2011

User Choice between Traditional and Computerized Methods: An Activity Perspective

Jun Sun
University of Texas - Pan American, jsun@utpa.edu

User Choice between Traditional and Computerized Methods: An Activity Perspective

Jun Sun
University of Texas – Pan American
jsun@utpa.edu

ABSTRACT

Numerous computerized methods emerge to replace traditional methods in people's personal, work and social lives, but many are hesitant to make the transition. This study examines the factors that influence human choice between different methods. According to Activity Theory, traditional and computerized methods are both tools that a person uses for a certain task. The situated experiences with various methods shape people's attitude toward using them later in terms of tool readiness. The understanding leads to hypothesized relationships between user-, method- and task-specific factors and the dependent variable. The results from an empirical study support that method experiences have strong direct effects, user characteristics have weak moderating effects and task situations have both moderating and mediated effects on tool readiness at different levels. This understanding provides researchers and practitioners the insight on how to facilitate the transition from traditional methods to computerized methods for different users and for different tasks.

Keywords

Activity Theory, choice behavior, computerized method, traditional method, tool readiness, multilevel modeling.

INTRODUCTION

The advances in information and communication technologies (ICT) provide people many computerized methods to do things that used to require traditional methods in their work, personal and social lives. Compared with traditional accounting ledgers, for instance, modern accounting information systems greatly improve job effectiveness and facilitate information sharing for accountants, managers and auditors. The introduction of all kinds of computerized methods has revolutionalized many aspects of human lives and dramatically increased the productivity (Castells, 1996).

However, not all people are open to computerized methods, especially those who are more comfortable with traditional methods (Joshi, 2005). Such resistance to new technologies leads to high opportunity costs to modern organizations and societies due to reduced efficiency, increased errors and wasted resources (Fisher and Wesolkowski, 1999). This has been recognized as a major cause of the phenomenon so-called productivity paradox, that is: the increase of productivity does not always follow the implementation of ICT applications (Brynjolfsson, 1993). To solve the problem, therefore, it is important to understand the factors that make differences in people's transition from traditional methods to computerized methods and find out ways to facilitate the process through efforts such user-centered design and task-oriented training (Malhotra and Galletta, 2004).

The existing research stream that is conceptually related to the issue of user resistance to computerized methods is the technology acceptance research that focuses on whether or not a user intends to use an ICT application. For example, Technology Acceptance Model suggests that the behavioral intention depends on the perceived ease-of-use and usefulness of an application (Davis, 1989). Such models are well-suited for explaining user behavior in the environment where there are few other options except the application in question (e.g. an ERP system in an organization). However, user resistance mostly comes from the hesitancy to replace traditional methods with computerized methods when both are available. Due to the "whether-or-not" conceptualization of dependent variable, user acceptance research is not capable of investigating how people make choices among different options (Benbasat and Barki, 2007).

The limitation is due to the socio-psychological paradigm of user acceptance research. The unit of analysis in the studies under this paradigm is an action between a subject and an object. Thus, the dependent variable is typically the behavioral intention directed to the object. From this action-based perspective, a traditional or computerized method is regarded as the object that a person uses. Because different methods have to be included in separate units of analysis, it is hard to tell which option a person would choose based on the intention regarding whether to use each method or not.

This study adopts Activity Theory, a meta-theory that does not require the use of action as the unit of analysis, to examine the human choice behavior related to traditional and computerized methods. The understanding lead to the identification of user-, method- and task-specific factors that may affect user willingness to switch from traditional to computerized methods.

METHOD CHOICE ACTIVITY

Activity Theory, rooted in Hegelian and Marxist philosophies, emphasizes the development of human subjects in their interaction with the material environment. The unit of analysis under this framework is an "activity", which carries the connotation of motivation in its original Russian term. The motive of an activity is to transform an object into an outcome, which is made possible through the use of tools (Vygotsky, 1981). An activity comprises a series of actions, each of which is what a subject is conscious of doing to attain an immediate goal (Leont'ev, 1978).

