THE EFFECT OF INSTANT EMOTIONS ON BEHAVIORAL INTENTION TO USE A COMPUTER BASED ASSESSMENT SYSTEM

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***Abstract*—Instant emotions affect our daily activities including learning procedures. This study examines which emotions influence learner's behavioral intention to use a Computer Based Assessment (CBA). We used Facereader during a self – assessment test to measure learner's instant emotions (Happy, Surprise, Angry, Fear, Disgust, Sad and Neutral) through facial expressions. In addition we used the Computer Based Assessment Acceptance Model (CBAAM) to evaluate the constructs that influence learners' behavioral intention to use a CBA. More specifically, this research aims at investigating the moderating effect of instant emotions on Behavioral Intention to Use a CBA system and the direct paths of the most important determinants such as Perceived Playfulness, Perceived Usefulness, Perceived Ease of Use, Perceived Content and Perceived Importance. An appropriate survey questionnaire was completed by 117 students. Results demonstrate that Emotions moderate the most important direct effects on Behavioral Intention to Use a CBA system and they play an important role in CBA's acceptance. Important implications of these results are discussed.**

Keywords— Emotions, Computer Based Assessment, Technology Acceptance, Affective Learning, Affect Recognition

I. INTRODUCTION

Computer Based Assessment (CBA) offers many advantages to learners and to educators [1]. The assessment/learning procedure is more personal, thus learners are able to recognize their strengths and their weaknesses. This is also important for educators since they are able to understand and provide more sophisticated guidance to each of their students. In addition the possibility of personalized feedback, the increased security, cost and time reduction are also very significant advantages of CBA ([2], [3], [4], [5]).

CBA's importance drives many researchers to investigate which determinants are important regarding CBA's acceptance. The Computer Based Assessment Acceptance Model (CBAAM) is a model that satisfactorily explains learners' intention to use a CBA [6]. Particularly, the CBAAM uses nine principal variables such as: Perceived Usefulness, Perceived Ease of Use, Perceived Playfulness, Perceived Importance, Social Influence, Facilitating Conditions, Perceived Content, Goal Expectancy and Computer Self-Efficacy in order to determine intention to use [7].

CBAAM is used and extended in order to better describe learners' intention to use a CBA. Useful results were provided regarding the effects of gender, personality and culture regarding the intention to use a CBA ([7], [8], [9]). Moreover, CBAAM was combined with new technologies such as Electroencephalogram (EEG) in order to provide better and more sophisticated measurements regarding important variables of CBA's acceptance [10].

Despite CBAAM's efficacy, there are many other important determinants that could affect learners CBA's acceptance. Recently, researchers' interest, regarding the role of emotions in learning procedures, has been increased ([11], [12], [13], [14]). It is well known, that positive emotions enhance learning and assessment procedures while negative emotions frustrate students and drive them to quit these kinds of activities.

Students' emotional experiences while using a CBA system may have some particularities which could also include "basic" emotions. For example, the effect of negative emotions, such as Sad and Fear, is too powerful, such as that the student's intention to use the CBA can be seriously decreased. CBA's difficulty could increase negative emotions and lead to even more wrong answers until the student's

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intention to use CBA and performance collapse [15]. In accordance, another important factor that could influence CBA's acceptance is the Fear of failure [16]. In contrast, positive instant emotions (e.g. Happy) might increase learner's willingness to use the CBA.

This paper investigates the moderating effects of instant emotions on the direct relationships among the most important determinants of learners' behavioral intention to use a CBA.

II. METHODOLOGY

A. Design of the Experimental Environment and Data Analysis

117 first-year students enrolled to the introductory informatics course, of a European University took place in our research. There were 45 males (38%) and 72 females (62%). The average age of students was 19.2 (SD=1.03). The participation to the CBA was voluntary. The course introduces informatics to the students. Students learn general concepts of Information Technology and algorithms. The CBA includes questions from this course.

CBA developed for a previous experiment, was customized based on the needs of the current study ([18], [19]). Throughout the assessment, a student selected his/her answer among four possible answers and confirmed his/her choice by clicking the "submit" button. The student could proceed to the next question by clicking the "next" button. Each student took the test alone in an appropriately designed room. The room had two spaces, divided by a curtain. In the first space, there was the PC on which the CBA was administered.

