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Positive and Negative Affect in IT Evaluation: A Longitudinal Study

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ABSTRACT

This study investigates the impacts of affective evaluations of IT on IT use decisions. We propose two object-based affective evaluation constructs: perception of an IT's capability to induce positive affect (PC-PA) and perception of the IT's capability to induce negative affect (PC-NA). A longitudinal study shows that PC-PA and PC-NA are distinct concepts that have different effects on commonly studied IT adoption factors, perceived usefulness (PU), perceived ease of use (PEOU), and attitude toward using the IT (ATB). These effects hold true during both initial use and continued use. PC-PA influences PU, PEOU and ATB but becomes less important to PU over time, and PC-NA only influences PEOU but becomes more important to PEOU over time. The study also offers a specific instrument on measuring affective evaluations of IT and points out future research directions.

Keywords

Affective evaluation of IT, positive affect, negative affect, technology acceptance, longitudinal study.

INTRODUCTION

Affective evaluations and cognitive judgments can both influence a user's IT acceptance decisions (Agarwal et al. 2000; Bhattacherjee 2001; Venkatesh et al. 2001). Research in affective evaluation of IT is blooming, with a limited number of studies published on identifying affective factors and their effects on cognitive beliefs, attitudes, and adoption decisions. But few studies have systematically examined such effects over time. This study focuses on examining affective evaluations and their roles on commonly studied technology acceptance and adoption factors. We address the following three research questions by conducting a longitudinal study in a mandatory IT use context:

RQ1. What are the effects of a user's affective evaluation of an IT on his/her cognitive evaluations (perceived usefulness and ease of use), attitude toward using, and intention to use the IT?

RQ2. Do the effects of affective evaluation on other factors change over time from initial use to continued use?

RQ3. Does one's affective evaluation of IT formed at the initial use stage influence his/her cognitive judgments, attitude and intention at the continuous use stage? If so, how?

THEORETICAL BASE AND RESEARCH MODELS

Affect and Its Structure

It is well established that a stimulus in one's environment has the capability to change a person's affect (Russell 2003). Affect is a general term for feelings, emotions, and moods. Psychologists consider affect to be a two-dimensional concept that can be described with a circumplex model. Among several commonly studied structures of affect, Watson and Tellegen (Watson et al. 1985; Watson et al. 1999) considered two dimensions, Positive Affect (PA) and Negative Affect (NA) to describe affect.

Affective Evaluation

Certain features of a stimulus may induce a particular affect in a person. Yet, people may have different affective reactions to the same stimulus. Russell named this Perception of Affective Quality (PAQ): an individual's perception of an object's ability to change his or her affect (Russell 2003). One's perception or evaluation of an object's ability to change his/her affect is a different concept from the affect itself. In this study, we focus on affective evaluations and their impacts.

Perception of IT's Capability to Induce Positive Affect and Negative Affect

Zhang and Li applied the perception of affective quality concept to the IT context and adopted the valence and activation dimensions to describe perceived affective quality in their studies. They treated it as a second-order concept and found the instrument did not fit the IT context well; thus they called for further development of IT-specific instruments (Zhang et al. 2004; Zhang et al. 2005).

In this study, in order to avoid the issue of second-order concepts and make the study findings easier to explain and compare, we considered two types of affective

evaluations that correspond to the two types of affect, positive affect (PA) and negative affect (NA), in Watson and Tellegen's PANAS (Watson et al. 1985; Watson et al. 1999). Specifically, Perception of an IT's Capability to induce Positive Affect (PC-PA) is an individual's perception or evaluation that an IT has the capability to induce positive affect in him or her; and Perception of an IT's Capability to induce Negative Affect (PC-NA) is the person's perception that an IT has the capability to induce negative affect in him or her. PC-PA and PC-NA are thus one's affective evaluations of an IT.

Affective evaluations and affect can be described in a similar way and may share overlapping measurement items since they share the same affective structure. This is in line with what Russell and colleagues did (Russell et al. 1980).

Research Models

In our first research model (Figure 1), we propose the relationships between a user's affective evaluations (PC-PA and PC-NA) and perceived ease of use, usefulness, attitude toward use, and behavioral intention. We believe that such relationships hold true regardless of IT use stages. In our second research model (Figure 2), we propose how PC-PA and PC-NA obtained at the initial use stage may have sustained influence at later stages.