The concept of tool in Activity Theory is very broad, including both technical tools (e.g. machines) and psychological tools (e.g. languages) (Vygotsky, 1981). From the activity perspective, different methods are the tools that people use to accomplish all kinds of tasks. For a certain purpose, there may be both traditional and computerized methods available. Because the motive remains the same, user behavior involving different methods can be examined within one unit of analysis.

Activity Theory emphasizes that a human activity needs to be examined under the behavioral context defined by its motive. Thus, it is necessary to take task context into account for the understanding user experiences with different methods. When traditional and computerized methods are used for a common purpose, user experiences with them are comparable. This activity perspective of method choice behavior makes it possible to examine the relationships among user, method and task. As depicted in Figure 1, the *subject* in such an activity is a *user*, the *tools* are different *methods*, and the *motive* for the subject to accomplish a task defines the *task context*.

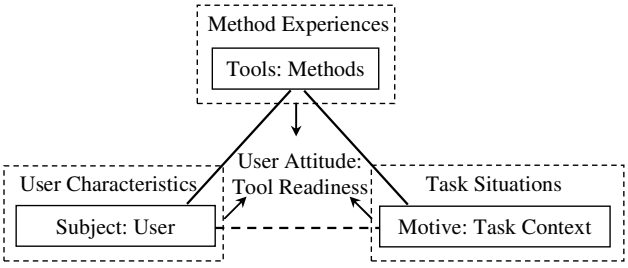

Figure 1. Method Choice Activity

The activity perspective clearly indicates three sources of influence related to user, method and task respectively on user choice between traditional and computerized methods. To predict human overt behavior and explain how it is influenced by various factors, the concept of attitude has been widely used in behavioral research (Eagly & Chaiken, 1993). An attitude object is what an attitude is directed to, and it is different from the concept of object in activity theory. In this study, the attitude objects are various methods, and they are not the object but tools from the activity perspective. Personality traits contribute to individual differences in human attitude toward the same attitude objects (Eysenck and Eysenck, 1985). In this study, such personality traits can be called user characteristics and they are user-specific factors. Experiences with attitude objects in form of relevant perceptions from cognitive, affective and behavioral processes lead to the formation of attitude (Eagly and Chaiken, 1993). Such perceptions from the use of each method can be called method experiences, and they are method-specific factors. In addition, the perceptions of the behavioral settings in which subjects have experiences with attitude objects regulate human attitude (Barwise and Perry, 1981). Such situational perceptions of a task context can be called task situations and they are task-specific factors.

Tool readiness, a construct conceptualized based on the premises of Activity Theory, is used to capture the effects of user characteristics, method experiences and task situations. It indicates how willing and prepared an individual is to employ a method for a certain purpose (Sun, 2011). Corresponding to the general actions of making the effort to use a method, following the rules in using it and utilizing the outcome from the use of it, there are three underlying factors of this latent construct: effort willingness, outcome acceptance and rule observance.

When there are multiple attitude objects involved in an activity, a hierarchical structure of attitude forms: the general attitude toward all of them at the between-subject level and the specific attitude toward each one at the within-subject level (Sun and Willson, 2008). Distinct in their natures, user characteristics, method experiences and task situations have different relationships with two components of tool readiness. Because a person's attitude toward each method is formed on the basis of the experiences with it, method experiences have *direct* effects on the specific component of tool readiness at the within-subject level. On the other hand, people's attitudes toward the same set of methods vary across individual users and task contexts. Therefore, user characteristics and task situations are likely to have *moderating* effects on the general component of user readiness at the between-subject level. Regulating the experiences with all the methods involved in a common task context, task situations also have *mediated* effects on the specific component of user readiness through system experiences.

RESEARCH VARIABLES AND PROPOSITIONS

System Experiences

Leading to the formation of tool readiness, relevant method experiences can be identified by examining the three general actions involved in using a method as mentioned above. Making the effort to use a method demands that a user take the initiative to make something happen; following the rules in using a method requires that a user accept and observe the underlying norms, standards and procedures during the process; utilizing the outcome from the use of a method implies that a user receive and apply the result to solve a problem. Method

experiences identified must capture user perceptions related to these actions.

