Affective Quality and Cognitive Absorption:
Extending Technology Acceptance Research

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Abstract

Agarwal and Karahanna (2000) suggested that holistic user experiences with IT contribute to users' evaluation of and reaction to using the technology. They proposed and empirically tested a construct named cognitive absorption that has preceding effects on important user technology acceptance constructs. We propose that an important antecedent of cognitive absorption is perceived affective quality (PAQ) of the target IT. Such perception is a user's impression on the IT itself prior to any other cognitive appraisal and evaluation on the consequences or potential interactions with the IT. Rooted in psychological work on affect and cognition, we develop a theoretical model that depicts the causal relationships among PAQ, cognitive absorption, cognitive beliefs, and IT use intention. A field study was conducted to validate this model. Our results indicate that PAQ is a strong antecedent to cognitive absorption, explaining 39% variances in it, and has direct impacts on cognitive beliefs.

1. Introduction

Understanding IT acceptance intention and behavior has gained tremendous attention in contemporary information systems (IS) literature. Over the years, several competing models have been developed. Despite the differences among the models, the convergence is that individual's beliefs about using IT have a significant influence on user's intention to use and actual usage behavior [1, 22]. Two such beliefs have been robustly tested: perceived usefulness (PU) and perceived ease of use (PEOU) of a particular IT [10, 11].

The antecedents of these cognitive beliefs and behavior intention (BI) vary among many studies that are driven by different perspectives on individual interacting with IT. Most of existing technology acceptance studies and models tended to focus predominantly on instrumental beliefs as drivers of individual usage intention. For example, technology acceptance model (TAM) posits that usage behavior is driven by the instrumental (perceived usefulness) and cognitive complexity (perceived ease of use) beliefs [1]. Agarwal and Karahanna, however, argued that holistic experiences with technology can serve as important explanatory variables in technology acceptance [1]. This argument is rooted in many decades of studies in psychology and is supported by abundant relevant investigations on user experiences, such as computer playfulness, enjoyment, flow, intrinsic motivation, and the recent movement to emphasize human affect and emotion in technology design within the fields of information systems and human-computer interaction.

In providing an alternative perspective to the dominant cognitive drives of technology acceptance, Agarwal and Karahanna [1] introduced the concept of cognitive absorption as the main determinants of the two cognitive beliefs. Cognitive absorption (CA) is a state of deep involvement or a holistic experience an individual has with an IT [1] and is heavily built on the concept of flow [9], absorption trait [21], and cognitive engagement [23]. Agarwal and Karahanna identified the following five dimensions of cognitive absorption: temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity. They proposed that two individual traits, personal innovativeness (PIIT) and computer playfulness (CP), are determinants of CA. Along with Self-Efficacy (SE), CA is hypothesized to be a proximal antecedent of the two dominant acceptance factors, PU and PEOU. The relationships among PU, PEOU, and behavioral intention (BI) were proposed to be consistent with many technology acceptance studies [10]: PEOU has a positive impact on PU, and PU and PEOU both positively influence BI. Although Agarwal and Karahanna provided very rich discussions and measures on cognitive absorption concept, they did not identify any other antecedents to CA besides the two IT-specific traits, computer playfulness and individual innovativeness in IT.

In this study, we propose that one type of affective reactions toward IT, perception of affective quality (PAQ) of an IT, is an important factor in user technology acceptance. PAQ is an individual's perception that an object has the ability to change his or her affective state [17]. We propose that PAQ functions as an antecedent to cognitive absorption (CA) and cognitive beliefs such as PU and PEOU. PAQ is directly related to the characteristics of IT and users' immediate impression on it prior to any in depth appraisal or evaluation of interacting with IT. Existing studies show that although built on immediate impression, PAQ is a more enduring affective reaction people have toward an IT, and its effect on other cognitive factors stay over time [24]. PAQ is possible to manipulate and therefore could have direct implications to IT designers to implement more affect-friendly or affect-aware technologies.

