzberg, and Pritchard, 2004; Roberts 1994; Roberts, 1991). Using sociological and psychological perspectives on gender as well as the findings of prior studies, we examine whether gender can influence the effective usage of feedback in a computerized managerial game. We expect to see that our female subjects use the feedback more effectively (take it more seriously) and thus make more accurate judgments.

As with many HCI studies, this research studies the ways in which people differ in their interactions with information technology. Specifically, it focuses on the ways men and women differ in their interactions with a software-based managerial decision making tool. The results of this research will help software creators and managers better understand how men and women react to feedback given via computer.

LITREATURE REVIEW

According to control theory (Campion and Lord, 1984), individuals' feedback utilization is influenced by their desire to minimize the disparity between accepted goals and standards and their actual behavior. While, effort is expected to stay stable when feedback indicates that the goals have been met (or exceeded), effort often increases when feedback indicates otherwise (Matsui et al., 1983). In other words, when current behavior is not successful, individuals change their strategies to adapt their performance to feedback (Taylor et al., 1984).

Research also indicates that gender may have an impact on feedback utilization. For example, there is evidence that women are more susceptible to the effects of feedback (Kast and Conner, 1988). Roberts and Nolen-Hoeksema (1990) found that women responded more to evaluations they received from others than did men. Further, women were equally influenced by positive and negative feedback. On-the-other-hand, men were influenced more by positive feedback and appeared to ignore negative feedback (Roberts and Nolen-Hoeksema, 1990). This is consistent with a number of studies (Pittman, Davey, Alafat, Wetherill, and Kramer, 1980; Ryan, 1982) which found that women view feedback as controlling while men find it merely informative.

Some have attributed these dissimilarities to differences in gender socialization. In fact, the social role theory asserts that gender differences in social behavior exist as a result of individuals acting in accordance with their social norms (Eagley, 1987). This is consistent with the early socialization model (Maccoby and Jacklin, 1974), which states that men and women undergo different socialization experiences whereby each learns gender-appropriate patterns of behavior. Boys encounter higher levels of negative feedback in their peer-groups than do girls. Interactions among boys tend to include aspects of dominance and power struggle (Maltz and Borker, 1983). Boys use threats, refusals, and demands much more than girls do when interacting. Thus they may learn to become some what immune or impervious to negative feedback and more self-assertive and aggressive (Marshall, 1984; Powell, 1988). Alternatively, girls' interactions within their peer-groups tend to be more communal, cooperative and polite (Block, 1983). They learn to be less aggressive and assertive (Greenspan, 1983). For example, girls are more likely to agree by consensus on a game to play, while boys are more likely to "fight it out". A dominant boy may "convince" the others what game is best to play.

The social role theory is further supported by Roberts (1991), who asserts that under instances of evaluative achievement situations, men are likely to "respond to the competitive nature of evaluative achievement and hence to adopt a self-confident approach that leads them to deny the informational value of others' evaluations. Women may be particularly likely to approach such situations as opportunities to gain information about their abilities" (p. 397). Thus men, socialized within a more combative peer-group, see the situation as a challenge and resort back to being less impervious to criticism. Alternatively, women, socialized in a more cooperative peer-group environment, are more likely to see the situation as an opportunity to learn more about themselves and their abilities. Thus they become more open to the feedback.

The above discussed studies provide evidence that men and women differ in utilizing feedback. However, little work has been done to examine the impact of gender on utilization of computerized feedback. The significant role of computers in today's business environment and the importance of feedback in decision making call for scientific examination of factors that can impact the effective usage of computerized feedback. This study addresses this need by examining the impact of gender on feedback utilization of a managerial decision support simulation. In other words, we examine whether gender can influence the way in which a person uses computerized feedback. The results of this study have important implications for HCI since they help to better understand how people interact with computers. They also add to the gender research because they extend our understanding of how gender affects decision making when computerized feedback is involved.