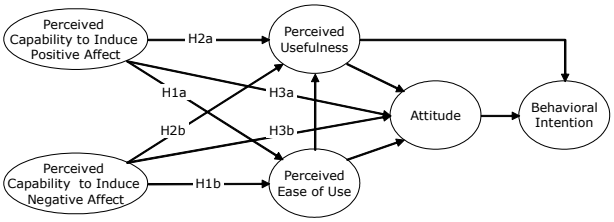

Figure 1. Model 1- Impacts of PC-PA and PC-NA on IT Adoption

People form affective evaluations of stimuli in their environment. This holds true for IT as an object in a user's environment. There are several theoretical arguments to support that affective evaluations of IT should have an impact on other behavior-based factors such as PU, PEOU, as well as attitude toward behavior (ATB). These include Russell's prototypical emotional episode (Russell 2003), Ajzen et al.'s object-based evaluations influence behavior-based evaluations (Ajzen et al. 1980; Ajzen et al. 2005). In the IT setting, if an individual feels that an IT induces strong positive affect, then s/he may look forward to using it and thus would justify that the IT is very useful. S/he may also overlook or downplay any potential obstacles in using it and would think that it does not seem to require extra effort to use it. If the individual feels that an IT induces strong negative affect, s/he may judge the ease of use and usefulness of the IT toward a negative direction thus would try to avoid. Therefore we propose Hypotheses 1a, 1b, 2a, and 2b.

H1a. A user's perception of an IT's capability to induce positive affect (PC-PA) has a positive effect on perceived ease of use.

H1b. A user's perception of an IT's capability to induce negative affect (PC-NA) has a negative effect on perceived ease of use.

H2a. A user's perception of an IT's capability to induce positive affect (PC-PA) has a positive effect on perceived usefulness.

H2b. A user's perception of an IT's capability to induce negative affect (PC-NA) has a negative effect on perceived usefulness.

Applying elaboration likelihood model (ELM) to the IT context, we posit that affective evaluations can impact attitude through both peripheral and central paths (Wegener 2001). When a person does not have enough motivation or ability to assess an IT, affective evaluations can impact his/her attitude toward using it as simple cues via the peripheral path. With high motivation and ability, a user can decide his/her attitude based on careful analysis of his/her affective evaluations. Thus we have:

H3a. A user's perception of an IT's capability to induce positive affect (PC-PA) has a positive effect on attitude toward using the IT.

H3b. A user's perception of an IT's capability to induce negative affect (PC-NA) has a negative effect on attitude toward using the IT.

The relationships among PU, PEOU, ATB and BI are consistent with the literature. We expect Model 1 hold true for both initial and continued use stages.

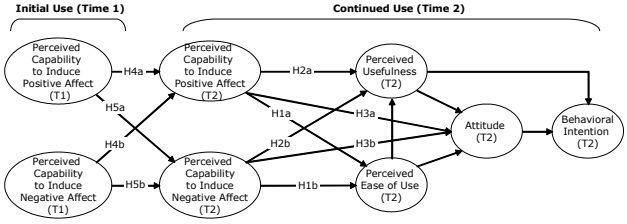

Figure 2. Model 2 - Long Lasting Effects of Initial PC-PA and PC-NA on IT Adoption

Besides investigating the impacts of affective evaluations at a certain moment, we are also interested in finding out whether PC-PA and PC-NA formed at the initial use stage (Time 1) would have a long lasting effect in the continued use stage (Time 2). Specifically, we wonder if PC-PA and PC-NA at Time 1 have influences on PC-PA and PC-NA and all other factors at Time 2.

Persuasion formation and change theories, including the elaboration likelihood model (ELM), shed light on the potential effects of early PC-PA and PC-NA on later PC-PA and PC-NA. At the continued use stage, a user is gaining more experience with using the IT. In addition, the user's motivation to evaluate the IT can be high,

especially in the mandatory use context. All these make him/her highly likely to take the central route in forming her current PC-PA and PC-NA. One important aspect of the central route is to access internal relevant information from memory, especially past evaluations of the same object. In this case, such internal relevant information is previous PC-PA and PC-NA, formed during the initial use stage. Limited empirical evidence shows that affective evaluations obtained at the early stage may hold fairly stable, or at least influence affect evaluations formed at later stages. Thus we propose:

H4a. Perception of an IT's capability to induce positive affect (PC-PA) formed at the initial use stage has a positive effect on PC-PA at the continued use stage.

H4b. Perception of an IT's capability to induce negative affect (PC-NA) formed at the initial use stage has a negative effect on PC-PA at the continued use stage.