To concentrate on PAQ's anteceding effects on CA and cognitive beliefs, we omit other constructs in Agarwal and Karahanna's research including IT specific traits and computer self-efficacy variables. Our model is then empirically validated by a field study with 194 students in the Web environment.

This study has both theoretical and practical contributions. The theoretical contributions of this study are three-fold. First, we challenge the conventional cognition driven approach in studying user technology acceptance by examining the affective drives in user's reactions toward using IT. Second, we identify an antecedent of cognitive absorption and cognitive beliefs that is more fundamental and has more manipulability. This antecedent explains a large portion of the variance in cognitive absorption, and adds the explanatory power to the commonly studied PU and PEOU. Third, this study validates the psychometric properties of the cognitive absorption construct proposed by Agarwal and Karahanna (2000). This is an important contribution as the IS literature has demonstrated that additional evaluations and replications of existing studies or construct measurements are important steps in establishing our knowledge and provides the basis for future research. Aware of some limitations of their work, Agarwal and Karahanna (2000) also called for additional replications and more empirical investigations of CA. Practically, this study prompts IT designers, stakeholders and trainers to pay attention to another important factor that influences individual reactions toward using IT. This factor, perceived affective quality of IT, is one step closer to the actual design of IT features, which is one future direction pointed out in the study.

2. Literature Review and the Theoretical Model

Three streams of research contribute to our study. The first one is the abundant studies on technology acceptance model and its extensions and variations. The second is studies of cognitive absorption. The third is the advancement on the role of affect in everyday and normal social judgments in psychology, social psychology and organizational behavior disciplines.

Among many models developed to explain IT acceptance, technology acceptance model (TAM) [10, 11] is the most well known [20] and has been widely tested and extended. TAM posits that two particular cognitive beliefs, perceived usefulness (PU) and perceived ease of use (PEOU), are of primary relevance for behavior intention (BI). Moreover, abundant studies in psychology and IS have proved that BI is a strong predictor of actual use behavior.

Agarwal and Karahanna challenged the existing technology acceptance studies being predominantly concerned with instrumental beliefs as drivers of individual usage intention [1]. Rooted in many decades of studies in psychology and recent explorations in IS field, they believed that users' holistic experiences with technology can be important explanatory variables in technology acceptance. One such experience is cognitive absorption (CA), an intrinsic motivation related variable, as a state of deep involvement with technology. Building on existing psychology studies, five dimensions of cognitive absorption were identified: temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity. CA is the antecedent of the two dominating technology acceptance factors, PU and PEOU. Despite the importance and promise of this research direction, very few studies have replicated or extended the original theoretical and empirical models by Agarwal and Karahanna. Among the few existing studies, Saade and Bahli [19] applied the cognitive absorption concept in the online learning context and empirically validated the impacts of cognitive absorption on PU and PEOU. In their study, cognitive absorption has three out of the original five dimensions: temporal dissociation, focused immersion, and heightened enjoyment.

Advancements in psychology and organizational behavior on the understanding of the roles affect has on various social judgments can be used to guide our exploration of this concept in IT environments. In an attempt to incorporate various theoretical views and frameworks on emotion and affect as well as motivation, Russell defined several important affective concepts and a theoretical framework on prototypes of emotional episodes [17]. In the framework, the concepts of core affect, affective quality, and perception of affective quality are closely related to this research.

Core affect is a neurophysiological state that is consciously accessible as a simple, nonreflective feeling that is an integral blend of hedonic or valence value (pleasure-displeasure, the extent to which one is generally feeling good or bad) and arousal or activation value (sleepy-activated, the extend to which one is feeling engaged or energized) [16, 17]. The key aspect of this concept is that it is free of objects and therefore free of any cognitive structures implied. Core affect is considered to be primitive, universal, ubiquitous, and is the core of all emotion-laden occurring events [17].

