THE PARADOXICAL EFFECTS OF FEEDBACK AND REWARD ON DECISION PERFORMANCE

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ABSTRACT

Decision support systems (DSS) are used to help employees make good decisions. A primary area of focus in DSS design is system usage. Feedback, a system characteristic, has been found to influence system usage and create a favorable experience for users. We extend Ryan et al.'s (1983) study on the interaction between feedback and reward to a DSS context. Our findings indicate a differential effect from their study when feedback is provided through a DSS and the focus is on decision performance rather than the precursor condition of intrinsic motivation.

INTRODUCTION

In many organizations, decision support systems (DSS) are being used to help employees or decision makers make good decisions [22]. An important consideration with such systems is continued system usage [32]. Past research has examined the influence of characteristics of the system [e.g., 30] on user behavior. For instance, feedback has been found to influence systems

usage [20] and create a favorable user experience [32]. Similarly, a user's experience of interest when performing a task has been found to be a primary motivator for performance [28].

Ryan et al. [26] studied the influence of feedback and reward on intrinsic motivation. Intrinsic motivation was found to maintain or increase if a reward is perceived to provide competence information. In contrast, intrinsic motivation is impaired if the reward is used to control task performance [25]. We extend Ryan et al.'s [26] work to examine the effect of feedback and rewards on decision performance using a DSS. Our study differs from previous research. First, we incorporate feedback in a DSS. Second, we administer feedback via pop-up messages as opposed to verbal feedback in prior studies [25] [26] [28]. Further, we focus on the effects of feedback and rewards on decision performance as opposed to focusing on the intermediary step of intrinsic motivation to perform as studied by Ryan et al. [26]. Finally, we measure decision performance directly as opposed to indirect measures in prior studies [7] [18] [33].

In the next section, we provide the theoretical framework and propose the hypotheses. The methodology is presented in the third section of the paper, followed by the results. Finally, the implications and limitations of our study as well as future research possibilities are discussed.

THEORETICAL DEVELOPMENT

Feedback

Any event can have two functional aspects: controlling or informational [9]. The informational aspect represents meaningful feedback, in that it signifies task competence [26]. Informational feedback enhances intrinsic motivation [23] [24]. A person with such feedback considers extrinsic rewards as affirmations of competence [11]. In contrast, the controlling aspect pressures people toward specified results [26] and such individuals behave in ways that they think they "should" [11]. Consequently, controlling events thwart creativity [1]. Individuals are more intrinsically motivated when they expect informational rather than controlling feedback [29].

Reward

Ryan et al. [26] proposed three types of reward structures; namely task-non-contingent, task-contingent, and performance-contingent rewards. Task-non-contingent rewards are given simply for doing a task, without consideration of task completion [12]. Task-contingent rewards are administered only after task completion [12]. Finally, performance-contingent rewards are given for superior performance in a task [12]. In the current study, we focus on two types of rewards, namely task-contingent and performance-contingent rewards.

Decision Performance

DSS generally improve user performance [31]. We provide a unique measure of decision performance by using conjoint analysis. Participants pick a most preferred alternative in a set of alternatives by allocating a total of 100 points across them to indicate the likelihood of choosing the alternative based on given attribute values [7]. Data obtained contain the individuals' utility functions [16]. This analysis is performed at an individual level because of variation in individual preferences [14] [15]. This measure has an advantage over existing measures in that it provides an immediate and reliable assessment of the qualitative aspect of decision performance.

HYPOTHESIS DEVELOPMENT

Effect of Feedback on Decision Performance

Prior research has reported an enhancing effect of feedback on decision performance. Thus, some feedback is better than none [26]. We propose H1a. While feedback enhances decision performance, differences may exist in feedback types [19]. With controlling feedback, individuals perform as expected of them, but they perform poorly [2]. Informational feedback influences decision performance positively [33]. Thus, individuals with informational feedback will perform better than those with controlling feedback, which leads to H1b. Further, since any feedback is better than none [26], we propose that individuals with informational or controlling feedback will perform better than individuals with no feedback, which leads to H1c and H1d.

