

A Study on Persuasive Technologies: The Relationship between User Emotions, Trust and Persuasion

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ABSTRACT

A successful persuasive technology is able to persuade people to change from one state to a more well known state. Therefore, to allow for a change, persuasive technology must be able to affect users' emotion and make the user trust the technology so that they will adopt the persuasive technology into their daily life routine, as well as continue to use the technology for long period. This paper is aimed to study the relation between users' emotion with trust and persuasion and how they may contribute to the success of changing a person attitude or behavior towards a certain context or issue. Twenty five participants have completed the study in 6 weeks by using two types of persuasive technology that were assessed at three different interaction stages: pre, during and post. Result shows that emotions have a significant effect on trust, whereas the effect of emotions on persuasion using the persuasive technology was mediated by trust.

KEYWORDS

Emotion, Persuasion, Trust, Persuasive Technology.

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I. INTRODUCTION

NOWADAYS, computing technologies are not only designed to help human performing daily tasks such as doing the administration work, or teaching in the classroom, but also to persuade and motivate people to change an attitude or behavior toward issues or objects. This type of computing technology known as persuasive technology is defined as "a technology that is designed to change attitudes or behavior through persuasion and social influence, but not through coercion" [1]. To persuade simply means to convince and therefore, trust is one of the key aspects of persuasion. It is the key to underpin confidence in user in using persuasive technology and also gives credence on the provided information or advices delivered through it which usually manifest themselves in the form of a change in attitude or behavior [2]. Since persuasion used specific strategies to elicit emotions in persuadees, that differ it from conviction where the strategies are primarily based upon reasoning [3]. Hence, as a consequence, emotion could play an important role in supporting behavior to build trust.

Particularly, there has been an increasing study on the influence of emotion on trust [4][5][6]. Those studies proved that emotion has brought impact and may alter the decision to trust with different emotion having different impacts. However, similar study that is related to persuasive technology is yet to found except [7][8]. Clearly, persuasion is a positive way compared to the negative meaning associated with coercion, thus emotion is consider to be the ideal means

to promote trust since it plays an important role in transmitting the induced emotion from a computer or computer software to the user [2]. This study is indeed motivated by the notion that (i) user's emotions is another important component towards the establishment of trust [9] and (ii) emotion could have a powerful influence over cognition and decision-making that could lead to cognitive actions to change someone attitude, as suggested by a number of research studies and theoretical models [10]. Thus, the objective of this study is to examine the relationship between emotion, trust and persuasion and how they affect each other. The next section of this paper will further describe the proposition of the relationship and the methodology used to study the proposition. Next, the result and discussion is presented to explain the discovered relationship. Lastly, the paper ends with conclusion.

II. BACKGROUND STUDY

Emotion has been defined in several ways by researchers in scientific community. According to Johnson-Laird et al [11], emotion is a feeling of emotional states, whereas Ortony et al [12] stated that emotions involved positive or negative valence, for example happy is a positive valence emotion while anger is under negative valence dimension. Emotions are acute, intentional states, which exist in a relatively short period of time, are related to a particular event, object, or action [13].

There were three reasons that make emotion a primary aspect of the experience of trust [14]; (i) experience of trust embodies affect whether in terms of intense feeling or subtle, (ii) different affective state may affect a person's experience of trust in making judgment towards others trustworthiness and (iii) trust is part of emotional that built on expectations. The lack of trust problem was still prominent and become the main concern in using persuasive technology

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[15]. Therefore, emotion is seen as the importance component that contributes to trust a persuasive technology. Not to mention, a number of researchers have put emotions as an important consideration in understanding the development of trust and its changes, for example, Williams [16] and Andersen and Kumar [17] suggested that emotions influence how people judge on others' trust, Tomlinson and Mayer [18] agreed that emotions have impact on trust repair, and a study showed that people experiencing positive valence (i.e. happy and gratitude) are more receptive to increase their trust level [6]. This could somehow summarize that expectation that we expect upon interaction is constitute by positive or negative feeling that we felt which lead to judgment or decision-making about something or someone.