Perceived Behavioral Control has been well recognized as a necessary condition for people to take initiative actions (Ajzen, 1991). Thus it is directly related to the action of making effort, particularly to figure out how to use a method in a certain circumstance. Developed under the action-based social psychology paradigm, however, it a construct limited to a specific action. The actions of following rules and unitizing outcome also involve the feeling of control (e.g. are the rules easy to follow or is the outcome relevant?). To represent a user's overall perception of control in all the actions, the term Sense of Control is used in this study.

The norms, standards and procedures implied in using a method for a certain purpose may or may not be consistent with a user's beliefs and expectations. According to Cognitive Dissonance Theory (Festinger, 1957), people tend to reduce cognitive confliction in terms of dissonance but rather seek cognitive harmony in terms of consonance. Thus, users would like to avoid some methods that impose the rules dissonant with their value systems but choose others the use of which lead to consonance. In this sense, Perceived Consonance directly captures the experience related to the action of following rules. Though less directly, such a perception is also relevant to the actions of making required effort and utilizing given outcome in terms of their properness.

An expectation of desired outcome is what motivates an activity (Leont'ev 1978). User perception regarding how the motive is fulfilled is the experience directly related to the action of utilizing the outcome from using a method. Thus, this method experience can be called Motive Fulfillment. Also, the effort required and rules imposed in using a method may affect such an experience in terms of how they lead to expected outcome.

Capturing user experiences with a method in the actions of making effort, observing rules and utilizing outcome, therefore, these method experiences lead to the formation of user attitude toward using it for a certain purpose. The discussion leads to the first research proposition:

P1: Method experiences, including Sense of Control, Perceived Consonance and Motive Fulfillment have strong direct effects on specific tool readiness at the within-subject level.

Task Situations

Tool readiness is not only shaped by users' direct experiences with different methods, but also regulated by their situational perceptions of the task context. Among the existing theories that explain the relationships between environment and behavior, the Self-Determination Theory (Deci and Ryan, 1985) is particularly relevant. It explains how task nature and settings regulate human behavior in terms of motivations and constraints. In addition, the theory posits several psychological constructs to capture the influence of task-related environment on human behavior. Perceived Task Interest and Perceived Task Importance are related to intrinsic motivation and extrinsic motivation respectively, and Perceived Task Self-efficacy and Perceived Task Tension are related to how comfortable a user with a task.

Together, these task situations regulate users' experiences with different methods in a context. For example, if a user is careless about or uncomfortable with a task, the overall negative task situation will weaken sense of control, perceived consonance and/or motive fulfillment in using relevant methods, leading to lower tool readiness. Also, people perceiving different task situations may have different levels of tool readiness toward the same methods involved. The next proposition is given below:

P2: Task situations including Perceived Task Interest, Importance, Self-efficacy and Tension have both moderating effects on general tool readiness at the between-subject level and mediating effects on specific tool readiness at the within-subject level.

User Characteristics

Various constructs have been developed to describe personality traits. The most well-recognized personality traits are the big five: openness, conscientiousness, extraversion, agreeableness, and neuroticism (Digman, 1990). Openness concerns the tendency to accept unusual ideas and seek adventures. Conscientiousness generally refers to the tendency to act responsively and show self-discipline. Extraversion is related to emotional expression and socialization. Agreeableness deals with whether a person is compassionate and cooperative toward others. Neuroticism is about how likely an individual experiences unpleasant emotions (e.g. anger and anxiety).

Once formed, personality traits remain relatively stable. However, human choice behavior is dynamic as it involves different methods for different tasks. Thus, general user characteristics are not supposed to explain a significant proportion of variation in tool readiness toward the same methods across individuals. Here is the third proposition:

P3: General user characteristics, such as openness, conscientiousness, extraversion, agreeableness, and neuroticism, have weak moderating effects on general tool readiness.

AN EMPIRICAL STUDY

Procedures

For the modeling and testing of the relationships described in the research propositions, observations need to be collected from an experiment in which there are both traditional and computerized methods available for different tasks. In this study, participants were randomly assigned to one of two groups for a prescription task and a statistics task respectively. For the task of acquiring a

medicine, there are two methods available: traditional paper-prescription method and computerized electronic-prescription method. For the task of testing a statistical hypothesis, there are also two options: traditional critical-value method and computerized p-value method. To help participants recall their direct and indirect experiences with different methods, the task scenarios were made as realistic as possible and the method steps were described in details. Also, the order in which participants are exposed to different methods was randomized.