Based on the above research, our question of interest is: *Does gender influence the ways in which a person uses computerized feedback to make decisions?*

HYPOTHESIS

Results from previous evaluative achievement studies (Baldwin, Granzberg, and Pritchard, 2004; Roberts 1994) and children peer-group socialization research (Maltz and Borker, 1983) reveal that gender does play a part in a person's acceptance and use of evaluative feedback. Given these findings, it is reasonable to argue that female participants, compared to their male counterparts, will utilize the feedback provided by the computerized managerial game more effectively. Since the evidence of effective feedback utilization is reflected in decision quality (Lim et al., 2005), it is reasonable to argue that female participants will make significantly more accurate judgments. We, thus, *hypothesize that females will make more accurate decisions than males.*

METHOD

The study was conducted in an experimental setting to control for feedback. A regression model was employed, where the independent factor was gender and the dependent factor was accuracy of judgment. A brief 15-minute training session was performed prior to the actual experiment in order to familiarize subjects with the task and software. This ensured that all subjects had a baseline understanding of the system.

Participants

Thirty two business undergraduate students (14 female and 18 male) in a land grant university were recruited to participate in this study. The subjects were recruited from a third year course required of all business undergraduate students. Participants were rewarded with points towards their final course grade. The recruits were informed that the study would involve a decision making task which would help further the researcher's work in decision making. All agreed to participate. None of the participants had any prior experience with the task.

Task

The task used in this experiment was a Multiple Cue Probability Learning (MCPL) task, which is often used to study decision behavior in a laboratory setting (Brehmer, 1998). In a MCPL task decision makers make a judgment about something they cannot see (a criterion) based on a set of data that they can see (cues) (Brehmer, 1998, Hammond, 1975). The MCPL tasks consist of several trials, through which decision makers learn to improve their judgments by utilizing the provided feedback.

The feedback provided by the computerized managerial task in this study consisted of a short history of the 5 most recent decisions (see Figure 2): a) subject's decision (the decision value entered by the subject to the system), b) the optimal decision (the best decision that could have been made given the provided cue values), and c) percentage error (the accuracy of decisions expressed as percentage of deviation from the optimal decision). To improve their decisions subjects were instructed to use the feedback to adjust their decision policy (adjust the policy they use to combine the provided cue values into a single decision). Subjects were told that a good decision is one that has a small percentage error. In other words, they were instructed to pay careful attention to their percentage error. In the case of a small percentage error (when they made a good decision) subjects were instructed to keep applying their decision policy to the remaining trials. If their percentage error was not small subjects were advised to reevaluate their decision policy. In other words, subjects were instructed to pay attention to the value of percentage error to adjust their policy accordingly and make good decision by keeping this value small (within a few percent points). Subjects were given a few demonstrations of what constitutes a good and a not so good decision. For example, a percentage error of 2.9 was pointed out as the indicator of a good decision while a percentage error of 14. 5 was not as good of a decision.

The task used in this study was based on Holt, Modigliani, Muth, and Simon's (1959) model of the production-scheduling problem. The production-scheduling problem was selected because it is a cognitively complex and managerially relevant problem, Judgment tasks, like the one used in our study, are often used to measure how judges learn to improve their judgments (e.g., Lim et al., 2005). Thus, this type of task is appropriate for students who have no prior experience with the problem (Swieringa and Weick, 1982, Cooksey, 1996). Furthermore, this task has been calibrated with actual data from a glass company (Holt et al., 1960) and has been used in many prior studies (Lim et al., 2005, Remus, 1987, Lim and O'Connor, 1996).

To motivate subjects to do their best, subjects were told that the decision aid used in this study was designed to help students to practice decision making, i.e., it was designed to be used in business courses (including the very course they were attending).

