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Abstract

The primary focus of a previous study proposed and tested a theoretical model that views the dyadic relationship between system developers and end-users as a social process. The model was tested using a laboratory experiment. Support for the theoretical model and associated hypotheses was found. This paper reports the results of an exploratory component of the original study that looked at how user and developer perceptions may change as a result of their interaction.

User and System Developer Interaction

Marchewka (1994) proposed and tested a theoretical model that views the dyadic relationship between system developers and end-users as an interaction process. The model is illustrated in figure 1 and suggests that power differences and goal interdependencies between the system developer and user influence the process between them.

Power is defined in terms of knowledge or expertise, and the distribution of power between the end-user and developer may be symmetrical (balanced) or asymmetrical (unbalanced). A distribution of power between the user and developer would be uniform symmetrical, for example, if both individuals share similar knowledge of the technology and the domain. On the other hand, a non-uniform symmetrical distribution of power would exist, for example, if the user had a high degree of domain knowledge while the developer had a high degree of technical knowledge. In both examples, the user and developer would have a balanced level of influence on the other. Systems developed in terms of symmetrical power distributions could be viewed as co-led by the user and developer. Conversely, an asymmetrical power distribution implies an imbalanced influence, where one individual would be able to direct or manipulate the actions of the other individual. Systems developed in terms of an asymmetrical power distribution may be viewed as being led by either the developer or the user.

Drawing upon Deutsch's theory of cooperation, the interdependence of goals between the system developer and end-user may be cooperative (i.e., goals perceived as being positively related) or non-cooperative (i.e., goals perceived as being non-positively related).

Consequently, the quality of interaction between the user and developer, in term of communication effectiveness resulting from the degree of mutual understanding and learning, ultimately affects the success or failure of the system.

The model was tested using a laboratory experiment. Support for the theoretical model and associated hypotheses was found. The results suggest that individuals with cooperatively-related goals had more positive communication, while individuals with non-cooperatively-related goals had more negative communication. Strong positive relationships were found to exist between positive communication and social cohesion and between social cohesion and the success of the application system.

As illustrated in figure 1, the first component of the model comprises the initial state of the distribution of power and goal interdependence between the user and developer. In the initial state, users and developers may have an initial perception of the distribution of power and goal interdependence prior to the interaction process.

As a result of the interaction process associated with systems development, the final perceptual distribution of power and goal interdependence state may change from the initial state. For example, an individual may enter into an encounter with the perception that their goals are positively related to another individual's goals. Subsequent, to their interaction, this particular individual may find that their goals are in fact related as initially perceived or that the goals of their counterpart conflict with theirs. Under the first scenario, the perception of the individual subsequent to their encounter would not change, while the perception of the individual under the latter scenario would most likely change.

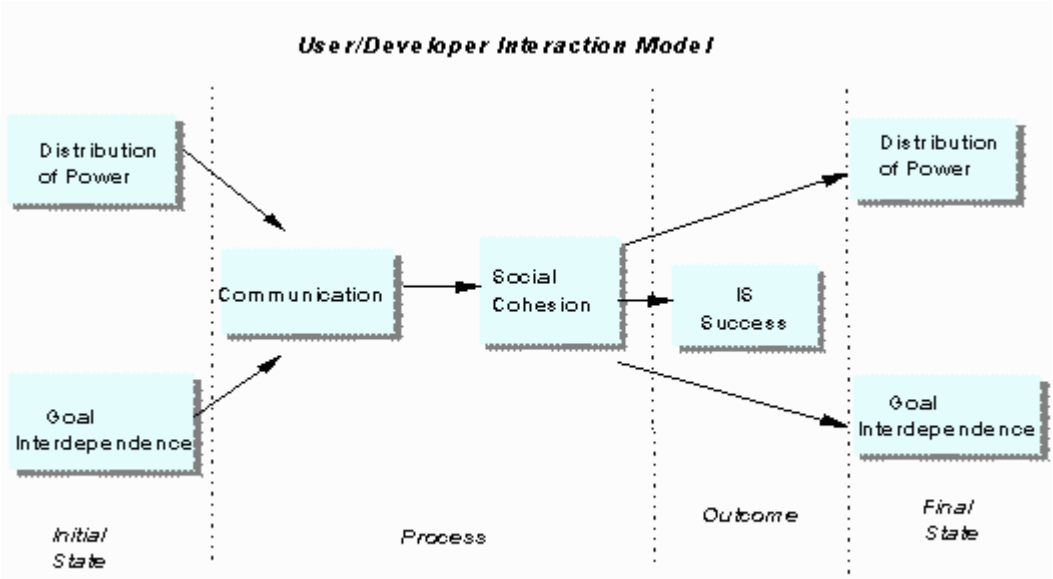

Figure 1.

