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THE IMPACT OF PERSUASIVE TECHNOLOGY ON USER EMOTIONAL EXPERIENCE AND USER EXPERIENCE OVER TIME

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ABSTRACT

Experience is key in deciding whether or not to adopt a system such as persuasive technology, which aims to persuade people to take up a targeted attitude or behavior. Thousands of persuasive technologies have been developed for commercial and academic uses; however, many studies on experience have mainly been conducted on products and none have focused on studying experience in the context of persuasive technologies. Therefore, this study aims to investigate emotional experience and user experience when using persuasive technology. Twenty-five participants comprising university staffs and students were given 6 weeks to use two different persuasive web applications—one on health and the other on environmental issues. A pre-post interaction approach was carried out to analyze the participants' emotional experiences; Positive and Negative Affect Schedule (PANAS) instruments and questionnaires were used to assess user experience based on the pragmatic, hedonic, and appeal quality of the web applications. From 20 PANAS emotions, only six emotions were found to have significant impact. Although

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a significant change happened in user experience perceptions from the pre-interaction to post-interaction stages, no significant change happened in user emotional experience. The findings imply that the changes in user experience perceptions over time may contribute towards altering persuasion, whether by increasing or reducing persuasion via persuasive technology. As a result, this study contributes new information to the theory of designing persuasive technology such that more concern is put on the hedonic quality and appealingness of a system for greater user experience and an emotionally impactful and successful persuasion.

Keywords: Emotional experience, hedonic dimention, persuasive technology, user experience.

INTRODUCTION

The field that utilizes computer technology to persuade people is known as persuasive technology. It is defined as technology that is created to assist attitudes and behavioral change without using oppression, but through persuasion and social influence (Oinas-Kukkonen & Harjumaa, 2008). For example, an email messaging system was used as a tool to study the behavior among respondents who aim to quit smoking (Lenert et al., 2004). The study managed to find higher quit rates among individuals that were provided with timely educational messages rather than the ones that did not receive these messages.

One of the critical issues in developing a technology or an application is experience (Forlizzi & Battarbee, 2004). For each technology or application that is developed to persuade people, experience determines the decisions that the user makes. Emotion is one of the human components that influence user experience. It can act as "a resource for understanding and communicating about what the user experiences" (Forlizzi & Battarbee, 2004, p. 264). This shows that emotion and user experience (UX) are related to each other. Emotion study has turned out to be an important research subject in Human-Computer Interactions (Partala & Kallinen, 2012; Wan Nooraishya & Nazlena, 2013; 2016). Emotion acts as a response to a feeling that a person has towards the artifact or the interaction that a person encounters with the artifact. For example, a user may feel disappointed or shameful after looking at the result of a progress chart of his or her calorie intake, which may affect the targeted weight loss. In other example, emotions such as anxiety and boredom restrict user from reaching its most level of experience in performing particular

acitivty (Wang et al., 2015). The term 'emotional experience' is used to signify the emotional outcomes that the user experiences, which can be classified into positive or negative emotions, resulting from a persistent use of persuasive technology.

UX and user emotional experience studies usually consider positive experiences (Hassenzahl & Tractinsky, 2006), satisfied and unsatisfied experiences (Hassenzahl et al., 2010; Partala & Kallinen, 2012), the full range of emotional experiences (Hazlett & Benedek, 2007; Partala & Kangaskorte, 2009) and UX over a period of time (Karapanos et al., 2009; Karapanos et al., 2010). Yet, all the studies that have been conducted mostly investigated a product (i.e. mobile phones) rather than a system. Emotion is a property of user experience (Park et al., 2011). For instance, spoken utterances in interpersonal interaction between individuals can provide information about a person's emotion. This will in turn trigger the other person's emotion, thus add to the property of their user experience (Mohd Nazid et al., 2015). Therefore, the elements used in designing the interface of a system such as persuasive technology will affect user experience, thus determining the emotional experience of the user. Even though emotion is responsible for the user eventually trusting a system (Wan Nooraishya and Nazlena, 2016), this study also believes that persuasive technology should offer positive experience for the user to continue adopting and using the persuasive technology and to assist them in changing their attitude, perception, or behavior. Persuasive technology has been employed especially in the domains of health (Myneni et al., 2013; Mohamad Lutfi et al., 2015, Nurul Ulfa et al., 2017), and environment (Mohamad Lutfi et al., 2015, Shih & Jheng, 2017; Anagnostopoulou et al., 2018). However, very little studies can be found on user experience in persuasive technology. The works of Segerstahl et al. (2010) and Tromp et al. (2011) stand out as the few in this field. Hence, this study aims to contribute new information on persuasive technology by studying the user's emotional experience and user experience by examining the changes in user experience and user emotional experience over time after persistently using persuasive technology. The objective of this study is to examine the differences in emotions and user experience when interacting with persuasive technology.

BACKGROUND STUDY

Persuasive Technology

Persuasion is as "an attempt to shape, reinforce, or change behaviors, feelings or thoughts about an issue, object or action" (Fogg, 2003). Technology is defined as persuasive technology when it meets three criteria (Fogg, 2003). First, the

persuasion process must be embedded in the Human-Computer Interaction (HCI) artifact. Second, the effect of the persuasion is planned and intentional. Third, the persuasive intention must be endogenous, or "built-in" into the product, as if the persuasive appeals came from the product itself. Moreover, Fogg (2003) differentiates three different roles that a computer could play towards becoming a piece of persuasive technology. First, a computer could act as a tool to increase user capabilities so that the target behavior can be more easily met, guide them through the process, and provide measurement or calculations that will motivate the users to move forward to achieve their target. For example, a weight loss application is considered as a tool if it provides features such as a body mass index (BMI) calculator and a calorie counter that allows the user to monitor his or her weight. Second, acting as a medium, a computer can also persuade people by providing experiences for them and allowing them to rehearse a behavior or explore the relationships of cause-and-effect by providing roles in an interactive-experience computer simulation. For example, a simulation game such as Stop Disaster allows the user to explore the cause-and-effect relationship in preventing disasters such as floods and tsunamis, specifically preventing adverse financial impacts in the aftermath. Third, a computer can be depicted as a social actor that creates a relationship with the users through providing social support via rewarding people with positive feedbacks. It is important to note that the third role of computer technology as a persuasive technology was not included in the current study as a stimulus to be evaluated.