Subjects

College students are relatively independent to solve all kinds of problems with both traditional and computerized methods in their lives. Thus the participants in this study comprised the students taking relevant courses at a university in the USA. There were 106 participants in the prescription-task group, and they were elicited from the students taking a computer literacy course. Before the experiment, they had already discussed the topic of electronic health that covered the use of electronic-prescription method. There were 87 participants in the statistics-task group, and they were elicited from the students taking a course in business statistics.

Measures

The Appendix includes all measurement instruments used in this study. The dependent variable was measured using the tool readiness instrument (Sun, 2011). User characteristics in terms of openness, conscientiousness, extraversion, agreeableness, and neuroticism were measured with a simplified version of big five personality inventory (Digman, 1990). Among method experiences, Sense of Control was measured with three items adapted from Ajzen's (1991) Perceived Behavioral Control scale. Perceived Consonance and Motive Fulfillment were measured with three items each developed for capturing relevant perceptions that people have in using various methods. Task situations in terms of Perceived Task Interest, Importance, Self-efficacy and Tension were measured with the post-experimental intrinsic motivation inventory (Deci and Ryan, 1985).

Statistical Analysis

Typothesized relationships were tested with a multilevel structural model. Based on Muthén's (1994) maximum-likelihood (MUML) method, within-subject pooled between-subject correlation matrices were generated from the repeated measures collected from the experiment (i.e. two sets of method experience and tool readiness responses for each subject). Both matrices were fit to the two parts of model at different levels simultaneously to get parameter estimates.

Results

At the within-subject level, all factor loadings of tool readiness were highly significant. At the between-subject level, the factor loadings were significant only in the prescription-task group but not in the statistics-task group. This indicated that whereas specific tool readiness was always salient, general tool readiness was salient only for prescription methods but not for statistics methods. In this study, general tool readiness captures the common attitude that participants have toward traditional and computerized methods. To the participants in the statistics-task group, therefore, the traditional critical value method and computerized *p*-value method had almost nothing in common.

At the within-subject level, all method experiences were significant in their effects on people's tool readiness toward each method. This supports the first proposition (P1) that Sense of Control, Perceived Consonance and Motive Fulfillment have strong direct effects on specific tool readiness. At the between-subject level, almost none of the user characteristics were significant in explaining individual differences in people's tool readiness toward both traditional and computerized methods. This supports the second proposition (P2) that Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism have weak moderating effects on general tool readiness. Across the two levels, most path coefficients associated with task situations were significant. This supports the third proposition (P3) that Perceived Task Self-Efficacy, Importance, Tension and Task Interest have both moderating effects on general tool readiness and mediated effects on specific tool readiness through system experiences.

In specific, Extraversion was the only user characteristic found marginally significant in the prescription-task group. Among the task situations, Perceived Task Self-Efficacy contributed significantly to the overall task situation (TASK) in both groups, and Perceived Task Importance was the other one that was significant in the statistics-task group. The mediating paths from TASK to common method experiences were significant. The path from TASK to general tool readiness was only significant in the prescription-task group.

DISCUSSION AND CONCLUSION

This study shows that method experiences, task situations and user characteristics have different effects on user readiness toward traditional and computerized methods. This has important implications for researchers and practitioners as they can figure out how to facilitate the transition from traditional to computerized methods for different users and tasks by assessing and comparing the effects of different factors on tool readiness.

For method experiences, it is possible to compare the significance of sense of control, perceived consonance and motive fulfillment in shaping user tool readiness toward each method. If many users are hesitant to adopt a computerized method because it evokes some negative experiences (e.g. perceived consonance) compared with an existing traditional method, developers may improve

relevant method design and training (e.g. through careful revision or detailed explanation of underlying rules). In this study, for example, many participants were not ready to switch from the traditional critical-value method to computerized *p*-value method due to low sense of control with the latter. It suggests that people probably need to have more hand-on experiences with the computerized method through the use of certain statistical softwares to enhance this method experience. Once users feel comfortable with a computerized method, they are likely to adopt the method and stick to it, even though the particular softwares may change.