Affective quality is the ability to cause a change in core affect [17]. Whereas core affect exists within the person, affective quality exists in the stimulus. Objects, places and events all have affective quality. They enter consciousness being affectively interpreted. Perception of affective quality (PAQ) is an individual's perception of an object's ability to change his or her core affect. It is a perceptual process that estimates the affective quality of the object. The perception of the affective quality of all the stimuli typically impinges at any one time (how pleasant, unpleasant, exciting, boring, upsetting, or soothing each is), then influences subsequent reactions to those stimuli [17].

Applying this PAQ concept to the IT environment, PAQ begins with how IT is being pleasant (valence value) and interesting (arousal value), and stays with IT without going deeper into any appraisals or evaluations on the consequences of potential interactions with IT. The above positions and discussions can be summarized in the model in Figure 1. The corresponding hypotheses follow.

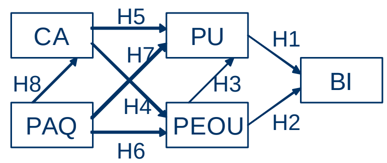

Figure 1. The theoretical model

The first three hypotheses (H1-H3) come mainly from numerous studies on the technology acceptance model (TAM) [10, 22]. Perceived usefulness is defined as the "degree to which a person believes that using a particular system would enhance his or her job performance." [10] PU has been found to significantly influence system utilization because a user's belief in the use-performance consequence. Perceived ease of use is a person's assessment that interacting with a system would be relatively free of cognitive burden [10]. It has shown that people are more likely to try a new technology if they perceive that little cognitive effort would be required for interacting with the system. Besides a direct impact PEOU has on BI, it has an indirect influence through PU. Davis argued that to the extent the lower cognitive burden imposed by a technology frees up attentional resources to focus on other matters, it serves the instrumental ends of a user [10]. The following hypotheses summarize the relationships among PU, PEOU and BI.

H1: Perceived usefulness of an IT has a positive effect on behavioral intention to use the information technology.

H2: Perceived ease of use of an IT has a positive effect on behavioral intention to use the information technology.

H3: Perceived ease of use of an IT has a positive effect on the perceived usefulness of the information technology.

H4-H5 are mainly from [1]. Agarwal and Karahanna argued that cognitive absorption is an underlying determinant of PEOU and PU. CA is expected to exhibit a positive influence on PEOU through all of its five dimensions. While experiencing temporal dissociation, the individual perceives herself as possessing ample time to complete a task, contributing to the perceived ease of use of the technology. With focused immersion, all of the attentional resources of the individual are focused on the particular task, thus reducing the cognitive burden level or mental workload. Amplified curiosity suggests that the act of interacting with the technology invokes excitement about available possibilities. Such excitement should serve to reduce the perceived cognitive burden associated with interaction. A sense of being in charge and exercising control over interaction should reduced perceived difficulty in task performance. Finally, heightened enjoyment means that enjoyable activities are viewed being less taxing [1].

Agarwal and Karahanna used self-perception theory [3] and cognitive dissonance theory [12] to justify the relationship between CA and PU. The basic logic is that individuals seek to rationalize their actions and reduce cognitive dissonance, a psychological state that arises when an individual holds two inconsistent cognitive structures at the same time. While in the cognitive absorption state, the individual rationalizes "I am voluntarily spending a lot of time on this and enjoying it, therefore, it must be useful." [1] Agarwal and Karahanna found empirical support of the theoretical model. Therefore, we have the following hypotheses on the relationships among CA, PEOU and PU.

H4: Cognitive absorption with an IT has a positive effect on the perceived ease of use of the information technology.

H5: Cognitive absorption with an IT has a positive effect on the perceived usefulness of the information technology.