There were 35 trials in this experiment. In each trial, the subjects were provided with five cues: the current month's demand, the demand for next month, the demand for two months ahead, current work force size, and inventory on hand (see Figure 1). Based on this information subjects had to decide how many units to produce. After the subjects entered their production decision into the system, the system provided subjects feedback regarding their performance. The feedback provided by the system included the optimal decision (the best decision that subjects could have made using the provided cues), the subject's decision (the decision value they entered into the system), and the discrepancy between the subject's decision and the optimal decision in form of percentage of error of the subject's judgment (outcome feedback) (see Figure 2). Subjects were instructed that in order to make good judgments they needed to learn from the provided feedback and to utilize it effectively.

The production-scheduling decision in this study was modeled through the following equation:

$$\text{Production Decision} = b_{10} + b_{11} * \text{(work force last month)} - b_{12} * \text{(inventory on hand)} + b_{13} * \text{(the current month's demand)} + b_{14} * \text{(the demand for next month)} + b_{15} * \text{(the demand for two months ahead)} \tag{1}$$

The coefficients for the above model were estimated for the production-scheduling decision at Pittsburgh Plate Glass (Holt et al., 1956, p.163). The coefficients values were b_{10}=148.5, b_{11}=1.005, b_{12}=0.464, b_{13}=0.464, b_{14}=0.239, and b_{15}=0.113.

The decision rule described in Equation 1 describes a perfect world. To mimic the real world in an experimental setting, an error term is generally added to the above equation (e.g., Lim et al., 2005, Lim and O'Connor, 1996, Remus and Kottemann, 1987). Consistent with prior research the error term added to our linear model was normally distributed and randomly generated. This error term had a mean of zero a standard deviation 188.

$$\text{Production Decision} = b_{10} + b_{11} * \text{(work force last month)} - b_{12} * \text{(inventory on hand)} + b_{13} * \text{(the current month's demand)} + b_{14} * \text{(the demand for next month)} + b_{15} * \text{(the demand for two months ahead)} + e \tag{2}$$

The participants were asked to play the role of a production plant manager, use the provided information (cues) and set the current production level. The task was presented to the subjects via desktop computers. The participants made their judgments by adjusting a slider or using a scrollbar to set their desired value. A small window on the bottom right corner of the screen displayed a message to motivate subjects to do their best. A judgment was submitted by clicking the button "I am satisfied with my current decision." Once this button was pushed the subject's judgment (the production value they entered into the decision aid), the optimal judgment (the production value generated by Equation 2), and the percentage error of the subject's judgment (outcome feedback) was displayed in a dedicated section of the screen. A short history of the subject's five most recent judgments along with their corresponding optimal judgment (the value generated by Equation 2) and the percentage error (outcome feedback) were also displayed. At the same time, a window displaying the value of the optimal judgment (the production value generated by the model in Equation 2) replaced the motivational message. A button labeled as “OK to Continue” was also displayed at this time. This button was used to start a new trial, i.e., a new set of randomly determined and statistically independent cue values. The task was designed in a way to prevent subjects from accessing previous screens or changing their previous judgments. Figure 1 and 2 are screenshots of the actual system.