H5a. Perception of an IT's capability to induce positive affect (PC-PA) formed at the initial use stage has a negative effect on PC-NA at the continued use stage.

H5b. Perception of an IT's capability to induce negative affect (PC-NA) formed at the initial use stage has a positive effect on PC-NA at the continued use stage.

Figure 2 shows the research model reflecting the above hypotheses. In order to test these hypotheses in the context of other relationships we proposed earlier, we also include the relationships at the continued use stage among PC-PA, PC-NA, perceived usefulness, ease of use, attitude, and intention in Time 2, which are shown in Figure 1.

RESEARCH METHODOLOGY

Study Setting, Target IT, and Participants

The research models and hypotheses were tested in a longitudinal study containing two surveys of university student evaluations of a newly upgraded learning management system, WebCT 6. The first data collection (Time 1) was conducted during the 3rd and 4th weeks of the fall semester of 2006 when students were getting started using WebCT 6. We consider this as the initial use stage. The second data collection (Time 2) was performed during the 11th and 12th weeks of the semester when classes were ending and students had been using WebCT 6 to quite some extents.

A total of 145 students participated in both surveys. Among them, 61% were male, 63% were Caucasian and 20% Asian, 80% were graduate students and 20% undergraduate students. The average age was 31 with a standard deviation of 10. They had been using computers for about 15 years (std = 6) and the World Wide Web for about 10 years (std = 3).

Both surveys measured the same constructs: perception of WebCT 6's capability to induce positive affect, perception of WebCT 6's capability to induce negative affect, perceived ease of use, perceived usefulness, attitude toward using WebCT 6, and intention to continue using WebCT 6. Due to the relatively complex instrument and the interval of at least seven weeks of data collections, it seemed impossible for the subjects to remember what they answered in the first survey. Thus there would not be any carryover effect in the second collection.

Operationalization of Constructs

All constructs were measured using multi-item 5-point Likert scales. Behavioral intention, perceived usefulness and perceived ease of use were measured using previously validated instruments (Wixom et al. 2005). Attitude toward using WebCT was measured based on the suggestions by Ajzen et al (2005, p.199).

The instruments for PC-PA and PC-NA were developed by the authors following classical instrument development procedures (Bearden et al. 1989; Davis 1989; McKinney et al. 2002; McKnight et al. 2002; Russell et al. 1980; Russell et al. 1981; Stanton 2001; Watson et al. 1988). First, a list of 81 adjectives to describe PC-PA and PC-NA was generated through 10 interviews. These items along with 16 more potential items obtained from literature review formed the original pool of measure items. They were judged on their content validity and classified into categories in an online survey with 26 participants. The reduced list of items was used in the two surveys reported in this study. Principle component analyses revealed two main factors with 5 items with the highest loadings in both surveys. These two factors are named perception of IT capability to induce positive affect (PC-PA) and perception of IT capability to induce negative affect (PC-NA).

Data Analyses and Results

PLS (partial least squares, PLS-Graph 03.00) was utilized to assess the measurement scales and the proposed hypotheses owing to its advantages of minimal demands on measurement scales, sample size, and residual distributions (Chin et al. 1996; Fornell et al. 1982).

All measurement scales were examined in terms of convergent validity and discriminant validity (Hair et al. 1998). The results show that the empirical data met the requirements for convergent and discriminant validities.

The Empirical models are show in Figure 3. Model 1 is largely supported at both stages.

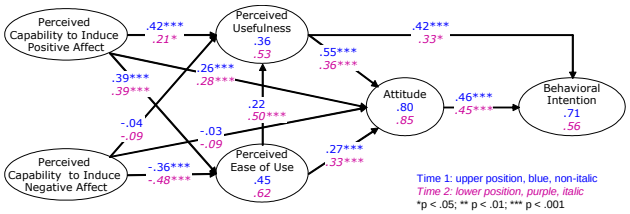

Figure 3. Model 1 for Initial (Time 1) and Continued Use (Time 2)

There are, however, three differences in Model 1 between initial and continued use. The first is the effect sizes of the strength of some linkages. The second is the impact of PEOU. The third difference is the amount of variances explained in the variables. It is worth noting that, in both stages, PC-PA influenced both PU and PEOU, but PC-NA only had influence on PEOU. Given that PU is a strong predictor of BI, and it is only influenced by PC-PA, it seems that having the ability to induce positive affect is extremely important. It may engender users' over estimation of usefulness of the system. Noticeable is that PC-PA's effect on PU is much stronger at the initial stage than the continued stage. This means that during the initial stage, users rely more on PC-PA to form their perception of the usefulness of the system than during the continued use stage. On the other hand, PC-NA has an effect on PEOU only, not on PU or ATB. This is a powerful finding, indicating that PC-PA and PC-NA are two conceptually different concepts, rather than two extreme ends of the same construct, and that PC-PA and PC-NA have distinctive effects on other factors. PC-NA's effect on PEOU increased as users continuously used the system.