Recent works have suggested that successful persuasive technology is based on positive user experience felt during interactions with the system used, for example, the evaluation that has been made by weight loss websites (Segerstahl, et al., 2010). This evaluation studies user experience from the perspective of persuasive techniques. It does this by identifying the drawbacks of the techniques that produce negative experiences in users. It was discovered that persuasive techniques such as self-monitoring, social facilitation, and suggestion demands extreme cognitive effort and emotional reactions from the user. One study on product design to alter human behavior proposed a notion that user experience is affected by the user intention and motivation to behave differently (Tromp et al., 2011). The study modeled user experience of a product into four continents (i.e. strong-apparent, weak-apparent, strong-hidden, and weak-hidden) with each of it exerting the types of influence that a product can carry: coercive, persuasive, seductive, and decisive. The study also outlined 11 design strategies, which fit with the four continents of the modeled user experience. Looking at past researches, this study however argues that being selective with persuasive techniques or applying different design strategies to improve user experience alone may not be an effective

approach for designing a successful persuasive technology if a system does not manage to provide a positive user experience nor trigger positive emotional experience from its user.

User Experience and Emotion

The concept of user experience (UX) is still lacking in definition (Law et al., 2008). However, according to ISO 9241-210 (2010), UX is defined as "a person's perceptions and responses that results from the use or anticipated use of a product, system or service". According to Hassenzahl (2004), UX exists from over-time interactions between a user and a system due to the changes in perceptions and emotions. In addition, UX affects the way the user evaluates a system through different components such as perception of instrumental and non-instrumental qualities, and from the emotional response (Mahlke & Thuring, 2007). Qualities of pragmatism, hedonism, and level of appeal were the earliest crucial concepts of user experience (Hassenzahl et al., 2000). Pragmatic quality is related to the functions and the design issues of a system, which enable people to accomplish task-related goals. Some of the variables used to evaluate pragmatic qualities are predictability, trustworthiness, and controllability. Hedonic quality refers to the attractiveness quality of a system that is not related to the task of user performance when using the system (such as interesting, originality, and innovativeness), which may be crucial to the user when assessing a system. The evaluation of pragmatic quality alone is not sufficient to assess the perceived quality of a system, thus integrating the evaluation of hedonic quality will bring impact to the evaluation as a whole. Thus, the combination of user judgment on both pragmatic and hedonic qualities will be used as the basis to evaluate a system's appeal.

For this study, the Positive and Negative Affect Schedule (PANAS) by Watson et al. (1988) is chosen as a method to assess emotional experience because of its capability to measure emotional experience over various time durations (i.e. momentarily, weekly, etc.). Besides that, the construct is valid and reliable for measuring what it is intended to measure (Crawford & Henry, 2004). In addition, the method has also been widely used in many studies related to the evaluation of user experience (Hassenzahl, 2008; Hassenzahl et al., 2010; Partala & Kallinen, 2012). Since human emotional experiences are formed from various emotional states, classification of emotional experiences in terms of positive and negative valences make it easy to identify the group of emotions experienced by users. PANAS consists of 20 emotions; 10 positive and 10 negative emotions. The positive emotions are: interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, and active. On the contrary, the negative emotions are: distressed, upset, guilty, hostile, irritable, ashamed, nervous, jittery, and afraid.

Positive experiences were the most studied experiences relating to emotions of user experience (Hassenzahl, 2008; Hassenzahl et al., 2010). PANAS was used as an instrument to assess emotions on autonomy, competence, and relatedness associated with the theory of self- determination in a study on the structure of positive experiences with technology (Hassenzahl, 2008). The study discovered that the source of positives experiences is autonomy and competence. Another study was conducted to examine the level of satisfaction regarding UX with technologies such as mobile phones and computers (Hassenzahl et al., 2010). The study exposed that in most satisfactory experiences, user emotions were found to have a correlation with the perceived hedonic and pragmatic qualities and also fulfilment of needs. Emotions such as feeling active, strong, proud, alert, and determined were found to significantly correlate with these qualities.

In addition, a study was carried out on an online learning tool to investigate variations of UX in terms of user emotions, psychological needs, and contexts (Partala & Kallinen, 2012). Using the PANAS system, the research study managed to discover 16 significant differences in user emotions. For most satisfactory experiences, the user was found to experience higher levels of positive emotions compared to moderate levels, and had low levels of negative emotions. Meanwhile, for most unsatisfactory experiences, the user experienced positive emotions on a moderate level and negative emotions marginally below moderate levels. Stimulation and identification of user experiences caused variations in positive emotions, whereas the enormous variations in negative emotions were attributed to issues in pragmatic quality. Hazlett and Benedek (2007) used EMG to detect facial muscles to investigate various ranges of emotional experiences, via measuring user emotions in two different interaction stages, which were pre-interaction and during interaction. The study found that facial EMG is limited in measuring emotional valence and information on specific emotions such as happy or sad was not provided. In a study to measure user's emotional valence and arousal when using interactive media, Partala and Kangaskorte (2009) used a non-pictorial Self-Assessment Manikin (SAM).

In a temporal study on user experience, various qualities of UX were found to be the factors that encourage the continued use of a technology (Karapanos et al., 2009). In the pre-interaction stage, the users were more focused on the hedonic quality, whereas in post-interaction, the aspect of how technology becomes important or significant to the user gained the most concern. Karapanos et al. (2010) conducted another study using the same approach albeit using the iScale tool. Although many research studies on UX were carried out on a temporary basis, only a few works studied user experience over time. Yet, empirical studies on persuasive technology related to emotional experience and perceived user experience have not been established as much.