The final perceptual state would then become the initial state for future encounters and episodes. The following proposition reflects the possible changes in perceptions resulting from the user and developer's encounter that was tested in the original study:

Proposition 1: *An individual's final perceptual state concerning the distribution of power and goal interdependence between the individuals in the dyad may change from their initial perceptual state.*

Research Design

A laboratory experiment was chosen as a research strategy to provide a high degree of internal validity. Subjects were recruited from a college of about 11,000 students in the southeastern United States. The 120 subjects (i.e., 60 dyads) who participated in the study included both graduate and undergraduate students. Of the 120 subjects, 67 were females and 53 were males. The average age for these subjects was 25.4 years. It appears that about 35% of the subjects could be classified as "non-traditional" students since 41 subjects indicated being 25 years or older.

The distribution of power treatment group included three levels: uniform symmetrical, non-uniform symmetrical, and asymmetrical. Moreover, the goal interdependence treatment group included two levels: cooperative and non-cooperative.

To operationalize domain knowledge, the subjects were given a case prior to the experiment. The case entailed a hospital setting where two subjects were paired and assigned to work together on a project. The project required the use of an electronic spreadsheet to create a graph and analyze the financial performance of a department within the hospital.

Subjects were assigned as having high or low domain knowledge based upon information they received in the case. Distributions of power were subsequently created by pairing subjects based upon their technical and domain knowledge classifications. The dyads were also assigned to either a cooperative or non-cooperative goal treatment group. In dyads with cooperative goals, each subject received a case that explained that the hospital encourages and rewards team effort. In addition, each subject was given the opportunity to gain five chances toward a $50 cash lottery if the dyad completed five tasks, as outlined in the case, within one hour. In this situation, both subjects receive the same number of chances towards the lottery for each task completed. Providing each subject with an opportunity to gain the same number of chances would simulate a "win/win" or "lose/lose" type of situation (i.e., goals that are positively related).

If the pair of subjects was assigned to the non-cooperative goal treatment group, the subject playing the role of the developer was told via his/her case that he/she would receive five chances toward the lottery if he/she completes a basic spreadsheet within 30 minutes. This individual would then forfeit one chance for every five minutes he/she continues after the 30 minute period. After 30 minutes, this subject was allowed to decide whether to continue or discontinue their participation. The intent was to simulate a situation where a systems developer would be more concerned with meeting time or budget constraints and less concerned with the functionality or features of the system.

The subject playing the role of the user, on the other hand, was informed that he/she would receive one chance for every task completed and was given one hour to complete the assignment. The subject playing the role of the developer, however, would most likely give up a portion or all of his/her chances if the subject playing the role of the user were to attain his/her goals. Here the goals of the individual would not be positively related. Regardless, each subject received at least one chance towards the lottery for participating in the experiment.

The experiment was refined over the course of three pretests and one pilot study. Although not detailed in this paper, the scores from the Judd Test and a pre-experiment questionnaire facilitated an analysis to verify that the treatments were manipulated as intended.

Results

Perceptual Changes

In the theoretical model it was proposed that the initial perceptions of the individuals involved in the ISD process may change subsequent to an encounter involving the user and developer. To analyze this proposition, a paired t-test was conducted to determine whether the subjects' initial perceptions changed after completing the assignment. Table 1 provides a partial listing of the 12 groups. The variable called PRECOOP represents the average of the 16 item scale used to measure cooperation. This variable was computed from the pre-experiment questionnaire that the subjects completed before working together on the assignment. In addition, a variable called POSTCOOP represents the average of a similar 16 item scale used to measure cooperation after the subjects completed the assignment and was taken from the post-experiment questionnaire. These variables served as a manipulation check and also to test whether goal perceptions changed. A paired t-test allows for the determination of whether the degree of cooperation changed over the course of the experimental session. *Note: Only portions of the tables will be presented in this paper due to space constraints.*

Group	Role	Power	Goals	PRE COOP	POST COOP	t-Value	df	2 tail sig.
6	DEV	Non-Uni	Ncoop	2.36	2.94	-2.23	9	.053 #
12	DEV	Unif.	Ncoop	2.87	3.99	-4.70	9	.001 **

*# - Signif. LE .10 * Signif. LE .05 ** Signif. LE .01*

Table 1. Summary of t-tests to Measure Differences in Goals

It appears that only group 12 has significant differences at the 0.05 level of significance. This group was comprised of subjects who were classified as having high domain and high technical knowledge. Moreover, these subjects were also paired with subjects who

had similar knowledge of the technology and the domain. In all 10 cases, the developer elected to leave at the 30 minute time limit. After the experiment all subjects were debriefed and, if the subject playing the role of the developer was assigned to the non-cooperative goal treatment, he/she was asked why they decided to stay or leave after 30 minutes. In many cases, the subjects in group 12 perceived that they were supposed to help the subject playing the role of the user for 30 minutes. Since the user was knowledgeable about the assignment and had expertise using electronic spreadsheets, the subjects in group 12 rationalized that they would help the user initially and then the user would be able to complete the assignment on their own. Since the user and developer were basically working on the same basic spreadsheet, the developer may have perceived that their goals were very similar and therefore the degree of cooperation increased. Interestingly, the users in the counterpart group did not share this perception. Although not statistically different, their average for post-cooperation is lower than that for their initial state of cooperation.