In this study, emotions are classified into two aspects of condition, namely the emotional states and emotional experience. Mental representation is the idea of something that could be reported [19] which in this case, it is related to the emotional state. Emotional states is referred to as conscious experience of emotional states that can be reported in terms of emotional words such as angry, happy, scared and sad. In appraisal theory, feeling is a mental representation of emotional experience, a state of conscious experience of emotion [13]. Emotional experience is the emotional response resulting from individual experience in using technology [20]. Emotional experience that user experienced is depending on the appropriateness of the interaction events with user's goal and values, and how user control the interaction event as well as their reaction towards the event [20]. Therefore, emotional experience can be used to show user 's emotional response that classified as pleasant (positive) or unpleasant (negative) resulting from interaction with technology.

Positive emotional response can build a sense of trust and engagement with users. People will forgive shortcomings occurred in an application or technology if the application or technology reward them with positive emotion. Therefore, a deep understanding of user emotions is an important aspect to establish trust and strengthen the persuasion process. Thus, we hypothesized that the emotion construct (i.e. emotional states and emotional experience) will predict trust in persuasive technology.

H1: *Emotion will positively affect trust in persuasive technology.*

A scientific definition of trust that is well accepted across disciplines is unclear. We illustrated several researchers' definition on trust that suited to our study. Mc Allister [21] defined trust as "the extent to which a person is confident in, and willing to act on the basis of, the words, actions, and decisions of another". In addition, Rousseau et al. [22] established trust definition as "a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another". However, trust in persuasive technology is defined as the expectation that users have on the technology to perform as it should be without harming the user [23]. Based on the overall definition of trust, we view trust in this study as the confidence towards the persuasive technology in carry out things as it supposed to do.

Consistent with the literature study on human perception in making trust evaluation [21][24], users' trust consist of cognitive and affective trust. Cognitive trust is referred to as elements that can increased trustworthiness towards a technology whereas affective trust is emotional response towards a technology [25][26]. As both perceptual beliefs are interconnected [21], therefore, trust in persuasion technology should be studied in both aspects to study the overall users' trust. Since trust is one of the key elements in the process of persuasion [1], one need to be persuaded repetitively in repetitive interactions which will only possible to happen if users trust the systems. Since [6] have discovered that emotion has influence on trust, we expect that its effect on persuasion using persuasive technology would be positively mediated.

H2: *Trust in persuasive technology will positively mediated the relationship between emotion and persuasion using persuasive technology.*

H3: *Trust will positively affect persuasion using persuasive technology.*

In addition, persuasion is defined as an individual's subjective evaluation of persuasive technology used and its impact on the self [27]. It is a form of influence to change the way a person's believe, behave, or feel [23]. Crano and Prislin [28] argue that the main aspect to be taken into account when it comes to persuasion involves the construction of basic attitudes. Persuasive technology is a human-computer persuasion since it promotes a method of persuasion using a computer technology [1]. Although computer is a non-living object, the intentionality to persuade is actually comes from the creator, distributor and the people who adopt the technology. The fact that trust is an important attributes in human-computer interaction (HCI) where trust has relation with computer designer's responsibilities to ensure that people who adopt the technology to change their attitude or behavior should achieve the desired intend of what the designers want to accomplish [23]. In the beginning, creating and providing people with persuasive technology may work primarily, however, after sometime it may create persuasion disorder and weaken trust [9]. Thus, emotion is seen as a component that can build confidence and strengthen the power of persuasion in persuasion technology. Thus, the following hypothesis is built.

H4: *There is a relationship between emotion, trust and persuasion in the use of persuasive technology.*

III. METHODOLOGY

To investigate the hypothesized role of emotion in this study, a total of 30 participants volunteered university students and staff from public and private university were employed for the study, in which 25 of them managed to complete the study in 6 weeks to use and evaluate two persuasive technology, fitness application and environmental game each represent different types of persuasive technology; tool and medium. The tool category PT consist of *MyFitnessPal*¹, *Fitocracy*² and *MapMyFitness*³ that allows for fitness monitoring including physical activity or/and food consumption. The medium category PT, *Fitocracy* and *MapMyFitness* have same goal to create awareness on issues of environment.