METHODOLOGY

Participants

Initially, the study recruited 30 participants based on their interest in health and environmental issues as well as their willingness to commit to a long-term experiment. However, only twenty-five participants managed to complete the overall stages of the experiment, which took six weeks to finish. The participants consist of 15 females and 10 males, who are among university staffs and students. The participants were recruited through advertisements in flyers and via Facebook. The age group of the participants is dominated by the age groups ranging from 21-to-25 years old, 26-to-30 years old, and 31-to-35 years old, with 7 persons representing each group. Three participants were in the age group of 36-to-40 years old and only one participant was in the range of 41-to-45 years old. We believed that this number of participants is considered big for longitudinal experiment as other studies by Gomez et al., (2009), Karapanos et al. (2009) and Kujala et al. (2011). Nine participants were recruited in a six months study on portable interactive devices such as MP3 and PDA (Gomez et al., 2009). Meanwhile, in user experience study, six participants were involved in a five weeks study on iPhone (Karapanos et al., 2009) and 20 mobile phone users participated in eight months study on smart phone usage over time (Kujala et al., 2011).

Experimental Design

Table 1 shows the design of participants in 3×2 matrices. Six groups were formed so that a restricted number of participants would be allocated for each group. All participants were randomly assigned to the groups such that a different pair of applications from health and environmental was used. For example, participants in group 1 used the pairing of MyFitnessPal and Stop Disaster, while group 2 used the pairing of MyFitnessPal and Pandemic 2. Group 3 participants used Fitocracy and Stop Disaster pair whereas participant in group 4 used Fitocracy and Pandemic 2 pair. The pairing of MapMyFitness and Stop Disaster is used by participants in group 5 and the pairing of MapMyFitness and Pandemic 2 application is used by participants in group 6. The design of participants was a mixture of between-subject design and within-subject design to allow each participant to get the opportunity to use both health and environmental applications simultaneously for 6 weeks. The selection process of the participants is explained in the next paragraph. The pre-interaction and post-interaction phases were designed to study the user's emotional experience and UX. Pre-interaction is the initial stage of user assessment conducted after

the participants have made the initial interaction with the applications, while post-interaction is the final assessment that participants make after their final interaction with both applications. Participants used both applications for six weeks on their own initiative.

Table 1

Design of Participants for Application Use

Health application	**Environmental game**	
	Stop Disaster	*Pandemic 2*
MyFitnessPal	Group 1	Group 2
Fitocracy	Group 3	Group 4
MapMyFitness	Group 5	Group 6

Procedures

Selection of participants: All participants voluntarily participated. Each had to go through a selection process before being assigned the applications to use. Firstly, the participants were asked to answer a physical activity questionnaire by Marcus and Forsyth (2003, p.21) to define their intention for performing physical activities. Based from the results, only those who were in the stages of contemplation, preparation, decision/action, and maintenance were recruited as participants. This is to ensure that the selected participants are ready and prepared for change since this study is related to the use of persuasive technology with the purpose of changing a person's behavior or attitude. In addition, selection of participants was also based on the stages of readiness for change, which will also help minimize participant withdrawal from the study. Next, a briefing about the range of applications selected for the study was introduced and the purpose of the applications, as well as how they work were also explained to the selected participants using a slide presentation.

Materials: To determine the web application to be included in the study, a process flow ranging from searching to screening was conducted. Several keywords were used to determine persuasive applications from the health and environmental sustainability domains by performing an online search. Table 2 presents 11 operational variables used for the tertiary levels of the screening process. The operational variables in the first screening level excluded applications that did not fulfill the general criteria used to define persuasive application, whereas the second screening level consist of seven operational variables excluded persuasive applications that did not fulfill the needed specific criteria. The third level of screening process is concerned with

the content of the persuasive application where it has to suit all range of users and is also applicable to the local people, in which persuasive applications that did not fulfill the criteria is excluded. As a result, the screening process managed to find five persuasive web-based applications that fulfill the needed requirements for the study, with three of the applications being related to health and two to environmental issues. The three health applications were MyFitnessPal, Fitocracy and MapMyFitness, played the role as tools to assist and increase user capabilities to achieve the desired target behavior by tracking physical activities and calories intake. Meanwhile, Stop Disaster and Pandemic 2 were the environmental games that acted as a medium to simulate the cause and effect relationship of disasters, for example flood and diseases spreading. Table 3 presents the source for the five applications. The Pandemic 2 application is yet to be studied compared to the other four applications. The important aspect for choosing these five applications is that each of the applications from the same domain shares the same goal, although they have different features and functionality. The shared goal of the health applications—MyFitnessPal, Fitocracy and MapMyFitness—is to allow for physical activity and weight-loss monitoring. The shared goal for the environmental applications—Stop Disaster and Pandemic 2—is to provide awareness to users relating to environmental issues i.e. pandemic diseases and disaster deterrence. Table 4 outlines the persuasive features and strategies of the selected persuasive web applications. Monitoring and tracking are examples of strategies mainly used in persuasive applications which act as a tool that provides features such as progress graph that allow users to monitor and to keep track of their physical activities and food consumptions through the calories burn and intake. Simulation is the strategy used in persuasive applications that act as medium to simulate the cause-and-effect relationship for certain scenarios such as disasters and diseases spreading.