Table 2 provides a summary of the paired t-tests that include only the cooperative and non-cooperative goal treatment groups.

Goals	Pre Coop	Post Coop	t-Value	df	2 tail sig.
Cooperative	4.28	4.31	-0.42	59	.675
Non-Cooperative	2.92	3.34	-2.61	59	.011 **

*# - Signif. LE .10 * Signif. LE .05 ** Signif. LE .01*

Table 2. Goal Interdependence Perceptual Changes

It appears that the subjects' perceptions in the cooperative treatment group did not change; however, a statistically significant difference was detected for the non-cooperative goal group. One reason could be that the subjects' perceptions changed in the non-cooperative goal groups where the developer decided to stay beyond the 30 minute time period. To test this proposition, paired t-tests were conducted for the non-cooperative treatment groups with respect to the developer staying or leaving after 30 minutes. As can be seen in table 3, there is a statistically significant difference in terms of the subjects' perceptions changing as a result of the developer electing to continue his/her participation.

Goals	Developer Stayed	Pre Coop	Post Coop	t-Value	df	2 tail sig.
Cooperative	True	4.28	4.31	-0.42	59	.675
Non-Cooperative	False	3.07	3.16	-0.49	43	.626
Non-Cooperative	True	2.49	3.84	-5.88	15	< .001

Table 3. Goal Perceptions Based on Developer Staying or Leaving after 30 Minutes

An interesting phenomenon was observed the non-uniform symmetrical/non-cooperative goal treatment group. In this dyad, the developer had high technical knowledge and low domain knowledge and was paired with an user with low technical knowledge and high domain knowledge. Even though the subjects had non-cooperative goals, it appears that power allowed the developer to change the interdependence of their goals from non-cooperative to cooperative. In short, the developer had such high technical knowledge (in terms of expertise in using electronic spreadsheets) that he/she could be altruistic and attain both his/her goals and the user's within the 30 minute time limit. Subsequently, the subjects' perceived that the level of cooperation increased. This particular phenomenon was observed in four of the experiment sessions.

A similar analysis was conducted to determine whether the perceptual power differences changed over the course of the experimental session. A variable PRETECH referred to a question in the pre-experiment questionnaire and POSTTECH refers to the same question in a post-experiment questionnaire. Both questions asked the subject to compare their counterpart's knowledge of electronic spreadsheets to their own knowledge. A paired t-test was conducted to determine whether these perceptions changed.

It appears that only three of the subject groups had statistically significant differences. Interestingly, the developers in group 4 (cooperative, asymmetrical) perceived that the technical knowledge of their counterpart increased. In discussions with subjects after the experimental session, many subjects believed that their counterpart gained knowledge about electronic spreadsheets or the assignment after working together. For example, even though someone may have little or no knowledge of electronic spreadsheets, the experience of observing the application of the technology along with the simplicity of the technology itself allow the individual to grasp the fundamental operations. Subsequently, an inexperienced individual may begin making certain suggestions that would lead the developer, for example, to perceive that the other individual's knowledge is higher than perceived originally.

On the other hand, the users in group 7 (non-cooperative, asymmetrical) perceived that the developer had less knowledge of the technology than perceived originally. One reason could be that these subjects felt a little vindictive since they were in the non-cooperative goal group and were told that the developer was quite knowledgeable about electronic spreadsheets. However, the subjects in group 7 perceived that the developer had more knowledge about electronic spreadsheets than originally perceived. Here the user in group 7 was told that the developer in group 8 (non-cooperative, asymmetrical) was just learning to use electronic spreadsheets. One reason may be that the users had so little knowledge of electronic spreadsheets that seeing even a novice use the system changed their perception.

Conclusion

The contribution of this study is to show that initial perceptions may (or can) change as a result of this interaction process. If these perceptions can change, we may be able to

structure the goals and power distributions between users and developers to make systems development more effective.

An important direction for research should determine what happens in future episodes and encounters. This may include individuals who participate in a number of episodes where the final state of one encounter may become the initial state for the next encounter. Do they change? Do they become reinforced? And more interestingly, how can the perceptual states be changed? That is, how can a non-cooperative group be made cooperative?

References

References and a complete working paper are available from the author.