The last three hypotheses (H6-H8) are specifically related to the role of PAQ. A number of recent studies in psychology argued that mood or core affect influences judgments. Russell's framework on emotional episode prototypes specifically stated that after the perception of affective quality of a stimulus, the individual would then assesses the stimulus' future prospectus and its relevance to her goals [17]. Such assessments of future prospectus and relevance to one's goals are very much similar to cognitive evaluations and beliefs. PAQ has two dimensions: pleasant quality and arousal quality that correspond to the two dimensions of one's core affect. The logic of PAQ's impact on PEOU is very similar to that of CA on PEOU. Both dimensions of PAQ should contribute to the individual's perceived ease of use: when the person considers the technology to be pleasant and interesting, the person would not perceive to have difficulty to interact with the technology. Feeling pleasant and being intrigued by the technology, the person would positively estimate the potential consequences of using the technology toward her goals according to the principle of mood congruence [4, 5]. Limited empirical evidence confirmed the positive roles PAQ has on PU and PEOU [24, 25]. Therefore, we have the following hypotheses.

H6: Perceived affective quality of an IT has a positive effect on perceived ease of use.

H7: Perceived affective quality of an IT has a positive effect on perceived usefulness.

By definition, PAQ is a person's estimation of whether a particular object, such as a technology, would change her core affect or psychological state [17]. A person may then be in such a state if she is so immersed by interacting with the object. According to Agarwal and Karahanna [1], CA is a psychological state that a person is in when interacting with a technology. It is reasonable to propose then that PAQ would occur before CA. The two dimensions of PAQ have direct connections to the five dimensions of CA. Seeing the technology to have the ability to make one feel pleasant and aroused can contribute directly and positively to eventually heightened enjoyment, amplified curiosity, focused immersion, being in control, and temporal dissociation. Therefore, we propose that:

H8: Perceived affective quality of an IT has a positive effect on cognitive absorption with the IT.

3. Methodology

To empirically test the model, a field study was conducted using survey method to collect data. Besides using the most commonly used structural equation modeling technique to validate the model, we applied Cohen's analysis as a supplemental tool to further explore the empirical evidence.

To maintain the continuity of the research stream on user experience with IT, we attempted to keep our methodology similar to Agarwal and Karahanna's study [1]. This includes the research type (a field study), the data collection method (questionnaire-based survey), the setting (university environment), and the sample (college students). The target technology was a university's website that students would use on a voluntary basis. The website provides rich information about the university for (prospective) students, faculty and staff, parents, visitors, and others. It offers university news, information of and links to departments and services (e.g., admission, enrollment, etc.), colleges and schools, and other activities or facilities that are related to on- or off-campus lives. Participants were 233 students (194 returned questionnaires were complete and usable) in a major northeastern university in the U.S. The sample represents a cross-section of majors and study programs (undergraduate and graduate). The researchers went to twelve classes and recruited the subjects on a voluntary basis. Students in these classes had access to the Internet. Questionnaires were collected during the class sessions. The questionnaire directed each subject to use a Web browser to visit the university's website and explore it to see whether this site could be useful for his or her university life. Then the questionnaire continued with measures of the constructs CA, PU, PEOU, BI, PAQ and demographic data.

Subjects averaged 21 years old (std.= 4.5); 62% were male, 54% were White, 25% Asian/Pacific Rim, and 21% other race. Subjects had an average of 10 years of using computers (std.=3.3), 7 years using the Web (std. = 2.1), and spent an average of 24 hours per week using the Web.

All constructs were measured using multi-item on 7-point Likert scales drawn from previously validated instruments, as shown in the Appendix. Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) were measured using Davis' original instrument [10]. Behavioral Intention to Use (BI) was measured using the items adopted by [1]. We adopted the cognitive absorption measure directly from [1]. Although questions were raised on several items with negative wording and low loadings [1], we decided to use the original wording largely due to the fact that at the time of our study, no other replications have shown whether the low loadings were caused by negative wording or other factors. The instrument for PAQ of IT was adopted from [18]. PAQ was measured along its 2 dimensions with 4 types of qualities, arousal, sleepy, pleasant, and unpleasant qualities. Each quality contained 5 adjective words. The subjects were asked to rate how accurately each word described the website on a 7-point Likert scale ("-3" = "Strongly disagree" and "3" = "Strongly agree").