Table 2

Definition of Operational Variables

No.	Level	Variables	Definition	Inclusion Aspects Based on Definition
1	1	Persuasive application	Gives information or provides features that are aligned with the characteristics of persuasive technology, as per Fogg (2003) and Oinas-Kukkonen & Harjumaa (2008)	Fulfill the required definition

(continued)

No.	Level	Variables	Definition	Inclusion Aspects Based on Definition
2	1	App platform	Applications can be accessed via online or offline and whether through web, iOS or android platforms	Application has to be online, web only, or can also be accessed via iOS or android platforms
3		Theme	States the issue or focus of the application; e.g. weight loss, physical activity, water saving, recycling, etc.	As long as it belongs to the health and environment domain
4	2	Type of app	The provided features have defined the type of persuasive technology based on the functional triad (Fogg, 2003): whether it is a tool, medium, or social actor	Application should from tool or medium type only
5		Target user	Identifies the primary targets for the application (e.g. age, gender, child, elderly)	Application should be targeted to a non-specific group of users
6		Delivery	Identifies language used to deliver the application to the user	Application should be in English or has the option for an English version
7		App availability	Inform whether the application is free to use, or has to be purchased or a trial period provided	Application is provided for free
8		Interactivity styles	Provides a wide-range of interactivity styles between the user (e.g. form-filling, menu selection, etc.) and the application (e.g. suggestion, etc.)	Application has more than one interactivity style
9		Device collaboration	Identifies whether the application requires a wearable or external device such as a pedometer, wristband, joystick, webcam, etc.	Does not require wearable or external devices to use with the application
10	3	App content	Identifies the content that fits with all ranges of users regardless of country and level of education	Content fits all ranges of user regardless of country and level of education
11		Focus of content	Identifies whether the content meets the demands of the local community (as a user), setting (user environment), and policies	Suits the local community (as a user), or setting (user environment) or policies

Table 3

Persuasive Applications Dataset

Application Name	Domain	Source/Reference of Application
MyFitnessPal	Health	http://www.myfitnesspal.com; Liang et al., 2014; Vaquero & Lopez, 2016
Fitocracy	Health	http://www.fitocracy.com; Vaquero & Lopez, 2016
MapMyFitness	Health	http://www.mapmyfitness.com; Vaquero & Lopez, 2016
Stop Disaster	Environment	http://www.stopdisastergame.org/en/playgame.html; Katsaliaki, & Mustafee, 2012; Coakley & Garvey, 2015
Pandemic 2	Environment	http://pandemic2.org

Table 4

Summary of Selected Persuasive Applications

Applications	Description	Examples of Persuasive Features	Examples of Used Persuasive Strategies
MyFitnessPal	A monitoring tool to assist weight loss and stay fit based on the calculation of calories from food intake and performed exercises.	Progress graph, calorie calculator	Monitoring, tracking, personalization
MapMyFitness	A monitoring tool that can record food intake and performed exercises through the calculation of calorie intake and calorie burned.	Progress graph, BMI calculator	Monitoring, tracking, personalized recommendations
Fitocracy	A fitness tracking tool cum social network for fitness application. The system uses gamification principles to motivate users such as using bonus quests, level ups, and badges.	Points, badges, level up	Competition, Recognition, monitoring, tracking
Stop Disaster	A simulation game on the prevention of disasters such as flood, tsunami, hurricane, etc. The game educates people on how to prevent and minimize the disaster so as to reduce the aftermath cost.	Report, disaster alert bar, key facts	Simulation, recommendation
Pandemic 2	A simulation game on the spread of disease. The game educates people on how diseases spread across the globe by recognizing the symptoms.	Information of affected regions	Simulation

Experiments: The same questionnaire was used for the health application and the environmental application, which were then distributed at specific seats in the lab. The participants were required to answer the section on demographic details on arrival. The same experimental procedure was repeated whenever the participants tried out different applications (App 1- health application, App 2- environmental game). The following description describes this procedure in more detail:

- *Pre-interaction*: The experiment for this stage was conducted on the first day. A period of one hour was set for the experiment to be completed, which consists of two sessions. The first 20 minutes requires the user to explore App 1 and the next 20 minutes was allocated to explore App 2. For the relaxation phase at the beginning and in-between each session, participants were given five minutes to listen to a calming sound and watch a calming view using the Calm web-based application (http://www.calm.com). A demo on using the application was conducted before the participants were permitted to try the applications by themselves based on given tasks. The demo was conducted using a slide presentation whereby a range of screenshots relating to the given tasks were presented and explained to the participants. After completing the task, the participants were required to answer the questionnaires.
- *Post-interaction:* The study in this stage was conducted in Week 6. Lab experiments are not required in this stage. Roughly 20 minutes were used to finish the same set of questionnaires on emotional experience and user experience. The questionnaires were answered based on the user's six-week experience using both App 1 and App 2. Using the Calm application, participants spent five minutes to relax at the beginning and in-between each session. After finishing the questionnaires, participants were permitted to leave the lab. A token of appreciation was given to the participants at the end of the post-interaction stage.

Tasks and Measures

Generally, similar tasks were outlined for the health application and the environmental application. The tasks are described as follows:

- *Health application:* First, for all types of health applications i.e. MyFitnessPal, Fitocracy and MapMyFitness, registration of user account using email or Facebook is required to access the applications. Then, the user needs to set up a profile and set the targeted goal. Next, using the provided database, the user can make a diary of physical activities and/or food consumptions. For starters, the user is requested to make a "yesterday" and a "today" diary. Lastly, the user needs to

look for the feedbacks or advice produced by the system, derived from the entered data.

- *Environmental game:* First, for the Stop Disaster game, the user has to select the 'easy' game level. For the Pandemic 2 game, the user needs to pick a role to play i.e. as a virus, bacteria or parasite. Then, in the given time frame and/or budget, the user has to play the game to complete the mission. Finally, the user can see his or her accomplishment from the report generated by the system.

The tasks illustrated above are mainly for the pre-interaction stage. In the post-interaction stage, no task is assigned to the participants except that they must answer the same set of questionnaires given in the pre-interaction stage purely based on their six-week interaction with both the health and environmental applications. As for the weekly interaction, a weekly WhatsApp message is sent to all participants (all of whom have been invited into a WhatsApp group) as a reminder to use the applications as often as they can and record their activities as well as answer the questions in the given interaction diary. However, to avoid bias in the process of persuasion where coercion is a 'No', no specific weekly activities or tasks were assigned to the participants. Participants were given freedom to use the applications in their own way by performing the available provided functions and observing their own progress through the progress chart or reports from the applications. Nevertheless, the findings of the weekly interaction are not reported and discussed in this paper.