The two researchers were in the second space. Students' instant emotions during the CBA were observed by two independent researchers and the FaceReader. The FaceReader, developed by Vicar Vision and Noldus Information Technology, recognizes facial expressions by distinguishing six basic emotions (Happy, Angry, Sad, Surprised, Scared, Disgusted, plus Neutral) with an accuracy of 89 percent [19]. The system is based on Ekman and Friesen's theory of the Facial Action Coding System (FACS) proved that the basic emotions correspond with facial models [20]. People express their instant emotions more easily when they are not being observed; therefore the camera of the FaceReader was hidden in a bookcase in order not to disturb the sense of privacy. Researchers, in their PC, were able to watch 1) FaceReader's indications in real time, 2) student's actions during the test through VNC viewer software. The experiment was organized in such a way to accurately record students' instant emotions that really appeared during the use of CBA and to filter mislead data, since FaceReader is accurate at 87% during a CBA [21]. Thus, the two researchers made their judgments based on the student's facial and bodily expressions (captured on camera), FaceReader's emotional recordings, and the student's interaction with the system (observed through VNC viewer). Those three sources of information enabled the researchers to measure the student's instant emotions. After the end of the CBA, the students had to answer the CBAAM's questionnaire.

The questionnaire consisted of 33 questions corresponding to the 10 latent variables of CBAAM (Table 1). The seven point Likert-type scale with 1 = "strongly disagree" to 7 = "strongly agree" was used to measure the items.

Partial Least Squares (PLS) analysis was performed to analyze the measurement and the structural model ([22], [23], [24]). PLS was applied in the present study as it was an appropriate technique of analysis for smaller sample size and for researches in early stages of development ([25], [26], [27]).

The measurement model's reliability and validity are proved by the internal consistency, convergent validity and discriminant validity ([28], [29]). The required values and our model values regarding reliability and validity are presented in tables 1 and 2.

Regarding the structural model we applied two criteria: 1) the variance measured (R^2) by the antecedent constructs. Values of the variance equal to 0.02, 0.13 and 0.26 are considered as small, medium and large respectively [30]; (2) t-values or p-values through the bootstrapping procedure in order to measure the significance of the path coefficients and total effects.

Finally, SmartPLS 2.0 was used for data analysis [31]. SmartPLS uses the partial least squares (PLS) method.

B. Research Model

The aim of this study is to explore the moderating effect of instant emotions such as Happy, Surprise, Angry, Sad, Fear and Disgust on the most important CBAAM's causal relationships. For that reason in our research model we investigate the moderating effect of instant emotions only on the most crucial determinants that have a direct effect on Behavioral Intention to use a CBA such as 1) Perceived Playfulness, 2) Perceived Usefulness, 3) Perceived Ease of Use, 4) Perceived Content and 5) Perceived Importance (Fig.1). Next, we will briefly describe each determinant of the research model:

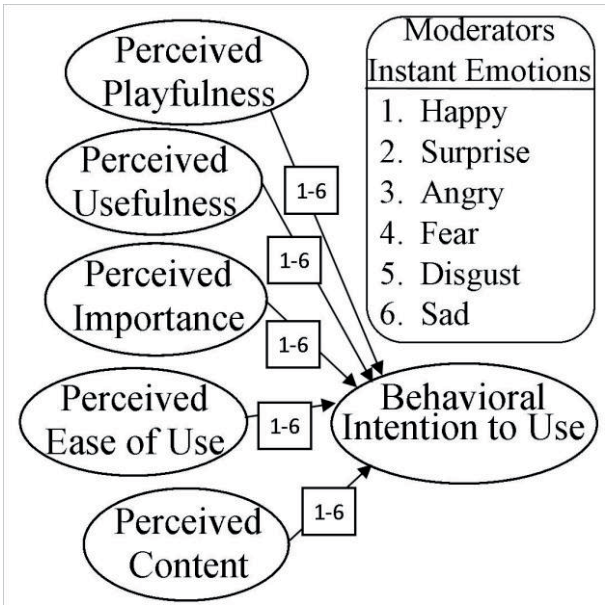

Fig. 1. Research Model

1) Perceived Playfulness

Perceived Playfulness (PP) is a three dimensional variable consisting of Concentration, Curiosity and Enjoyment. Previous studies showed that Perceived Playfulness has a significant positive effect on Behavioral Intention to use the Web [32] and on the Behavioral Intention to use a CBA [6].