H1a: Individuals who receive feedback will perform better than individuals who do not receive feedback.
H1b: Individuals with informational feedback will perform better than individuals who receive controlling feedback.
H1c: Individuals with informational feedback will perform better than individuals who do not receive feedback.
H1d: Individuals with controlling feedback will perform better than individuals who do not receive feedback.

Effect of Rewards on Decision Performance

The effect of rewards on performance has been found to depend on task characteristics [4]. With choice tasks, individuals with a reward will perform better than individuals without a reward [4], leading to H2a and H2b. However, differences exist between reward types [10]. With a task-contingent reward, the task is completed, but there is no focus on task performance. Conversely, performance-contingent rewards lead to higher performance since individuals are motivated to work harder [17]. Thus, performance-contingent rewards can be more effective than task-contingent rewards in improving decision performance [21], leading to H2c.

H2a: Individuals who receive task-contingent rewards will perform better than individuals who do not receive any reward.
H2b: Individuals who receive performance-contingent rewards will perform better than individuals who do not receive any reward.
H2c: Individuals who receive performance-contingent rewards will perform better than individuals who receive task-contingent rewards.

Interactive Effect of Feedback and Rewards on Decision Performance

Since the interactive effect of feedback on decision performance has not, to our knowledge, been tested before, we use Ryan et al.'s [26] study as a basis for this study. Compared to the no-feedback/no-reward condition, intrinsic motivation was found to be higher under the informational feedback/performance-contingent reward condition and lower under the controlling feedback/performance-contingent reward condition. The positive relationship between overall intrinsic motivation and decision performance is well-documented [e.g., 6]. We expect the results from our study to be similar to those of Ryan et al.'s [26] study. We propose

the following research question:

RQ: Do feedback and reward interact to affect decision performance?

METHODOLOGY

The experiment consisted of a 3 (no feedback, informational feedback, or controlling feedback) x 3 (no reward, task-contingent reward, or performance-contingent reward) between-subjects design.

Participants

A total of 151 undergraduate students participated in the study. They were suitable for this study because they performed two tasks that they face as students: an apartment and a career selection task. The participants' ages ranged from 18 to 24 and the mean was 21.

Task

The participants performed two choice tasks; namely an apartment and career selection tasks. Both tasks have been used in prior studies [5] [8]. The apartment selection task was used to train the participants while the career selection task was the experimental task. Both tasks were simple enough to allow participants to complete the requirements without additional training.

DSS

The DSS supported the additive compensatory decision strategy. Participants compared two alternatives simultaneously by comparing each attribute. They weighted each attribute according to its importance. The preferred choice was the alternative with the highest weighted value.

Independent and Dependent Variables

The feedback manipulation was consistent with that of Ryan et al.'s [26] study. The informational feedback group received the messages, such as "You did well!", while the controlling feedback group saw those messages with this phrase: "just as you should!". The reward manipulation was consistent with that of prior research [18] [27] [28]. The participants in the *task-contingent reward* group were told that they would receive $5 for doing the task, while those in the *performance-contingent reward* group were told that only those who performed better than 80% of the other participants would receive the reward.

Derivation of the decision performance measure involved a laborious, but rigorous process. It was obtained by evaluating the quality of the participants' final career choices. More information about the derivation of the dependent variable and the experimental procedures is available upon request from D. Veena Parboteeah (parbotev@enmu.edu).

RESULTS

Before testing the hypotheses, the Pearson Product Moment correlation was used to determine whether any potential covariates might have an impact on the dependent variables. The results

did not suggest the presence of any covariates. To test the hypotheses, planned contrasts were conducted. The results provided support for hypotheses H1a and H1d, while hypotheses H1b and H1c were rejected. Further, no support was found for H2a and H2b, while hypothesis H2c was supported ($p = 0.00$).

The results for the interactive effect of feedback and rewards on decision performance were expected to be similar to those of Ryan et al.'s [26] study. Thus, when feedback was present, the no-reward condition was expected to perform better than the performance-contingent reward condition. However, the results did not support this proposition. Consistent with Ryan et al.'s [26] study, the informational feedback/performance-contingent reward group marginally outperformed the no-feedback/task-contingent reward group ($p = 0.07$). Further, the controlling feedback/performance-contingent reward group performed better than the no-feedback/task-contingent reward group ($p = 0.01$). Finally, based on the results, the no-reward group performed better than the task-contingent group when feedback was absent.