In both interaction stages, participants were asked to evaluate their emotional experience and user experience from the beginning until the final extent of experiencing it. User experience is related to user emotional experience (Hassenzahl, 2010; Park et al., 2011). Hence, the users must answer both questionnaires so that the interaction between the user and the persuasive applications in persuading the user to change his or her behavior through the application can be determined. Using the original order of PANAS, participants had to evaluate 20 emotions from a scale of 1-5 (1 indicating "not at all" or "very slightly", and 5 indicating "extremely") comprising ten positive and ten negative emotions (Watson et al., 1988). The positive emotions are: interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, and active. On the contrary, the negative emotions are: distressed, upset, guilty, hostile, irritable, ashamed, nervous, jittery, and afraid. On the other hand, the scales for user experiences were derived from the work of Hassenzahl et al. (2000) and measured using 7-point semantic differentials based on the pragmatic, hedonic, and appealingness qualities of the applications, with the lowest rating representing the positive adjectives. Table 5 presents the adjectives for measuring user experience.

Table 5

The Adjective Pairs used to Measure User Experience

User Experience Perception	Adjectives
Pragmatic	Comprehensible – Incomprehensible
	Supporting – Obstructing
	Simple – Complex
	Predictable – Unpredictable
	Clear – Confusing
	Trustworthy – Shady
	Controllable – Uncontrollable
	Familiar – Strange
Hedonic	Interesting – Boring
	Costly – Cheap
	Exciting – Dull
	Exclusive – Standard
	Impressive – Nondescript
	Original – Ordinary
	Innovative – Conservative
Appealingness	Pleasant – Unpleasant
	Good – Bad
	Aesthetic – Unaesthetic
	Inviting – Rejecting
	Attractive – Unattractive
	Sympathetic – Unsympathetic
	Motivating – Discouraging
	Desirable – Undesirable

Sources: Hassenzahl et al., 2000.

Data Analysis

User experience was analysed and categorized into two segments. A paired-sample t-test was used to compare differences in user experience as a whole and according to the user experience dimension i.e. pragmatic, hedonic, and overall attractiveness. The independent-sample t-test was used for gender comparison of user experience and its dimension. Meanwhile, a Wilcoxon signed rank test was used in the second segment of the analysis to analyse the pair-wise comparison of user experience and its dimensions according to the categories of application. To analyze the rating responses for user experience, the 7-point semantic differential scales were coded in SPSS using scales of 1-7 with 1 representing the positive adjectives and 7 representing the negative adjectives. Mean values of adjectives of less than 4 suggest a positive response, while mean values greater than 4 indicate a negative response.

Similarly, emotional experience was also analysed and categorized into two segments. The first segment analysed emotional experience as a whole, whereas the second segment analysed emotional experience according to the category of applications. Hence, for the first segment, the paired-sample t-test was used to compare the differences between both interaction stages of positive and negative emotions as well as the items under all PANAS emotions, and an independent-sample t-test was used for the gender comparisons of positive and negative emotions and all PANAS items. The second segment analysis of emotional experience used Wilcoxon's matched pair rank test in all the pair-wise comparisons for both interaction stages and for each item under the PANAS emotions. Table 6 summarizes the statistical analyses used in this study.

Table 6

Summary of Statistical Analysis

Statistical Analysis	**Purpose of use**
Paired-sample T-test	To analyze the differences in user experience as a whole for both pre-interaction and post-interaction.
	To compare the differences in user experience in terms of pragmatic, hedonic, and appealing quality for both pre-interaction and post-interaction.
	To analyze the differences in emotional experience as a whole for both pre-interaction and post-interaction.
	To compare the differences in emotional experience according to categories of application for both pre-interaction and post-interaction.
Independent-sample T-test	To analyze gender comparison for user experience and its quality.
	To analyze gender comparison for emotional experience and its PANAS items.
Wilcoxon Signed Rank test	To compare the differences in user experience in terms of pragmatic, hedonic, and appealing quality according to categories of application for both pre-interaction and post-interaction.
	To compare the differences in emotional experience for each items under PANAS emotions according to categories of application for both pre-interaction and post-interaction.

FINDINGS

This section describes the findings of user experience, emotional experience, and gender differences when using persuasive technology. The findings are presented into two segments: as a whole and according to the category of application. The results are further split into separate sections for emotional experience, and user experience. Table 7 summarizes the demographic data of the participants. From the total of 25 participants, 22 of them were university students from UKM, UPM, and UiTM while the other three participants were university staffs from UKM, UniKL, and University of Nottingham Malaysia. Although all participants were IT literates, only 18 of them had the experience of using similar kinds of persuasive applications, with most of the applications related to health. Some of the participants have less than 6 months of experience in using the related persuasive applications, while others have the experience between 6 months to 1 year.

Table 7

Demographic Data of Participants

Variable	Value	Frequency	% of Respondents
Gender	Male	10	40.0
	Female	15	60.0
Age (years old)	21-25	7	28.0
	26-30	7	28.0
	31-35	7	28.0
	36-40	3	12.0
	41-45	1	4.0
Ethnic	Malay	18	72.0
	Others	7	28.0
Education	Foundation Level	2	8.0
	STPM/Diploma	1	4.0
	Bachelor's Degree	9	36.0
	Master's Degree	13	52.0
Field of study	IT	8	32.0
	Engineering	4	16.0
	Business & Finance	1	4.0
	Pure Science	5	20.0
	Social Arts & Social Science	6	24.0
	Others	1	4.0
Designation	Student	22	88.0
	Employee	3	12.0

User Experience

Figure 1 presents the mean ratings for the three components of user experience perception. The smaller the mean rating, the better the quality of the applications. From the graph, we can see that the user perception of pragmatic quality is smaller than the hedonic and appealing quality in both interaction stages. Hence, in terms of task-related goals, the users think that all applications have what it takes to allow them to perform a task towards achieving the goal of either creating awareness of environmental issues or monitoring physical activities and weight loss. On the other hand, the hedonic quality has the highest mean rating compared to the other qualities in both interaction stages, followed by the appealing quality.