2) Perceived Usefulness

Perceived Usefulness (PU) described as the degree to which a person believes that using a particular system will enhance his/her job performance [33].

3) Perceived Ease of Use

Perceived Ease of Use (PEOU) is defined as the degree to which a person believes that using the system would be free of effort [33].

4) Perceived Content

CBA's Perceived Content (PC) is defined by two aspects: 1) the students' perceptions about the course's content and 2) the students' perceptions about the questions during the CBA. Therefore, learners firstly evaluate the content based on their experience during the course, for example if it is difficult, interesting and useful and secondly during the CBA, if the questions are clear and understandable.

5) Perceived Importance

Perceived Importance (PI) measures how much important is the CBA for the learner. In Perceived Importance, the students actually rate the importance of the CBA regarding their courses, their academic performance and their academic future.

III. Results

In this section we demonstrate the data analysis' results. Table 1 confirms the convergent validity since the items' factor loadings, composite reliability and the average variance extracted exceed the adequate values, respectively. Tables 1 and 2 do not include instant emotions since these variables are not latent, therefore their values regarding Cronbach a, Composite Reliability and AVE are 1.

TABLE 1. Results for the Measurement Model

Constructs / Items	*F. L. (>.7)*[a]	*Cr. a (>.7)*[a]	*C.R. (>.7)*[a]	*AVE (>.5)*[a]
Perceived Usefulness (PU)		.88	.93	.82
PU1**:** Using the Computer Based Assessment (CBA) will improve my work.	.90			
PU2: Using the Computer Based Assessment (CBA) will enhance my effectiveness.	.93			
PU3: Using the Computer Based Assessment (CBA) will increase my productivity.	.88			
Perceived Ease of Use (PEOU)		.77	.87	.69
PEOU1: My interaction with the system is clear and understandable.	.84			
PEOU2: It is easy for me to become skilful at using the system.	.87			
PEOU3: I find the system easy to use.	.77			
Perceived Content (PC)		.83	.89	.67
PC1: CBA's questions were clear and understandable.	.87			
PC2: CBA's questions were easy to answer.	.85			
PC3: CBA's questions were relative with the course's syllabus.	.73			
PC4: CBA's questions were useful for my course.	.80			
Perceived Playfulness (PP)		.86	.91	.71
PP1: Using CBA keeps me happy for my task.	.77			
PP2: Using CBA gives me enjoyment for my learning.	.87			
PP3: Using CBA, my curiosity stimulates.	.86			
PP4: Using CBA will lead to my exploration.	.87			
Perceived Importance (PI)		.77	.86	.68
PI1: I believe that CBA is important for my course	.85			
PI2: I believe that CBA is important for my academic performance	.84			
PI3: I believe that CBA is important for my future	.78			
Behavioural Intention to use CBA (BI)		.89	.93	.81
BI1: I intend to use CBA in the future.	.92			
BI2: I predict I would use CBA in the future.	.88			
BI3: I plan to use CBA in the future.	.92			

[a] Indicates an acceptable level of reliability and validity, F. L. Factor Loading, Cr. a Cronbach a, C.R. Composite Reliability, A.V.E. Average Variance Extracted

Moreover, the discriminant validity is supported since the square root of the average variance extracted (AVE) of a variable is larger than any correlation with another construct. In table 2, the diagonal values are the AVEs and the rest values are the correlations between the variables.

TABLE 2. Discriminant validity for the measurement model

	BI	PC	PEOU	PI	PP	PU
BI	**.81**					
PC	.54	**.66**				
PEOU	.57	.61	**.68**			
PI	.35	.23	.19	**.68**		
PP	.63	.65	.46	.32	**.71**	
PU	.60	.65	.66	.28	.69	**.81**

Table 3 demonstrates the statistical significance of the structural model. To detect the moderating effect of learners' instant emotions on the relationships among learners' perceptions regarding Playfulness, Usefulness, Ease of Use, Content, Importance and Behavioral Intention to use the CBA, we create interaction constructs among each learners' instant emotions and each of the five aforementioned determinant of Behavioral Intention to use the CBA ([34], [35]). In order to measure p-values we applied a bootstrap procedure with 1000 resamples.

