

# Impact of Users' affect states on their privacy concerns

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## Abstract.

**Background.** Evidence from psychological research indicates that emotions could influence human reasoning (concerns) and behaviour [1]. Our literature review revealed that, direct measurement of the effect of emotion on users' privacy concerns has not been adequately explored; most studies rely on survey based methodologies to assess users' affect states and privacy concerns. However in this concept paper, we propose a random control trial, which will involve inducing emotion, measuring privacy concerns and intentions.

**Aim.** We investigate how induced affect states (happiness and fear) influence users' privacy concerns.

**Method.** In the pre-test study, 9 participants were randomly exposed to different affect inducing stimuli films, their facial expressions were recorded and analysed using purpose built software packages

**Results.** The pre-test results indicated that respondents affect states were successfully induced, the direct measurement tools used effectively recorded and analysed the facial expressions captured. Data collection and analysis is still ongoing for the follow-up study.

**Conclusions.** The findings provide building blocks for further research in exploring the direct measurement of impact of affect states on privacy behaviours and privacy decision making. These also contribute towards the existing knowledge on online user privacy concerns and privacy decision making processes. This will be of interest to researchers in ecommerce, psychology, affective computing, policymakers and usable privacy.

**Keywords:** privacy concerns, affect states, IUIPC, Facereader

## 1 Introduction

In behavioral sciences, norms and decisions are known to influence behaviors. However both constructs are influenced by different factors. The factors that influence a decision towards behavior include "past experiences, a variety of cognitive biases, an escalation of commitment and sunk outcomes, individual differences, including age and socioeconomic status, and a belief in personal relevance" [6]. These factors among others all impact the decision making process and the decisions made. On the contrary, norms are considered "constraining behavior" [2]. They described "Social norms, as the customary rules that govern behavior in groups and societies". Most often, in social

science literature, norms are regarded as “exogenous variables” that provide a guideline on how human behavior should act within given context. It can be said that factors that influence norms are externally driven by culture, societal laws compared to factors that influence decision toward a behaviour which are more cognitive based, and intrinsic in nature.

Until recently, emotion was not considered as a primary factor in decision making, however this has been addressed in research reviews and calls made for more investigation into the role emotions play a role in decision making, [7]. This can be extended to usable privacy research, most research on decision making has focused on privacy concerns, privacy behaviours and how they are measured. We observed that there is minimal documentation on the impact and direct measurement of emotions on privacy concerns. Hence In this concept paper, we propose a random control trial, inducing emotion, measuring privacy concerns and intentions.

This paper is structured as follows: first background and related work will be discussed, subsequently the methodology proposed for the trial will be discussed, followed by the results from the previously conducted pre-test and finally the discussion on the pre-test carried out and conclusion.

## **2 Background and related work**

In this section we report on general research stating how emotions influence behaviour, we also discuss privacy concerns and its measurement, stimuli on affective psychology, affect measurements as manipulation check.

### **2.1 Emotion and behavior**

Though the Theory of Planned Behaviour does not reflect emotion as one of the factors or components that influence behaviours, research in behavioural sciences and psychology have documented evidence on the key role emotions play in decision making and behaviours. In order to make strategic decisions, people tend to rely on their feelings, [5]. Evidence found by Wakefield [23], among other documented ecommerce research suggests that consumers’ affect states can influence their purchasing behaviours and privacy concerns.

### **2.2 Stimuli from affective psychology to induce emotions**

Affect states can be induced with the use of different techniques and tools. These include exposure to emotional slides, mental imagery, autobiography recollection, Velten mood-induction, use of stimuli films to mention a few [21].

In the study reported here, emotive film clips: the restaurant scene in When Harry meets Sally and The Champ were used. These films have been tested and validated for inducing happy and sad affect states in various stimuli studies, [21]. The use of

scenarios in usable privacy experiments has been in existence [22, 26]. Privacy situations based on real life incidents, which users can identify with, are described within the scenarios. In the follow-up study, we built on health related scenarios which have been known to elicit fear and happy affect states. Two separate scenarios were developed and used in this study.

### **2.3 Manipulation check**

Two types of manipulation check were used in the course of the experiment; psychophysiological based (Facereader (FR) and Microsoft Emotion Recognition(ER)) and questionnaire based (PANAS-X and a modified version of Brief Mood Inventory). The checks were used to ascertain the effectiveness of the stimuli used. Facereader and Emotion recognition measured the participants affect states directly while PANAS- X and BMI gave self-report measured values of their affect states.

We used the PANAS- X form as manipulation check on the induced affect state, following the methodology used by [4]. A comparison on the affect states: happy (joyfulness) and sadness showed that the manipulation was successful.

### **2.4 Measures**

#### **2.4.1 Affect states.**

We selected three complimentary tools to measure affect states because we wanted to avoid relying solely on a self-report tool.