The data analysis consists of three phases. Partial Least Squares (version PLS-Graph 03.00) is used for the first two phases. PLS has advantages of minimal demands on measurement scales, sample size, and residual distributions [7, 13]. It is also appropriate for predictive testing, rather than testing a well-developed theory [2, 6]. Given that the model in Figure 1 has never been tested, PLS is considered appropriate for this study.

In the first phase, confirmatory factor analysis (CFA) is conducted to assess the measurement model. All the constructs are modeled as reflective and most of the constructs in the model are measured using multiple indicators, rather than summated scales. The only exceptions are CA with five dimensions and PAQ with four dimensions. They are estimated by using a method of repeated indicators known as the hierarchical component model [15], because both CA and PAQ are second order factors. In the second phase, we use structural equation modeling technique to test the theoretical model. The structural model is estimated by using factor scores for CA's five indicators and PAQ's four indicators derived from the first stage. Since structural equation modeling cannot rule out alternative models in a given dataset, we include a third phase of analysis where we utilize Cohen's path analysis method [8] to further explore the empirical evidence about the causal relationships among major constructs.

4. Results

4.1. Measurement model

The measurement model was examined for convergent and discriminant validity. Convergent validity was assessed by reliability of items, composite reliability of constructs and average variance extracted (AVE). Discriminant validity was assessed by examining cross-loadings and the relationship between correlations among constructs and the square root of AVEs.

Reliability of items was assessed by examining each item's loading on its corresponding construct. A common rule of thumb suggests that the item loading should exceed .70. However, .50 is also acceptable for new applications or situations when other items measuring the same construct have high reliability scores [2, 6]. PLS analyses showed that four items (FI3r, AQ1, AQ5, and SQ5) exhibited loadings of less than .50 to their corresponding construct. They were dropped from further analyses. The measurement model was then re-examined. Table 1 shows the descriptive statistics of the constructs (excluding the dropped the items). Factor analysis results show that all loadings are above .50, and the majority above .70, indicating adequate reliability of items.

Table 1. Descriptive Statistics of Constructs

Construct	Mean	Std.
CA		
Temporal dissociation	-0.29	1.30
Focused immersion	-0.03	1.17
Heightened enjoyment	0.09	1.16
Control	0.68	0.97
Curiosity	-0.18	1.25
PAQ		
Arousal	0.36	1.09
Sleepy	-0.69	1.06
Pleasant	0.86	0.92
Unpleasant	-1.31	1.09
PEOU	1.13	1.23
PU	0.47	1.19
BI	1.45	1.28

Results for composite reliability are in Table 2, all largely meeting the 0.70 criterion [14]. AVE measures the amount of variance that a construct captures from its indicators relative to the amount due to measurement error [6]. It is recommended to exceed 0.5. As shown in Table 2, all the constructs met this guideline.

AVE is also suggested to serve as a means of evaluating discriminant validity [14]. The square root of the AVEs should be greater than the correlations among the constructs, which indicates that more variance is shared between the construct and its indicators than with other constructs. In Table 2, the shaded numbers on the leading diagonals are the square root of the AVEs. Off diagonal elements are the correlations among constructs. All diagonal numbers are greater than the off diagonal ones, indicating satisfactory discriminant validity of all the constructs. Another criterion for assessing discriminant validity is that no measurement item should load more highly on any construct other than the construct it intends to measure [6]. An examination of cross-factor loadings shows that all items satisfied this guideline. This indicates that PAQ and CA are different constructs confirmed by empirical evidence.