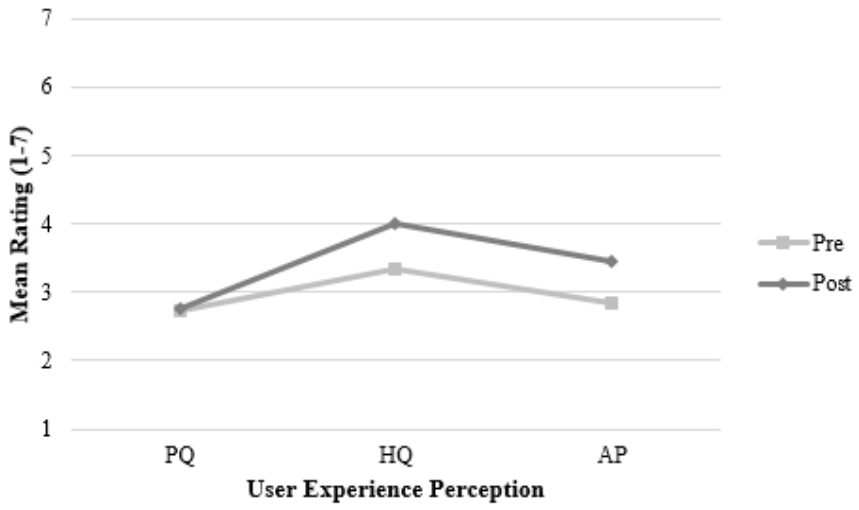

Figure 1. Mean Ratings of User Experience Perceptions (indicates PQ = pragmatic quality, HQ = hedonic quality, AP = appealingness quality).

Based on Figure 2, the participants rated the three perceptions of user experience: pragmatic, hedonic, and appealing quality that comprises 23 adjectives with nearly similar ratings. The data informs the comparison of user ratings on the adjectives in the pre-interaction and post-interaction stages throughout the persuasive applications. In both interaction stages, the responses to all adjectives of pragmatic quality for the persuasive applications were regarded as positive. In the meantime, the hedonic quality of the persuasive applications was rated as interesting (HQ1), exciting (HQ3), impressive (HQ5), original

(HQ6), and innovative (HQ7) in the two interaction stages. Yet, the persuasive applications were labeled as cheap (HQ2) in response to the negative hedonic quality in both stages of interaction. Earlier, in the pre-interaction stage, the persuasive applications were labeled as exclusive (HQ4), however in post-interaction, it was later scored as standard. For both interaction stages, the appealing quality of the applications was labeled as pleasant (AP1), good (AP2), aesthetic (AP3), inviting (AP4), attractive (AP5), motivating (AP7), and desirable (AP8), but different labels were given to AP6 in the pre-interaction stage, where the applications were labeled as sympathetic, and later labeled as unsympathetic in post-interaction.

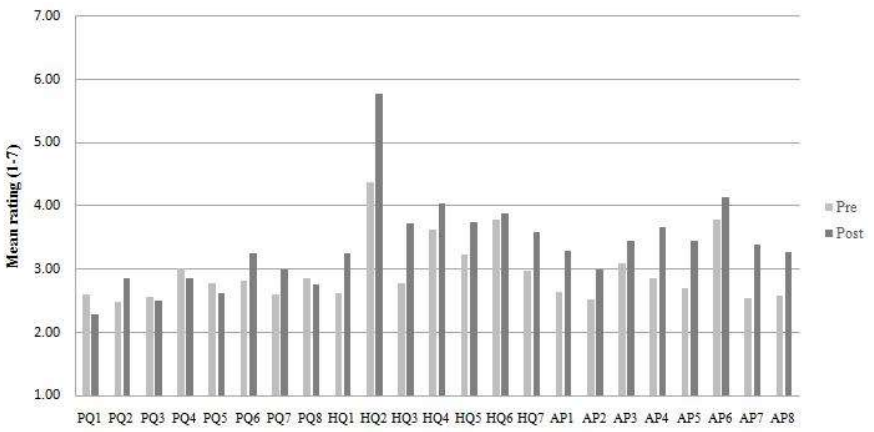

Figure 2. Mean Ratings of the Adjectives on User Experience (indicates PQ = pragmatic quality, HQ = hedonic quality, AP = appealingness quality).

The finding shows that significant differences were found in the user experience perceptions of the participants from pre-interaction (M = 2.97, SD = 1.11) to post-interaction ((M = 3.41, SD = 1.30), t (49) = 2.79, $p<0.05$). The changes in perceptions of user experience were attributed to the games rather than the health applications, as the significant changes in user experience when playing the games increased steadily from Md = 3.05 to Md = 4.24, Z = 2.34, $p<0.05$. In addition, the perceptions of user experience were studied to determine the perception with the most significant impact on user experience when using the persuasive application. The analysis shown in Table 8 shows that the hedonic and appealing perceptions affected user experience and were significantly strong from pre-interaction to post-interaction. Both perceptions increased substantially with a larger effect size.

Table 8

Paired-sample T-Test Analysis on User Experience (UX) Perception

UX Perception	N	Pre-interaction		Post-interaction		Sig.	Eta effect size
		Mean	*Std. Dev.*	*Mean*	*Std. Dev.*		
Pragmatic	50	2.72	1.15	2.77	1.11	0.74	0.002
Hedonic	50	3.34	1.35	4.00	1.48	0.001	0.23
Appeal	50	2.84	1.23	3.48	1.58	0.002	0.20

On the other hand, Table 9 shows the influence of user experience perception on user experience when using a persuasive application. The 6-week period using the health application did not affect the users' pragmatic, hedonic, or appealingness perceptions, which indicates that the participants were clearly having a positive experience when using MyFitnessPal, Fitocracy, or the MapMyFitness applications. However, the use of environmental games for the duration of 6 weeks brought significant changes to the medium effect size in the user's hedonic and appeal perceptions, but not to their pragmatic perception. The median scores for pragmatic perception remained positive, but the median scores for the hedonic and appeal-level perceptions changed from positive to negative responses between pre- and post-interaction. The participants found that both games, Stop Disaster and Pandemic 2, were less attractive and appealing after quite sometime playing them. This can be seen from the responses that the participants gave when they were asked whether or not they would continue to use the games or applications in the future. From the total of 25 participants, 19 people declared that they would keep using the health applications while only 9 would continue to play the environmental games in the future.