#### **2.4.2 PANAS-X.**

Retaining the original PANAS-X format however only the component emotions that add up to give scores for fear and happiness affect states were used [29]. This was done in order to minimise the length of time the subjects spent in the experimental condition. A web form with the relevant fields and Likert scales was designed and used to capture subjects' responses and saved in the database.

#### **2.4.3 Privacy Concerns.**

We selected IUIPC scale because it has been considered reliable, widely tested by other researchers [20]. It is a 10-item privacy concern questionnaire with a seven point Likert-type scale anchored between "strongly disagree" and "strongly agree". It measures users' privacy concerns under the following dimensions a) control (3), b) collection (3) (c) awareness of privacy practices (4). The scores are within the interval of 10 to 70 provided the subjects answer all questions [16].

## **3 Methodology**

In this section, we describe the procedure used in conducting the user study.

We replicated existing methods used in eliciting emotions from psychology research [21]. We measured affect states and privacy concerns using a complimentary set of tools. The short version of Positive Affect and Negative Affect States – Extended (PANAS - X), and Brief Mood Introspection Scale (BMIS), were used to measure affect states subjectively while video recording of the users was captured for further analysis with Facereader (FR), and Microsoft Emotion recognition application (ER). Internet Users Information Privacy Concerns (IUIPC) scale was used to measure users' privacy concerns.

### **3.1 Inducing emotions.**

As discussed above, the two methods used in inducing emotions in this study were exposure to stimuli films and the use of emotive scenarios. These methods have been tested and validated in different research fields [4].

We propose a combined approach which involves both the direct measurement and self-report based measures of affect states and measuring responses to the privacy concern survey, using Internet Users Information Privacy Concern survey. We explored the feasibility of this approach in a follow-up study and realised that there were loose ends regarding the data capture that need to be resolved.

The pre-test experiment in which we induced sad and happy affect states with videos, was successful. This is discussed in further detail in the result section.

### **3.2 Testing manipulation checks**

In the pre-test we had observed from the results indicated that the participants experienced the induced happy and sad affect states.

## **4 Results**

All inferential statistics are computed with two –tailed tests and at an alpha level of 0.05.

The results reported here are from the pre- test study. Wilcoxon Signed Ranks tests were carried out on the data sets collected from the three tools indicated that the induced happy affect after exposure to the happy stimulus, were statistically significantly higher than the scores after exposure to sad stimulus.

### **4.1 PANAS-X**

Results from the Wilcoxon signed rank tests when using PANAS-X tool, indicate there is a statistically significant difference in a viewer's happy affect score between happy (Median = 21) and sad (Median =14 ) stimuli films, Test statistic  $Z = -2.207$ , p-value,  $p = 0.027 < .05$ , effect size,  $r = 0.55$ . The mean score for happy affect when happy film was watched (mean=21.43), with SD =4.65, differed from the mean score, when sad film was watched (mean = 15.57) with SD =6.188. The tests also indicated a statistically significant difference in a viewer's sad affect score between happy (Median = 5) and sad (Median =10) stimuli films,  $Z = -2.023$ ,  $p = 0.043$ ,  $r = 0.51$ .

## 4.2 Facereader

The results from the Wilcoxon signed rank tests when using Facereader tool, indicate a statistically significant difference in a viewer's happy affect score between happy (Median = .2918) and sad (Median = .0008) stimuli films,  $Z = -1.483$ ,  $p = 0.138$ ,  $r = 0.37$ . The mean score for happy affect when happy film was watched (mean = 0.310), with  $SD = .310$ , differed from the mean score, when sad film was watched (mean = 0.095) with  $SD = .247$ . Also observed was a significant difference in a viewer's sad affect score after exposure to happy and sad stimuli films test statistic,  $Z = -1.483$ ,  $p$ -value = 0.138, effect size,  $r = 0.37$ . The mean score for sad affect when the happy film was watched, (mean = 0.0004) with  $SD = .000089$  differed from the mean score when sad film was watched, (mean = 0.0351) with  $SD = 0.0844$ .

## 4.3 Emotion recognition

When using Emotion recognition tool, the results from the Wilcoxon signed rank tests showed that, there is a significant difference in a viewer's happy affect score between happy (Median = .952) and sad (Median = .011) stimuli films,  $z = -2.366$ ,  $p = 0.018 < 0.05$ ,  $r = 0.59$ . The mean score for happy affect when the happy film was watched (mean = 0.720) with  $SD = .372$ , differed from the mean score, when sad film was watched (mean = 0.075), with  $SD = .179$ . Also observed was a significant difference in a viewer's sad affect score between happy (Median = .00017) and sad (Median = .03783) stimuli films,  $z = -2.366$ ,  $p = 0.018$ ,  $r = 0.59$ .

# 5 Discussion

The study applied the methodology used in previous affect based studies to a privacy context, [4]. The aim of the pre-test was achieved as we observed that the non-subjective measurement by FR and ER had accurately detected the induced affect states. The analysis of the results also showed that emotion induction using stimuli films worked.