Table 2. Composite Reliability & Correlations of Constructs

	Items #	Composite Reliability	AVE	TD	FI	HE	CO	CU	AQ	SQ	PQ	UQ	PEOU	PU	BI
TD	5	.93	.73	.85											
FI	4	.89	.66	.62	.81										
HE	4	.90	.68	.64	.61	.82									
CO	3	.81	.58	.33	.35	.44	.76								
CU	3	.94	.83	.60	.63	.71	.39	.91							
AQ	3	.85	.65	.47	.42	.59	.36	.28	.81						
SQ	4	.89	.67	-.21	-.21	-.39	-.36	-.28	-.47	.82					
PQ	5	.88	.60	.32	.41	.54	.40	.51	.68	-.37	.77				
UQ	5	.91	.67	-.12	-.21	.49	-.45	-.28	-.33	.70	-.49	.82			
PEOU	4	.92	.74	.21	.31	.36	.56	.30	.23	-.27	.40	-.41	.86		
PU	4	.92	.73	.28	.35	.43	.32	.48	.41	-.30	.39	-.32	.47	.85	
BI	3	.97	.90	.17	.23	.19	.20	.24	.22	-.10	.25	-.15	.31	.54	.95

Table 3. Outer Model Loadings

CA-TD	.77
CA-HE	.87
CA-FI	.79
CA-CO	.66
CA-CU	.85
PAQ-AQ	.81
PAQ-SQ	.75
PAQ-PQ	.84
PAQ-UQ	.75
PEOU1	.81
PEOU2	.84

Table 3. Outer Model Loadings

PEOU3	.88
PEOU4	.91
PU1	.90
PU2	.89
PU3	.84
PU4	.78
BI1	.95
BI2	.96
BI3	.93

Note: All loadings are significant at .001 level.

Table 3 shows the outer model loading in the model context, indicating that all constructs have satisfactory indicator loading except CA-CO, which is slightly lower than .70. This will be discussed in the summary section.

4.2. Structural model

Figure 2 shows the result of the structural model. PLS does not use model fit indices. The explanatory power of a structural model could be assessed by the R square values (variance accounted for) in the dependent latent variables. Figure 2 shows that 29.2% of the variance in BI is explained by the model; 33.3% in PU by CA, PAQ and PEOU together; 23.8% in PEOU by PAQ and CA, and 39% in CA by PAQ.

All hypotheses but H2 are supported by the data. There is no evidence to show that PEOU has a significant impact on BI. This is no surprising because a number of previous technology acceptance studies indicate that this linkage is situational and not always significant [e.g., 22]. In general, the theoretical model in Figure 1 is confirmed. PAQ is a significant and positive antecedent of CA. Both PAQ and CA affect two cognitive belief variables PU and PEOU, which in turn influence behavior intention.

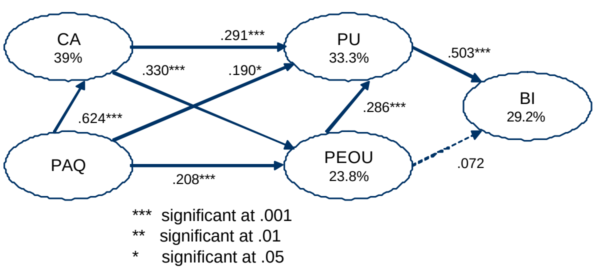

Figure 2. Structural model

4.3. Cohen's path analysis

Structural equation modeling (SEM) is limited in detecting causal directions in a path model thus cannot rule out alternative models in a given dataset. That is, if our theoretical model has CA->PAQ, meaning CA is the antecedent to PAQ, the model may still be confirmed by the same dataset due to the limitations of covariance-based methods such as SEM. In order to gain confidence that beyond the theoretical reasoning, the dataset is in favor of treating PAQ as the antecedent of CA, we utilize Cohen's path analysis method [8] as a supplementary analysis.

Cohen's method is a generalization of multiple linear regressions. The rationale underlying this method is that the estimated correlations based on path analysis should be as close as possible to the actual correlation. The estimated correlations are calculated based on both causal connectedness and directions of paths. Therefore, the "path" is critical. Change in the causal relationships causes changes "paths" through which some factors are connected with the others and subsequently influence the estimated correlations. The overall difference (or error) between estimated and actual correlations is thus an important indicator of the goodness of the proposed causal relationships. Cohen et al proposed to use the total squared error (TSE) between the actual correlation matrix and the estimated correlation matrix for the model as a model evaluation criterion [8].