Different experimental design approaches were used to measure different aspect of evaluation. User emotions were measured at three stages of interaction; pre, during and post, while user's trust were measured in pre-post interaction stages, whereas, persuasion were measured in post-interaction stages. Quantitative measurement scales for each aspects of evaluation were adopted from several studies. Each measurement for aspects of evaluation was using a 5-point Likert scales. Two types of measures were used to evaluate construct of emotion; Geneva Emotion Wheel (GEW) [13][29] that consist of 20 items is used to measure emotional states while Positive and Negative Affect System (PANAS)[30] which also consist of 20 items (10 items of positive valence, 10 items of negative valence) is used to measure emotional user experience. Meanwhile, measurements of trust in PT consist of 10 items. Four of them measured cognitive trust [31] whereas six items measured affective trust [25]. User evaluations towards the PT and its effect on user after 6 weeks of usage were measure using three items from [27].

The hypotheses testing was conducted using regression and correlation analyses to investigate the effect of variables (i.e. emotion, trust) towards persuasion using persuasive technology

1 <http://www.myfitnesspal.com>

2 <http://www.fitocracy.com>

3 <http://www.mapmyfitness.com>

from pre-interaction to post-interaction as suggested by the theory of prominence-interpretation [1]. For that reason, a dummy (D) variable is created to clean the time factors in emotion and trust variable since each variables were measured at three (pre-during-post) and two (pre-post) interaction stages, but not for persuasion variable as it was measured in post-interaction stage only. The value of “0” is given to pre-interaction and value “1” is given to post-interaction.

IV. FINDINGS AND DISCUSSIONS

The background profile of participants is presented in Table I. The study which involved 25 participants was dominated by fifteen female participants compared to ten male participants in whom eighteen of them are Malays. The participants come from five different age groups; each seven of them from group below 25 years, between age 26 to 30 years, and between age 31 to 35 years, while three participants were from age group 36 to 40 years and only one participant was above 40 years old. These participants consist of twenty two university students from UKM, UiTM and UPM, as well as eight university employees from UKM, Nottingham University and UniKL. Out of the twenty five participants, 32 percent of them were from the IT background.

The results analyses of the hypotheses testing are presented in Table I and Table II.

From the results in Table I, we can see that the correlation coefficient suggests that the user’s emotions and user’s trust in persuasive technology have a moderate linear relationship, and found to be .195 indicates 19.5% of the variance in trust, $F(2, 47) = 5.69, p < 0.05$ shows that user’s trust changes significantly with respect to differences in user’s emotion. The equation on the influence of user’s emotions towards user’s trust in using persuasive technology is $2.305 + 0.074\text{Emotion}$. The relationship between emotion and trust in persuasive technology was positive ($\beta = .353$) with trivial effect size ($B = 0.07$). As predicted, effect on user’s emotions influenced user’s trust in using persuasive technology, thus supporting H1. This mean, for each increment or decrement happens in user’s emotions will affect the increment or decrement of user’s trust towards persuasive technology. Result from this finding demonstrates that positive emotions (increment in valence) will increase user’s trust level, whereas negative emotions (decrement

in valence) will led to the decrement of user’s trust level [4][6][32].

Our model of emotion which constitute of emotional states and emotional experience explains 13.5% of the variance in trust. Of these two variables, emotional experience makes the largest unique contribution ($\beta = .345, p < 0.05$) compared to emotional states that makes insignificant contribution ($\beta = .044, p > 0.1$) to user to trust persuasive technology. This finding was unexpected and suggests that the mixed emotional states (i.e. consist of different valence and control) that users experienced and rated in evaluating the persuasive technologies have lead to this result in which different emotional states have different effect on trust. This finding corroborates the findings of [33], who found that different emotions caused different effects on people’s judgment. Moreover, based on the reasons behind the experienced emotional states that users felt in this study, most of the users’ emotional states were triggered by individual lead control, in this case, emotions of self-control (user) and emotions of other-person control (system, i.e. persuasive technology). It seems possible that these results are due to the simultaneous experience of positive and negative emotional states that occurred from different source of control in which [4] claimed that emotional states trigger by self-control will have no influence on trust, while emotional states trigger by the used systems will determined users whether or not to trust. Hence, measuring emotional states as a whole seems to not affecting trust.