In many occasions, it is the undesired task situations that lead to people's negative method experiences with all the methods involved. Compared with traditional methods, computerized methods are more likely to take the hit as people's attitudes are more volatile toward new methods than existing ones (in this study, computerized methods evoked larger standard deviations of tool readiness factors than traditional methods). If so, organizations can adjust the task context itself or provide more task-oriented training. For instance, managers can break a complex task into multiple smaller tasks, and show employees how to do each with one computerized method at a time. Once employees find it not so hard to handle the tasks with computerized methods, they are likely to switch to them from existing traditional methods. In this study, participants did not like the statistics task as much as the prescription task. To help them adopt the computerized method, the whole task can be divided into three smaller tasks: entering data, running analysis and interpreting results. Showing how to use the computerized method in each step and comparing the procedures with the traditional method may help users enhance the task-related perceptions and get prepared for the transition.

Some user characteristics may also be relevant to certain tasks that require the use of certain methods. In this study, for instance, extraversion was found relatively salient in the prescription-task group because of the social interactions required (i.e. talking with the professionals in clinics and pharmacies). The variable Extroversion had positive effect on general user readiness, suggesting that introvert people are less ready to use either traditional method or computerized method to get medicine than extrovert people. If a user characteristic makes significant individual differences, it may suggest the necessity to customize method design and training for particular user groups. In the above example, a customized training program may guide introvert users through the service encounter required for the use of electronic prescriptions to help them adopt the computerized method.

REFERENCES

1. Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211.
2. Barwise, J. and Perry, J. (1981). Situations and attitudes. *The Journal of Philosophy,* 78, 668-691.
3. Benbasat, I. and Barki, H. (2007). Quo vadis, TAM? *Journal of the Association for Information Systems,* 8, 4, 211-218.
4. Brynjolfsson, E. (1993). The productivity paradox of information technology. *Communications of the ACM*, 36, 12, 66-77.
5. Castells, M. (1996). *The Rise of the Network Society*. Cambridge, MA: Blackwell.
6. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13, 3, 319-339.
7. Deci, E. L. and Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. New York: Plenum.
8. Digman, J.M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology*, 41, 417-440.
9. Eagly, A. H. and Chaiken, S. (1993). *The Psychology of Attitudes*. Fort Worth, TX: Harcourt.
10. Eysenck, H. J. and Eysenck, M. W. (1985). Personality and individual differences. NY: Plenum.
11. Festinger, L. (1957). *A Theory of Cognitive Dissonance*. Stanford, CA: Stanford University Press.
12. Fisher, W. and Wesolkowski, S. (1999). The social and economic costs of technology resistance. *IEEE Canadian Review*, 31, 14-17.
13. Joshi, K. (2005). Understanding user resistance and acceptance. *Journal of Information Technology Cases and Application Research*, 7, 1, 6-20.
14. Leont'ev, A. N. (1978). *Activity, Consciousness and Personality*. Englewood Cliffs: Prentice-Hall.
15. Malhotra, Y. and Galletta, D. F. (2004). Building systems that users want to use. *Communications of the ACM,* 47, 12, 88-94.
16. Muthén, B. (1994). Multilevel covariance structure analysis. *Sociological Methods & Research*, 22, 376-398.
17. Sun, J. (2011). Human choice between computerized and traditional methods: Assessing tool readiness from the activity perspective. *Computers in Human Behavior*, 27, 1, 391-401.
18. Sun, J. and Willson, V. L. (2008). Assessing general and specific attitudes: An activity perspective and a multilevel modeling approach. *Educational and Psychological Measurement*, 68, 2, 245-261.
19. Vygotsky, L. S. (1981). The instrumental method in psychology. In J. V. Wertsch (Ed.), *The Concept of Activity in Soviet Psychology* (pp.134-143). Armonk, N.Y.: Sharpe.