In this study, we are particularly interested in the causal relationships involving PAQ and CA, because we believe that PAQ is an antecedent to CA as well as to PU and PEOU. The rest of the causal model including PU, PEOU and BI has been studied and confirmed extensively in previous research.

In conducting Cohen's analysis, we compare all possibilities (or legal paths in Cohen's terminology) of the causal directions between PAQ and the other three factors CA, PU and PEOU. We also considered the causal relationship between CA and PEOU since both direction, CA→PEOU and PEOU→CA, have theoretical support [cf. 1]. Theoretically, there are a total of 16 possible models[1] (=2^4). However, not all the models/paths are eligible according to the following rules: (1) a path cannot go through a node twice; (2) there must be a path from every variable to the dependent variable; and (3) the model should not include more than one undirected arc (for independent causes) [8]. As a result, eight out of the 16 models can be considered as candidate models, as indicated in Table 4.

The total squared errors (TSE) are calculated to compare all the eight models. The results (Table 4) show that the proposed model (Model 1) has the smallest total squared error of 0.077. In other words, this model minimizes the difference between estimated and actual correlations and fits

[1] For N relationships, there are 2^N possibilities since each relationship includes two possible directions (A→B and B→A).

the empirical dataset best. We therefore conclude that our proposed theoretical model is also empirically superior to other alternative models in terms of causal relationships.

Table 4. Summary of Cohen's Path Analysis

Model	Causal Direction	Total Squared Error
1	PAQ→CA PAQ→PU PAQ→PEOU CA→PEOU	0.077
2	**CA→PAQ** PAQ→PU PAQ→PEOU CA→PEOU	0.148
3	**CA→PAQ** PAQ→PU **PEOU→PAQ** CA→PEOU	0.199
4	**CA→PAQ** **PU→PAQ** **PEOU→PAQ** CA→PEOU	0.275
5	PAQ→CA PAQ→PU PAQ→PEOU **PEOU→CA**	0.121
6	PAQ→CA PAQ→PU **PEOU→PAQ** **PEOU→CA**	0.095
7	**CA→PAQ** PAQ→PU **PEOU→PAQ** **PEOU→CA**	0.106
8	**CA→PAQ** **PU→PAQ** **PEOU→PAQ** **PEOU→CA**	0.133

Note:
1. The bold are the relationships different from the proposed model (model 1).
2. Other relationships between among CA, PU, PEOU and BI stay the same for all the models

5. Summary and Conclusion

This study takes an affect-driven approach to extending the technology acceptance research. Besides confirming the important role of cognitive absorption on cognitive beliefs such as perceived usefulness and ease of use, we theoretically identify and empirically validate an important antecedent of cognitive absorption and cognitive beliefs: user's perceived affective quality of IT. This construct explains a significant amount of variance in CA (39%) and has significant direct impacts on both PU and PEOU. It is thus an important factor that contributes to our understanding of user's technology acceptance intention and behavior.

This study empirically evaluates the multi-dimensional cognitive absorption and perceived affective quality constructs in a similar setting with similar types of respondents as in Agarwal and Karahanna's study [1]. It thus has similar types of limitations as in [1]. These include the respondents and setting that may affect external validity of the study and the potential for common method variance to exist due to the data collection method [1].

Similar to earlier studies on PAQ in IT field [24, 25], we adopt the measurement of PAQ from a well validated instrument in psychology for affective quality attributed to surrounding environments [18]. We encounter similar results in that although in general the psychometric properties of PAQ is acceptable, some items (such as A1, A5, and S5) cannot load satisfactorily on their perspective factors and have to be dropped from further analysis. This indicates that the PAQ instrument is not quite suitable to the IT context and may need further refinement or adjustment.