In Model 1 of the regression model on persuasion in Table I, user’s emotions is significantly ($p < 0.05$) related to persuasion with 25.1% variance in persuasion. However, to examine the mediation effect of trust on the relationship between user’s emotion and persuasion using persuasive technology, correlation coefficient in Model 2 suggests a strong linear relationship between user’s emotions and persuasion that mediates by user’s trust which can be explained by 74.3% of the variance in persuasion using persuasive technology, $F(2, 22) = 31.73, p < 0.001$. Since the user’s emotion variables exerts its total influence through the mediating variable, $p > 0.1$ ($\beta = .051, p = 0.69$), there exists full mediation by the trust variable giving support to H2. The equation suggesting that trust mediates the relationship between user’s emotions and persuasion $-0.758 + 0.015\text{Emotion} + 1.129\text{Trust}$. This finding suggests that users’ trust will increase when they felt positive emotions; thus the likelihood for the users to be persuaded is higher when they

TABLE I. SUMMARY OF REGRESSION FOR VARIABLES PREDICTING TRUST AND PERSUASION

Dependent Variables	Trust			Persuasion					
	Model 1			Model 1			Model 2		
	B	SE B	β	B	SE B	β	B	SE B	β
Independent Variable									
User emotions X ¹	.073	.028	.353**	.148	.054	.501**	.015	.038	.051
Mediator									
Trust in persuasive technology Y ₁							1.129	.174	.833***
R		.442			.501			.862	
R ²		.195			.251			.743	
Adj. R ²		.161			.218			.719	
R ² Change		.195			.251			.492	
F		5.692**			7.668**			31.732***	

Note: *** $p < 0.001$, ** $p < 0.05$, * $p < 0.1$

TABLE II. PEARSON PRODUCT-MOMENT CORRELATION BETWEEN VARIABLES

Variables	X	Y	Z
X. Emotion	-		
Y. Trust	.349*	-	
Z. Persuasion	.501*	.861**	-

Note: ** $p < 0.001$ (2-tailed), * $p < 0.05$ (2-tailed)

have high trust in the persuasive technology which corroborates the ideas of [9], who suggests design for persuasion, emotion and trust. Trust is important to persuasion in using persuasive technology as it may affect users' intention to use the technology as well as leverage the continuation used of the technology [34]. The effect of emotions that were exerted into trust should encourage user to develop confident towards the persuasive technology and at the same time increase the persuasion effect on them.

As shown in Table II, there was a moderate, positive correlation between user emotions and trust in persuasive technology ($r_{xy}=.35, p<0.05$), with positive emotions associated with high level of trust and negative emotions associated with low level of trust. A strong, positive correlation was found between user emotions and persuasion using persuasive technology ($r_{xz}=.50, p<0.05$) as well as between trust in persuasive technology and persuasion using persuasive technology ($r_{yz}=.86, p<0.001$) with the positive association indicates that increases in one variable correspond to increases in the other.

V. CONCLUSION

A persuasive technology should be design to be able to elicit positive emotions in users using different persuasion principles or strategies in making them to trust the technology and thus, successfully persuade users to the target attitude or behavior. As predicted, the relationship between users' emotions in using persuasive technology and trust towards persuasion is found to be positive. It can be presumed that positive emotions increase user's trust, while negative emotions will impact user's trust by decreasing it. The effect of emotions on persuasion is found to be mediated by trust positively and thus indicates the association between the three variables. Nevertheless, this study managed to shed some lights on the effect of users' emotions on users' trust and persuasion in using persuasive technology. The findings could encourage for further investigation on emotions elements used in persuasive technology that could leverage trust and persuasion.

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