Meanwhile, gender differences in ratings were found only for hedonic and appealing qualities in post-interaction. The responses showed that the female participants (average 4.32) found that the persuasive applications were not attractive enough as compared to the males (average 3.51), $p = 0.05$ in assessing hedonic quality. For appealing quality, the female participants (average 3.85) did not find the persuasive applications as appealing as the male participants (average 2.87), $p<0.05$ after using the applications for 6 weeks. These results are rather attributed to the use of environmental games among female participants, where they became less interested in using the persuasive games after a few interactions because of the saturated information gained from playing the games.

Table 9

Analysis of Wilcoxon Signed Rank Test on User Experience (UX) Perceptions (indicates H = health applications, E = environmental games)

UX Perception	N	Pre-Median		Post-Median		Z.		Sig.		Effect size (r)	
		H	*E*	*H*	*E*	*H*	*E*	*H*	*E*	*H*	*E*
Pragmatic	25	2.25	2.75	2.25	3.00	-0.34	-0.62	0.73	0.54	0.05	0.09
Hedonic	25	3.29	3.43	3.71	4.43	-1.64	-3.06	0.10	0.002	0.23	0.43
Appeal	25	2.50	2.88	2.75	4.25	-1.49	-2.82	0.14	0.005	0.21	0.4

Emotional Experience

Figure 3 depicts the mean ratings of the pre- and post-interaction stages on ten positive emotional experiences. The result of the statistical analysis showed no significant differences in the users' positive emotions in pre-interaction (M = 2.57, SD = 0.89) to post-interaction stage (M = 2.68, SD = 1.24), t (49) = 0.44, p>0.1.

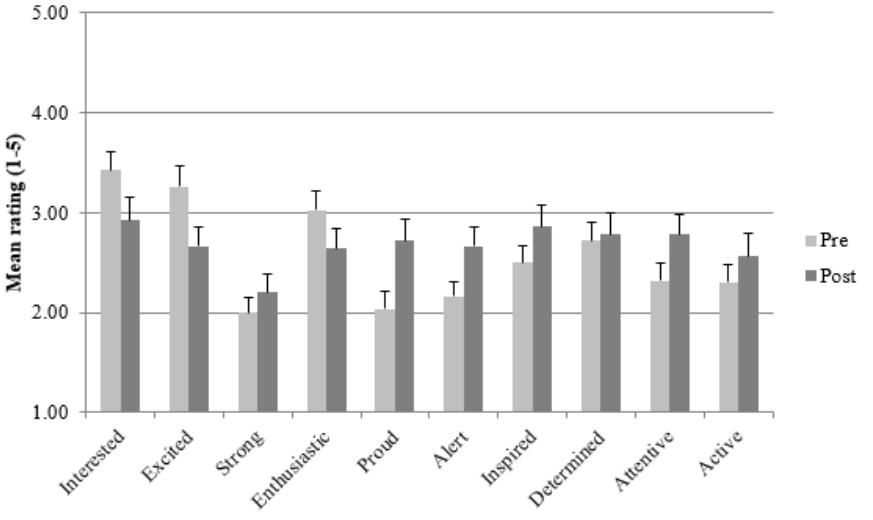

Figure 3. Positive emotional experiences (mean and standard error of mean).

Figure 4 presents the pre- and post-interaction stages on the mean ratings of ten negative emotional experiences. The result is also similar to the ratings of positive emotions where negative emotions were found

to be insignificant from the pre-interaction (M = 1.62, SD = 0.67) to post-interaction stage (M = 1.68, SD = 0.88), t (49) = 0.38, p>0.1. Nevertheless, out of 20 PANAS emotions and from the analysis conducted on the pair-wise comparison for all the emotions in the pre- and post-interaction stages, six significant differences were discovered. Four out of six emotions were positive emotions while the rest are negative emotions because the positive emotion ratings were significantly higher than the negative emotions. This shows that in both interaction stages, the user felt more positive emotions rather than negative emotions. Hence, by looking at Figure 1, obviously, the participants were experiencing a more positive user experience rather than a negative one. Thus, this results in users feeling positive emotions. Despite the changes in the perceived user experience, the emotional experience did not undergo significant changes from pre-interaction (M = 2.10, SD = 0.61) to post-interaction (M = 2.18, SD = 0.62), t (49) = 0.66, p>0.1.

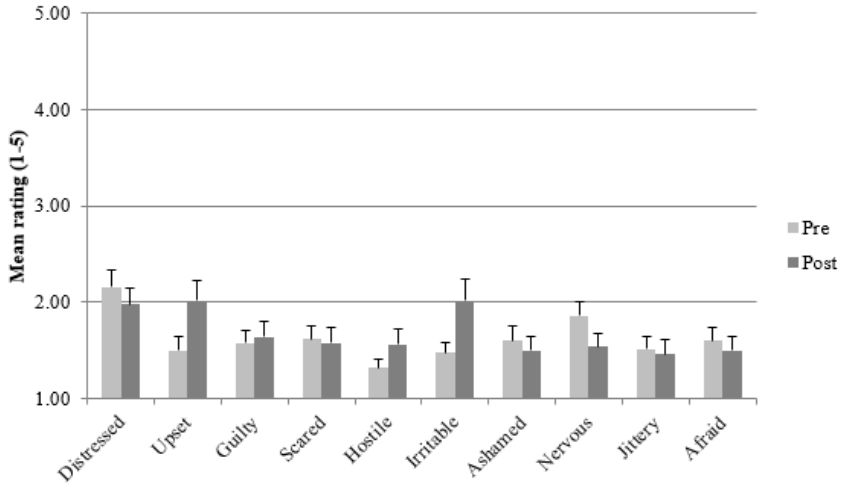

Figure 4. Negative emotional experiences (mean and standard error of mean).