This study confirms the psychometric properties of the CA construct in general, although one item (FI3r) of the Focused Immersion dimension has a low loading, and has to be dropped. Incidentally, this item was reversely scaled, as was the CO2r item that Agarwal and Karahanna found problematic in their study (belonging to the Control Dimension). Like Agarwal and Karahanna, we suspect that the overall convergence of this FI dimension might be improved by utilizing a positive wording of this FI3r item. CO2r has a relatively low loading in our study as well. But we decide to keep it in the study, because it is just slightly lower than .70, yet greater than .50. The entire CO dimension has a relatively low loading on CA (.66 as in Table 3) compared to the other four dimensions, although it is significant, and CA's composite reliability is satisfactory. This is very similar to what Agarwal and Karahanna found. Joining Agarwal and Karahanna, we encourage more empirical evaluations of the CA construct, especially the control and focused immersion dimensions, and the reversely scaled items.

Our study has both theoretical and practical implications. Theoretically, we challenge the long time cognition driven paradigm on technology acceptance research by supporting the holistic reactions humans have toward IT and go one step further to identify the primitive affective reactions that precede user's cognitive absorption and holistic experience.

Practically, our study calls IT designers' attention to affective qualities of an IT. Users may generate perception of the affective quality of an IT very quickly, usually before its functionality and usability are appraised. An uncomfortable feeling at the first glance can easily drive a potential user away. To attract and sustain more users and enhance user experience, IT practitioners should build IT that not only works well, but also elicits favorable perceptions in terms of affective quality. Thus besides developing IT that are perceived to be useful, easy to use, fun to use and get involved, it is even more important to make sure that IT has pleasant and interesting qualities as these qualities go a long way to enhance perceived usefulness, ease of use, and fun to use.

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7. Appendix. Survey Instrument

Perceived Affective Quality	Arousal quality		Sleepy quality	
	AQ1	intense	SQ1	inactive
	AQ2	arousing	SQ2	drowsy
	AQ3	active	SQ3	idle
	AQ4	alive	SQ4	lazy
	AQ5	forceful	SQ5	slow
	Pleasant quality		Unpleasant quality	
	PQ1	pleasant	UQ1	dissatisfying
	PQ2	nice	UQ2	displeasing
	PQ3	pleasing	UQ3	repulsive
	PQ4	pretty	UQ4	unpleasant
	PQ5	beautiful	UQ5	uncomfortable

Cognitive Absorption	Temporal Dissociation	
	TD1	Time appeared to go by very quickly when I was using the university website.
	TD2	I spent more time on the university website than I had intended.
	TD3	Time flew when I was using the university website.
	TD4	When I got on to the website, I ended up spending more time than I had planned.
	TD5	Sometimes I lost track of time when I was using the university website.
	Focused Immersion	
	FI1	While using the university website I was able to block out most other distractions.
	FI2	While using the university website, I was absorbed in what I was doing.
	FI3	When on the university website, I got distracted by other attentions very easily.
	FI4	While on the university website, I was immersed in the task I was performing.
	FI5	While on the university website, my attention did not get diverted very easily.
	Heightened Enjoyment	
	HE1	I had fun interacting with the university website.
	HE2	Using the university website provided me with a lot of enjoyment.
	HE3	Using the university website bored me.
	HE4	I enjoyed using the university website.
	Control	
	CO1	When using the university website I felt in control.
	CO2	I felt that I had no control over my interaction with the university website.
	CO3	The university website allowed me to control my computer interaction.
	Curiosity	
	CU1	Interacting with the university website made me curious.
	CU2	Using the university website aroused my imagination.
	CU3	Using the university website excited my curiosity.
Perceived Ease of Use	PEOU 1	It was easy for me to become skillful at using the university website.
	PEOU 2	Learning to operate the university website was easy for me.
	PEOU 3	I find it easy to get the university website to do what I wanted it to do.
	PEOU 4	I find the university website easy to use.
Perceived Usefulness	PU1	Using the university website would enhance my effectiveness in college.
	PU2	Using the university website would enhance my productivity in college.
	PU3	I find the university website would be useful in my college life.
	PU4	Using the university website would improve my performance in college.
Behavior Intention to Use	BI1	I plan to use the university website in the future.
	BI2	I intend to continue using the university website in the future.
	BI3	I expect my use of the university website to continue in the future.