TABLE 3. Results of learners' instant emotions moderating effects

MODERATING EFFECT	COEFFICIENT	T-VALUE	SIGNIFICANCE
PPxHappy→BI	0.31	2.22***	YES
PPxSurpise→BI	0.21	1.99**	YES
PPxAngry→BI	0.24	2.03**	YES
PPxSad→BI	-0.14	1.83*	YES
PPxFear→BI	-0.09	1.81*	YES
PPxDisgust→BI	-0.06	1.12	NO
PUxHappy→BI	0.24	2.79***	YES
PUxSurpise→BI	0.11	1.62	NO
PUxAngry→BI	-0.02	0.55	NO
PUxSad→BI	-0.24	2.60***	YES
PUxFear→BI	-0.14	1.86*	YES
PUxDisgust→BI	0.14	0.42	NO
PEOUxHappy→BI	0.34	2.63***	YES
PEOUxSurpise→BI	0.05	1.45	NO
PEOUxAngry→BI	-0.15	1.00	NO
PEOUxSad→BI	0.14	1.49	NO
PEOUxFear→BI	-0.03	1.36	NO
PEOUxDisgust→BI	0.02	0.52	NO
PCxHappy→BI	0.17	1.80*	YES
PCxSurpise→BI	-0.14	1.86*	YES
PCxAngry→BI	-0.04	1.24	NO
PCxSad→BI	-0.19	1.99**	YES
PCxFear→BI	-0.27	1.97**	YES
PCxDisgust→BI	0.09	1.02	NO
PIxHappy→BI	0.37	2.91***	YES
PIxSurpise→BI	-0.25	1.91*	YES
PIxAngry→BI	-0.11	0.87	NO
PIxSad→BI	0.23	2.49***	YES
PIxFear→BI	-0.06	1.29	NO
PIxDisgust→BI	0.03	0.64	NO

Table 3. Hypothesis testing results, *p < 0.1, **p < 0.05, ***p < 0.01.

IV. DISCUSSIONS AND CONCLUSIONS

This research tries to figure out how learner's instant emotions affect the acceptance of a Computer Based Assessment System. The study showed that learner's instant emotions influence the relationships of CBAAM. Particularly, we found that Happy is the most influential instant emotion since it has a significant positive moderating effect on the relationships between Perceived Playfulness, Perceived Usefulness, Perceived Ease of Use, Perceived Content, Perceived Importance and Behavioral Intention to use the CBA. Angry instant emotion has a significant positive moderating effect only on relationship between Perceived Playfulness and Behavioral Intention to Use. Fear and Sad instant emotions have a significant negative effect on relationships between Perceived Playfulness, Perceived Usefulness, Perceived Content and Behavioral Intention to use the CBA, while Sad has also a negative effect on the relationship between Perceived Importance and Behavioral Intention to Use. Surprise instant emotion has a significant positive moderating effect only on the relationship between Perceived Importance and Behavioral Intention to use the CBA, while it has a negative moderating effect on the relationship between Perceived Playfulness, Perceived Content and Behavioral Intention to use the CBA.

Results showed that the most influential positive instant emotion is Happy. This means for learners with many Happy instant emotions during the CBA, that their perceptions regarding Playfulness, Usefulness, Ease of Use and Content of a CBA system are stronger determinants of Behavioral Intention to use the CBA than the corresponding perceptions of learners without many happy instant emotions. This is a very logical result. Learners with many Happy instant emotions, obviously find the procedure playful, useful, and easy to use. Therefore, their perceptions regarding Playfulness, Usefulness and Ease of Use have a higher influence on their Behavioral Intentions. In addition, another factor that creates Happy instant emotions was the CBA's Perceived Content. Specifically, students' perceptions regarding Content strongly influence their Behavioral Intention to use the CBA, when they experience many Happy instant emotions.