We have built on this and extended the design of the follow-up study. The follow-up study design entails the administration of a privacy concern survey, shorter version of PANAS-X survey and a Brief Mood Inventory scale immediately after exposure to stimulus films. Using the Protection Motivation Theory as the overarching theory, we posit the users with fear affect states tend to be more privacy conscious and would be more concerned about their personal details than those with happy affect states. The follow-up study set to explore if privacy concern scores of users with induced happy affect states was higher than those with induced fear affect states. A preliminary follow up study with 70 participants had been carried out, data compilation and data analysis is still ongoing as it is a very rigorous process.

## 5.1 Measurement instruments for privacy concerns

In a comprehensive review on surveys used to assess privacy concern, compiled by [20], he pointed out that "the need for measurement instruments for privacy concern is

twofold. First, attitudes and opinions about data protection cannot be established and compared without reliable mechanisms. Second, behavioural studies, notably in technology acceptance and the behavioural economics of privacy require measures for concern as a moderating factor". Most studies have relied on the use of surveys to assess privacy concerns; the questions in the surveys have been considered as disjointed, thus yielding questionable results [20].

Given the subjective feedback provided by surveys, using an approach that builds on a real time measurement mechanism of privacy concerns would mean less reliance on the human's ability to recollect and this means more accurate results. However we observed that studies on privacy concerns which use real time measurement mechanism and also take into consideration the effect of emotion on attitude / concerns are few. To address the paucity of knowledge, we explored the combined use real time (Facereader and Microsoft Emotion Recognition software to measure user's affect state) with subjective self-reporting (PANAS, IUIPC to measure affect state and privacy concerns respectively) measurement tools. These tools have been used and validated in various fields.

In the follow up study, the Initial results indicate the questions within the IUIPC survey used were set to capture participants long term based concerns that is norms rather than an immediate or close term concern [16]. We postulate the need for close term privacy intention/ concern questionnaire that would capture respondents immediate privacy concerns. We observed that the responses from the IUIPC survey did not seem to capture users' close term privacy concerns; rather the responses captured were more of norms.

We carried out pretests with other surveys known to assess users' privacy concern - Concern for Information Privacy [16] and manage personally identifiable information. However the results so far have been inconclusive.

## **5.2 Privacy decisions and the involved personal stakes decisions are made in the experiments.**

In the demographic survey, participants had to decide either to give out some personal details (video recording of personal image, gender, age). Participants were given the option of not participating if they were not comfortable with having video recording of their facial expressions carried out.

## **5.3 Influence of alcoholic beverage and recreational drug consumption**

In the follow up study, the influence of alcoholic beverage, recreational drug consumption on measurements was addressed using self-report questions in the demographic survey. Most participants had responded that they had not taken such substances. Self-report method was used because the questions used have been validated in the National Health Survey conducted in England [27]; moreover conducting further investigation would require the analysis of blood sample tests, breathalyzers which we are not skilled in handling.

## **5.4 Ethics**

The pretest and follow up studies adhered to the ethical guidelines of the university. The participants were informed that their personal identifiable information will be

stored in hard and electronic copies. The participants gave their consent by signing the consent forms after reading the information sheet. Each participant was compensated with a five pounds amazon voucher. None of the participants experienced any harm, as they were not exposed to the sad stimulus film for a prolonged time. The duration of the sad stimulus was 90 seconds. The induced sad affect state was transient and wore off after a short while.

## **6 Lessons learned for actual experiment to be run:**

### **6.1 Sample sizes needed**

It was difficult to determine the actual sample size needed for the experiment. We are not aware of any similar previously carried out studies with the joint use of PANAS-X, FR and ER to refer to. Rather a statistical tool G-Power 3 was used to determine the sample size. Initially a large number of respondents was required however a change in statistical design from independent sample test to a mixed design which involved a within and between repeated measures design, led to a reduction in the number of participants required.

### **6.2 Strong randomization**

In order to avoid the bias that could be introduced by the order in which the participants undertook the study, strong randomisation is required.

### **6.3 Emotive Film stimuli**

Though the films have been tested and validated in various studies, however it is difficult to ascertain the level of affect state induction for those who had watched the stimuli films before and knew what to expect in each film.

It was observed that participants who had previously watched the sad stimulus film, The Champ were looking forward to the famous scenes – slight smiles could be seen on their faces as they anticipated the film scenes. There might be need to develop a new set of stimuli films based on the new generation films that have been released.

During the debriefing on the follow up study , a number of participants stated that they had expected the questions to be based on the films watched and wondered why privacy related videos were not used.

## **7 Conclusion**

Based on the pre-test results from the inferential and descriptive statistics, it can be said that the stimuli films had significant influence on most of the viewers' happy and sad affect states; while ER and PANAS-X significantly measured the happy sad affect

states; this is in contrast with the measurement derived by FR. However the results indicate that FR could detect and measure viewers' happy affect but no detection of sad affect. There is need to carry out further tests on the impact of affect states on privacy concerns with the above mentioned tools with the FR and measuring sad affect.

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