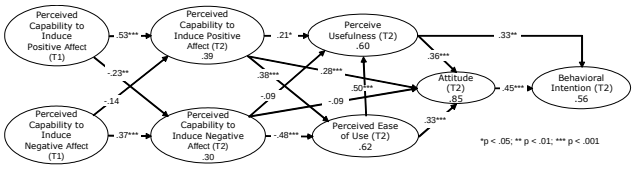

Figure 4. Empirical Model 2

The empirical model for Model 2 is shown in Figure 4. The nature of the relationships between all of the constructs at the continued stage did not change because of the addition of initial PC-PA and PC-NA. Initial PC-PA and PC-NA did have influences on PC-PA and PC-NA during continued use, while one of such influences is insignificant: PC-NA_T1 (Time 1) did not significantly influence PC-PA_T2 (Time 2). The variances explained in PC-PA_T2 (39%) and in PC-NA_T2 (30%) indicate that the initial affective evaluations have a moderate influence on later affective evaluations, and the later affective evaluations have other contributing factors. Supplemental analyses show that PC-PA_T1 and PC-NA_T1 had no any direct impact on any other factors in Time 2

CONCLUSION

This study investigates the impacts of one's affective evaluations. We introduced perception of IT's capability to induce positive affect (PC-PA) and perception of IT's capability to induce negative affect (PC-NA). These two perceptions are different from each other, rather than two ends of one dimension. An IT specific instrument was developed to measure these two affective perceptions. Our longitudinal study with a particular type of IT in a particular context shows that the two affective evaluations are indeed independent to each other, have different effects on other technology acceptance factors, and change differently over time. The instrument demonstrates satisfactory psychometric properties.

For RQ1, our study revealed that PC-PA has direct influences on PU, PEOU and attitude, but not on intention; PC-NA has direct influence only on PEOU. These direct influences are true at both the initial and the continued use stages. Given the important impacts of PE, PEOU, and attitude on intention as supported by this study and many other technology acceptance studies, this finding indicates that PC-PA and PC-NA are important factors to consider in technology acceptance research.

For RQ2, our empirical model indicates that the effects of PC-PA and PC-NA do change over time. Specifically, PC-PA becomes less important to PU, but remains relatively the same to PEOU and attitude. PC-NA, on the other hand, becomes more important on PEOU. Together, they explained more variances in PU, PEOU and attitude during the continued use stage than in the initial stage.

For RQ3, we found that PC-PA and PC-NA at Time 1 do influence those at Time 2. Their influences on other factors at Time 2 are indirect, only via PC-PA and PC-NA at Time 2. This illustrates that affective evaluations made during initial use stage can be carried over to later stage, and thus do have a sustained effect.

This study enriched our theoretical understanding of the short-term and long-term effects of affective evaluations on IT use decisions. With this understanding, a newly developed IT specific instrument was used and validated in this study. This treatment of PC-PA and PC-NA not only simplifies the instrument and data analysis, but also allows us to find intriguing and specific effects of PC-PA and PC-NA on other IT adoption factors. Such effects are easier to explain and can be better used to guide practice of IT design.

This study, along with a good number of other studies, makes a clear statement that affect plays an important role in user interactions with IT. Omitting affective variables can neglect a significant part of the phenomenon thus limiting our progress in this research area. We hope to inspire more research efforts on considering both affective and cognitive factors into technology adoption research and other IS research areas that involve humans. For example, the next immediate research questions would be: what factors would contribute to one's affective

evaluations, such as PC-PA and PC-NA? How could we build IT in certain ways so that users would perceive IT's affective capability in a desirable way? Fortunately, there are some studies already on the way along these directions. More research efforts are needed.

This study offers a new approach to understand users' affective reactions of IT. Besides the theoretical basis we use, utilizing a longitudinal method allows us to unearth a number of interesting findings we would not be able to find otherwise. There is a lot of room for better understanding and continued exploration.

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