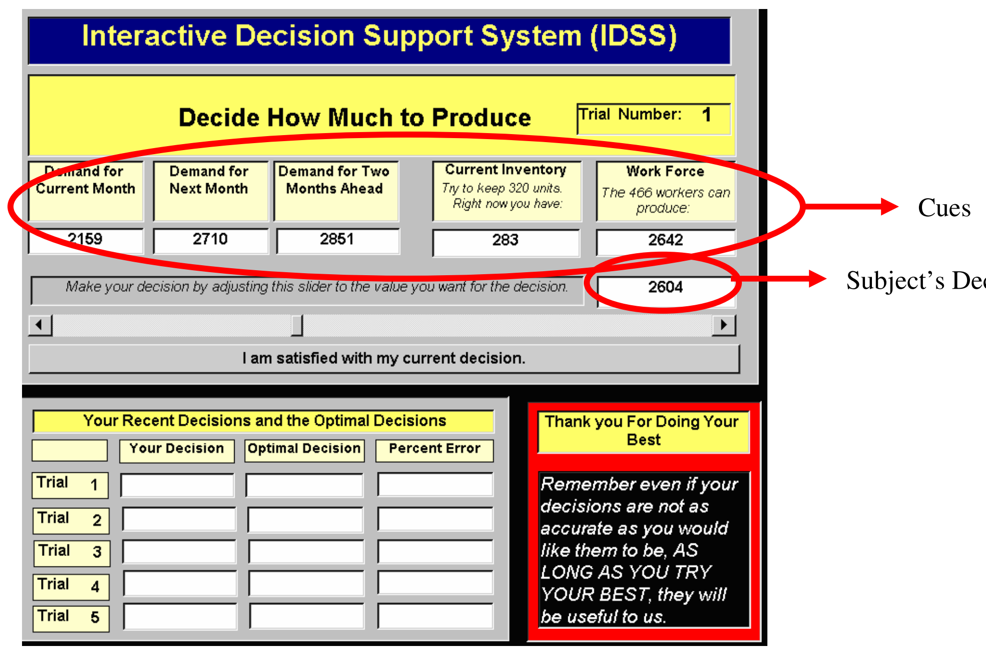

Figure 1: Sample decision screen before pressing the button “I am satisfied with my current decision”

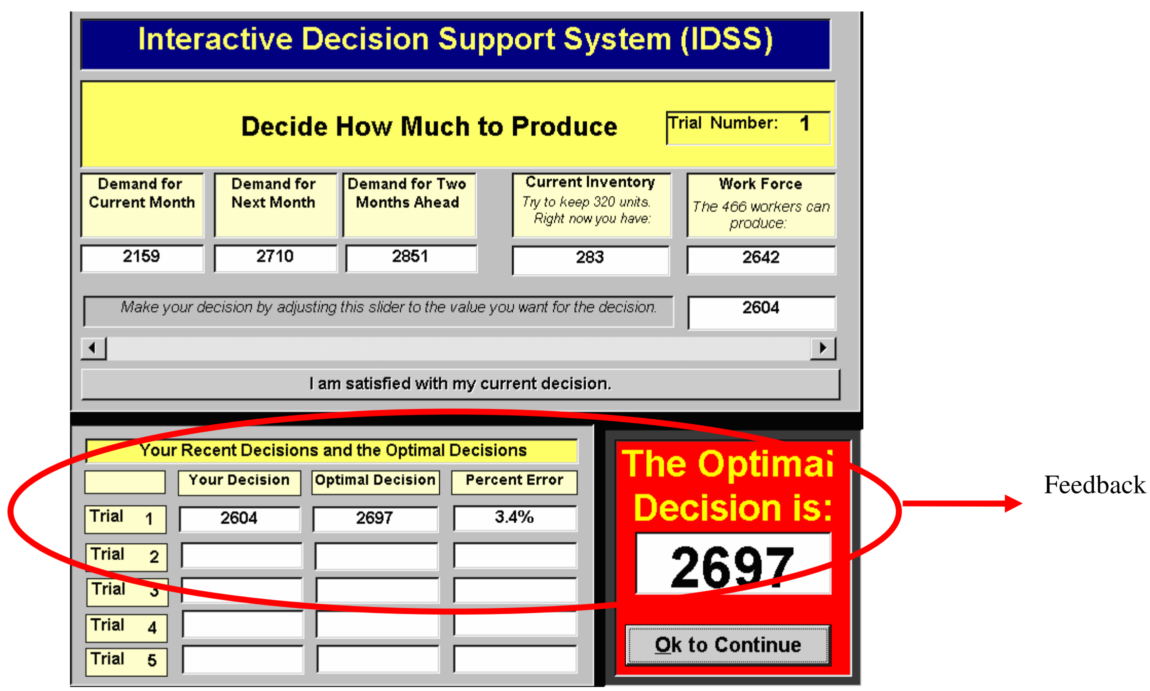

Figure 2: Sample decision screen after pressing the button “I am satisfied with my current decision”

Measurements

Accuracy of a decision is often operationalized as the deviation of a decision from the decision provided by a normative strategy (Todd and Benbasat, 1992, Lim et al., 2005). Consistent with prior research (Todd and Benbasat, 1992, Lim et al., 2005) accuracy was measured by calculating the deviation of subject's judgments from optimal judgments. in other words, For each subject, the mean of absolute differences between subject's production decisions and the optimal production decisions in trials 1 to 35 were calculated. These means of absolute differences or errors were then used to compare the accuracy of decisions between the female and male decision makers. It is important to note that this metrics is often used by managers to measure performance (Makridakis, 1993).