Surprise is also an instant emotion that impacts CBAAM. However its results are controversial. First, Surprise instant emotion increases the impact of Perceived Playfulness on Behavioral Intention to use the CBA. Second, Surprise instant emotion decreases the effect of Perceived Content and Perceived Importance on Behavioral Intention to use the CBA. Obviously, learners that experienced Surprise instant emotions found some CBA's features (e.g. an unexpected question) as disadvantages. The results indicate that learners who perceived their selves as well prepared and recognized the procedure as important did not want surprises. Surprise instant emotions were an indication of unmatched learner's perceptions and reality regarding CBA's Content and Importance. Consequently, results indicate that Surprise instant emotions probably will not increase learner's intention to use the CBA. This is a very interesting result that future studies should examine. More specifically, it should be examined under which circumstances Surprise instant emotions have a positive or a negative effect on CBA's Intention to Use.

Another important result is that Angry instant emotion has a positive moderating effect of Perceived Playfulness and Behavioral Intention to Use the CBA. Despite the fact that Angry instant emotion is considered as a negative instant emotion, its effect on the relationship between Perceived Playfulness and Behavioral Intention to use the CBA is positive. This might be explained by the fact that learners with Angry instant emotions were self-motivated to answer better to the next questions of the CBA more than learners with low rate

or without Angry instant emotions. This also means that learners with high Angry instant emotions were more passionate with the system and they treat the CBA as a computer game that each right question is a win and each wrong question is a loss. Therefore, they perceive Playfulness as a more important determinant to use the CBA than the other learners. However, feature studies should analyse if there is a high limit of angry instant emotions for learners that could frustrate or drive them to quit. Of course this limit is personal and depends on each learner's perceptions and goals regarding CBA.

Sad and Fear instant emotions have a negative moderating effect between Perceive Playfulness, Perceived Usefulness, Perceived Content and Behavioral Intention to use the CBA. Sad instant emotion has also a negative moderating effect between Perceived Importance and Behavioral Intention to use the CBA. Specifically, we could argue that individuals with higher rate of Sad and Fear instant emotions are less influenced by Perceived Playfulness, Perceived Usefulness and Perceived Content to use the CBA. This is an expected result. Learners that did not answer correctly the CBA's questions or they did not understand them or they did not prepare for the CBA, probably they did not found CBA playful, useful and with the right content. In addition, they express their sadness and their fear many times through their faces captured by the FaceReader. Thus, these negative instant emotions (Sad and Fear) reduce the effect of Perceived Playfulness, Perceived Usefulness and Content on Behavioral Intention to use the CBA.

Finally, Disgust instant emotion does not have any moderating effect on the research model's relationships. Probably, Disgust is an instant emotion that it is quite difficult to be expressed by students' facial expressions and consequently be captured during the use of the CBA.

To our best knowledge, this is the first study to indicate that student's instant emotions could influence positively or negatively the most crucial causal relationships regarding students' Behavioral Intention to Use the CBA. Table 4 illustrates the sign of the instant emotions' effects on the direct causal relationship among the most important variables and Behavioral Intention to Use the CBA.

TABLE 4. Instant emotions moderating effects on causal relationships

	Happy	Surprise	Sad	Fear	Angry	Disgust
PP→BI	+	+	-	-	+	/
PU→BI	+	/	-	-	/	/
PEOU→BI	+	/	/	/	/	/
PC→BI	+	-	-	-	/	/
PI→BI	+	-	-	/	/	/

"+" Indicates a positive effect, "-" Indicates a negative effect, "/" Indicates no effect

To conclude, this paper provides useful information to practitioners, researchers and educators regarding the effect of instant emotions on CBA's acceptance. It is the first time those instant emotions where captured and measured during a CBA and analysed regarding their effects on CBA's acceptance. Future studies have to be applied in this direction with different samples with other characteristics (e.g age, course, culture) for further confirmation. More and more, technology gives us new opportunities to measure emotional and physiological data. Facial Expressions are not the only solution to measure instant emotions. Instant emotions could also be measured by other equipment, such as Electromyography (EMG), Galvanic Skin Response (GSR), and EEG. The integration of different sources of data and their combination with traditional self-report methods would provide innovative explanations in the context of Technology Acceptance. This kind of data, as the data measured and analyzed in this research paper, could provide solid scientific ground in order to deliver more personalized and sophisticated CBA's systems based on learners' interactions with these systems.

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