All mean values of the positive emotions and negative emotions from the PANAS items were analyzed for positive user experience and negative user experience. Table 10 presents the results, which show that the users experienced more positive emotions in the pre-interaction stage in both conditions of positive and negative user experiences. However, in the post-interaction stage, the emotional experience that users felt were linked to the condition of related user experience in which the users felt more positive emotions for a positive user experience and more negative emotions for a negative user experience.

Table 10

Positive and Negative User Experience in Pre-Post Interaction

	Pre		Post	
	Positive Emotion	Negative Emotion	Positive Emotion	Negative Emotion
Positive UX	2.67	1.66	3.26	1.37
Negative UX	2.06	1.45	1.52	2.28

For each category of persuasive application, the changes in the users' emotional experience between pre- and post-interaction stages were assessed. The result shows that for the persuasive health applications, no significant changes were found in both positive emotions $Z = 1.26$, $p>0.1$ and negative emotions $Z = 0.48$, $p>0.1$. Similarly, there were also no significant changes reported for the environmental games whether for positive emotions $Z = 0.46$, $p>0.1$ or negative emotions $Z = 0.98$, $p>0.1$. An analysis on the changes in each item of PANAS emotions from pre- to post-interaction stages was then conducted. For the persuasive health applications, the result revealed that five emotions underwent significant changes in post-interaction, compared to pre-interaction with four positive emotions and one negative emotion. The users experienced pride $Z = 2.12$, $p<0.05$, alertness $Z = 2.18$, $p<0.05$, inspiration $Z = 2.25$, $p<0.05$, being active $Z = 1.78$, $p<0.1$ and upset $Z=1.75$, $p<0.1$ in post-interaction compared to the pre-interaction stage. Meanwhile, for the persuasive environmental game, three significant changes in emotions were found in post-interaction compared to pre-interaction with two being positive emotions and one only being negative emotion. The users experienced emotions of interest $Z = 1.78$, $p<0.1$, excitement $Z = 2.05$, $p<0.05$ and irritability $Z = 1.98$, $p<0.05$ in post-interaction compared to pre-interaction. A significant gender difference was found for only three out of twenty PANAS items in the pre-interaction stage, with 2 negative emotions and one positive emotion. The male participants experienced the emotion of "guilt" (average 1.95) slightly more than the female participants (average 1.33), $p<0.05$ and experienced emotions that are "hostile" (average 1.60) more than the female participants (average 1.13), $p<0.05$. However, the female participants experienced "enthusiasm" (average 3.33) more than the male participants (average 2.55), $p<0.05$.

OVERALL DISCUSSION

Generally, the study shows that time is a significant factor that alters the way users evaluate and feel about persuasive technology. Although this

study was conducted with two different domains of applications (i.e. health and environment), the result shows that the effect of user experience when using persuasive technology is very much significant in which a positive user experience may lead to successful persuasion, whereas a negative user experience will contribute to the decline in or failed persuasion. Although the time factor did not much impact the emotional experience as a whole, it really affected certain states of emotions such as the feeling of inspiration, interest, and determination. In order to increase the validity and reliability of the research, especially for the ratings of user experience and emotional experience, situation control was implemented in the experimental procedures, where the participants were exposed to a calm and neutral condition to eliminate any influence on their emotions when making the individual ratings.

User Experience

Overall, when using persuasive applications, most participants experienced a positive user experience rather than a negative user experience for both interaction stages. The post-interaction ratings tend towards negative experiences although the mean values show that the participants experienced a positive user experience. Undoubtedly, there were differences in the participants' asessment of the adjectives of user experience perceptions when using persuasive technology for the six-week duration. Hence, this result corresponds to the view that user experience perceptions change eventually. However, the changes seems to not affect the participants' emotional experience. This finding is entirely different from the result of Hassenzahl (2008) where he claims that changes in emotions and perceptions over time are what creates the user experience. This claim was however made based on product investigation rather than investigation of a system. Another prominent finding from this study is on the user experience perceptions, which totally contradict the research findings of Hassenzahl (2004), which studied an interactive product such as the MP3 player. The study found that pragmatic qualities (also called perceived usability) changes over time as the qualities are affected by experience in the sense that users may encounter usability problems, while hedonic and appealing qualities remained the same over time. However, our investigation into persuasive technology use discovered that evaluation of pragmatic qualities are found to be consistent over the interaction stages but evaluation of hedonic and appealing qualities are affected over time. Participants were more concerned with the hedonic and appealing qualities as they might not have encountered any usability problems during their initial interaction until the post-interaction, which is similar to a study by Karapanos (2009). The contradiction between the pragmatic qualities found by Hassenzahl (2004) and that of this study may have been influenced

by the participants' background for this study, where 32 percent are from an IT background; hence, they might not really have encountered any usability problems, as they are highly literate in using computers and the Internet.

Emotional Experience

Among the main positive emotions that the participants felt in the pre-interaction stage were emotions of "interest", "excitement" and "enthusiasm". On the other hand, among the main positive emotions that the participants felt in the post-interaction stage were emotions of "interest", "inspiration", "determination" and "attentiveness". The feeling of excitement, interest and determination are often associated with a positive user experience (Hassenzahl, 2008; Hassenzahl et al., 2010). In the pre-interaction stage, for a positive user experience, the participants reported a nearly moderate level of positive emotions and just a slight feeling of negative emotions. Surprisingly, for a negative user experience, the participants reported just a little more positive emotions than negative emotions. In the post-interaction stage, for the positive user experience, the participants experienced a slightly higher than moderate level of positive emotions and just a little negative emotion. On the contrary, for the negative user experience, the participants experienced a little more negative emotions compared to just a slight feeling of positive emotions. These results are in parallel with the notion that the approach and avoidance system (related to positive and negative emotions) in humans is distinct and relatively independent (Lang, 1995). The findings show that most of the results are independent from gender. Therefore, the conclusion drawn here points towards further research into the elements of persuasive applications through qualitative methods in relation to assessing the outcome of user experience and users' emotional experience over time.

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