Procedure

On the day of the experiment, the participants gathered in their classroom. Upon arrival, the subjects received a card with a randomly assigned seat number typed on it. Subjects were informed that this experiment investigated decision making. They were told that the software package that they were about to use was designed to practice managerial decision making. Subjects were told that this software could be adopted in their business courses including the very course they were attending.

To motivate subjects to do their best, they were told that by doing their best to make a decision, whether accurate or not, they would provide invaluable input for the investigations at hand and will help to improve the software package. The subjects were given a short tutorial of the task. Subjects were instructed that in order to make good decisions they would need to utilize the provided feedback. Subjects were told when the outcome feedback (percentage error) is within few percent, it indicates that a good decision was made. After the tutorial, the subjects were then asked to go to their designated computers in the computer lab and begin.

In the computer lab, the subjects activated the software package that included two practice trials and the actual task that consisted of 35 trials. The software was designed in a way that participants had to complete the practice trials before they could start the actual task. After finishing the task, the subjects were debriefed and asked to leave the room. The entire procedure did not exceed one hour.

RESULTS

To make good judgments decision makers have to utilize the outcome feedback provided by the decision support system. In other words, the more effectively they utilize the feedback the better their decisions will be. Consistent with prior research (Lim et al., 2005) effective feedback utilization was measured through accuracy of the judgments. As in prior research (Todd and Benbasat, 1992, Lim et al., 2005) decision accuracy was measured as the deviation of subjects' judgments (the decision values they entered into the system) from the normative strategy (the decision value generated by Equation 2).

In judgments tasks, like the one used in this study, subjects learn to improve their performance by utilizing the provided feedback. Literature suggests that subjects use the first trials (roughly 12 trials) to adopt a strategy (Remus, 1984, Remus, 1987, Remus and Kottemann, 1987). In other words, if the feedback is effective, it is expected to have improved performance after initial trials (roughly 12 trials). To assess changes in the performance of a judgment task, it is customary to examine subjects' performance in blocks of trials (e.g. Gillis, 1975). To verify that the feedback provided by the system helped the subjects to improve their judgments we divided our 35 trial task into two blocks of 15 and 20 trials and compared the performance between these two blocks. The results of the one tail paired t-test showed that the accuracy of the subjects' judgment (measured as the mean absolute error (MAE) of judgments) in the first 15 trials (MAE =197.45) was significantly lower (df=31, t=1.80, p=0.04) than the accuracy of the judgments in the last 20 trials (MAE=178.43). these results are consistent with prior research (Remus, 1984, Remus, 1987, Remus and Kottemann, 1987), which indicates that the first trails are used to adopt a decision strategy and thus performance improves after these initial trials. Moreover, these results verify that the provided feedback was effective (i.e., if the feedback was not effective or accurate it would have been unlikely to observe improved performance in the second block of trials).

Our hypothesis asserts that female subjects use the provided feedback more effectively than their male counterparts. Since effective feedback utilization is evident by decision quality (Lim et al., 2005), we used the following regression model to analyze our experimental data:

$$MAE = b_0 + b_1 * GEN \quad (3)$$

In the above equation MAE is the variable representing the mean absolute error of judgments (the deviation of subjects' judgments from the normative strategy). GEN is a dichotomous variable representing subjects' gender (0 for male and 1 for female).