DISCUSSION

The results confirmed that some feedback is better than none [26]. No support was found for H1b and H1c, which may be related to the interplay between technology and user behavior, which leads to greater acceptance of controlling feedback. The theory of technology dominance suggests that users will often allow the system to take a position of dominance [3]. Compared to the no-feedback and informational feedback groups, the controlling feedback group felt that the DSS provided them with positive feedback on how well they were doing.

While no support was found for H2a, the results on decision performance were consistent with Ryan et al.'s [26] findings for intrinsic motivation. The results did not provide support for H2b and such findings may be attributed to the participants' high motivation due to the nature of the task. The participants in the performance-contingent reward group performed better than the task-contingent reward group, supporting H2c.

Our research question looks at whether feedback interacts with reward to affect decision performance. Ryan et al. [26] found that intrinsic motivation under the performance-contingent reward condition was lower relative to the no-reward condition, when feedback was present. We did not find similar significant results and this may be related to the perceived task interest effects on motivation as noted in the discussion of the results for H2b.

Ryan et al. [26] found that the informational-feedback/performance-contingent reward group had higher intrinsic motivation than the controlling-feedback/performance-contingent and no-feedback/task-contingent reward groups. Our findings indicated that decision performance did not differ between the informational-feedback/performance-contingent reward and controlling-feedback/performance-contingent reward groups. This result is attributed to the participants' positive response to controlling feedback as discussed in the results for H1. Consistent with Ryan et al.'s [26] finding, our results indicate that the informational-feedback/performance-contingent reward group marginally outperformed the no-feedback/task-contingent reward group.

Finally, the participants in the controlling-feedback/performance-contingent reward group performed better than the no-feedback/task-contingent reward group. This finding contradicts

that of Ryan et al.'s [26] study. However, this finding is not surprising based on the combination of the positive response of the participants to the controlling feedback coupled with the positive effect theorized for the performance-contingent rewards on decision performance in our study.

Limitations

The standard limitations of laboratory experiments apply to our study. A major criticism of such experiments is their limited external validity [13].

IMPLICATIONS

Implications for Future Research

Future research can examine how differences in culture or educational background affect users' reactions to reward structures and feedback characteristics. Further, there is a need to examine the influence of various task characteristics (e.g., interest) on motivation (intrinsic and extrinsic) and decision performance. Similarly, future research can investigate how motivation and decision performance are influenced by environmental factors (e.g., accountability) and user characteristics (e.g., prior DSS experience). Additional work can explore the effect of reward structures and feedback types on alternative dependent variables, such as perceived DSS effectiveness. Finally, researchers can examine how other DSS characteristics (e.g., ease of use or interaction support) can influence motivation and subsequently, decision performance.

Implications for Designers

The results indicate that regardless of the feedback type, some feedback is better than none. In particular, the results also support the call by Johnson et al. [20] for designers to incorporate positive feedback in DSS design. Positive feedback appears to lead to favorable user perceptions, which in turn leads to improved decision performance. The results also indicate that task-contingent rewards undermine decision performance relative to no reward, while performance-contingent rewards enhance decision performance relative to task-contingent rewards. As such, designers should be cognizant of the reward types that exist in DSS-supported decision environments. The incorporation of appropriate reward structures in the design of DSS appears to be important and can impact user perceptions, and subsequently, decision performance.

CONCLUSION

The research reported examined the impact of feedback and reward on the decision performance of DSS users. Our introduction of the utility function to assess decision performance provides a reliable measure for assessing the effectiveness of decision-making. Use of the utility function allows us to assess the actual decision performance, as opposed to the underlying motivations that determine effort, and in turn, decision performance. This study provides new insights into the effects of feedback and rewards on decision makers in their usage of a DSS and where feedback is driven by computer interaction.

REFERENCES

References are available upon request from D. Veena Parboteeah (parbotev@enmu.edu).