The results of the regression analysis showed that 16% (R2=0.16) of variation in the above equation is explained by the variable GEN and that this variable was significant (b_1= -30.61, t=-2.40, p=0.02).

The results of the t-test revealed that the mean of the absolute error for female subjects (MAE = 169.37) was significantly lower (t = 2.40, df = 30, p = 0.02) than the mean of the absolute error for male subjects (MAE = 199.97). The results of a second t-test revealed that the mean percentage of error (MPE) for female subjects (MPE=6.8%) was also significantly lower (t = 2.33, df = 30, p = 0.01) than the mean percentage of error for the male subjects (MPE=8.1%).

The results of the regression analysis and the t-tests show that female subjects made significantly better judgments. In other words, these results show that female subjects utilized the provided computerized feedback more effectively.

DISCUSSION

The result of this study showed that female subjects, compared to their male counterparts, utilized the computerized feedback significantly more effectively. As Kast and Conner (1998) asserted, women were more affected by feedback and, as posited by Roberts and Nolen-Hoeksema (1990) they responded to that feedback more than men. The results of this study also lend further support to the social role theory (Roberts, 1991) which asserts that men, being more competitive, would adopt a more self-confident approach when viewing feedback and would be less accepting of self-critical information (feedback). Women on-the-other-hand appeared to act inline with this theory. They tended to treat the feedback as an opportunity to learn more about themselves and were more willing to internalize and apply the feedback to future decisions. These results enhance research in both the HCI and gender domains by highlighting the gender affect on decision making when computerized feedback is involved.

Limitations and Future Research

For this initial study it was important to have a controlled environment to reveal if there were any effects of gender on feedback utilization of a computerized decision aid. The need to control for confounding variables led to our using a lab setting with student subjects. A future study would expand the research into actual computerized decision making tools used by professional managers. This would add greater depth to the current research and extend it into a real-world setting. Another interesting area for future research is to investigate how the computerized feedback is presented. It is possible that the "tone" or visual presentation of the feedback may affect men differently than women. For example, men may prefer textual-based feedback to graphical data or the reverse. This certainly would add to the insight into how creators of computerized decision tools develop the feedback mechanisms.

The generalizability of the result of this study is limited by the use of subjects who were not experienced in the task. The objective of this study was to investigate the impact of gender on the utilization of feedback provided by a decision aid. Thus, subjects were required to use the feedback provided by the decision aid (not their experience) in order to improve their judgments. Thus, the results of this study are applicable to decision makers learning a new task or adopting a new decision aid. Future studies, are needed to examine whether experience can mediate the gender effects on feedback usage observed in this study. Moreover, future studies can examine other possible mediating factors such as computer self efficacy.

Conclusions and Implications

Given the results of this research, the answer to our research question would be yes! Gender does play a role in how people accept and use computerized feedback. Women make better decisions than men when computerized feedback is provided. Given these gender differences it would make sense for people designing decision support systems to keep their targeted users in mind. Are they predominantly male or female? Could feedback be personalized? For example, personalized menus could be provided that allow users to choose how they would like their feedback to be presented to them. Perhaps the feedback would be better accepted and utilized if presented in a positive form rather than a neutral or negative one. Our results emphasize the importance of user involvement during the design process and particularly in the feedback design phase of development.

There may also be implications for organizational groups or teams who use computerized-based tools. Although this research did not focus on group-based decision making tools there is research into mixed-gender groups, which supports the idea that men and women differ in how they respond to negative feedback (Karakowsky and Miller, 2002). Reinforcing the social role theory, the group-based research found that men attempt to control the environment, while women tend to seek group harmony.

Also, our results may provide additional insight for managers. By paying attention to gender differences, managers could potentially encourage and/or emphasize the importance of feedback utilization by establishing policies and/or reward systems.

It may be possible to establish training sessions on the computerized-decision making tools, which emphasize the different gender-based styles of feedback utilization. This would allow male and female decision makers to make more effective and enlightened decisions, since they would better understand how they perceive computerized feedback, given their "gender tendencies."

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