

# Investigation of the Effect of Incidental Fear Privacy Behavioral Intention (Technical Report)\*

*Uchechi Phyllis Nwadike*  
Newcastle University, UK

*Thomas Groß*  
Newcastle University, UK

## Structured Abstract

**Background.** Incidental emotions users feel during their online activities may alter their privacy behavioral intentions.

**Aim.** We investigate the effect of incidental affect (fear and happiness) on privacy behavioral intention.

**Method.** We recruited 330 participants for a within-subjects experiment in three random-controlled user studies. The participants were exposed to three conditions neutral, fear, happiness with standardised stimuli videos for incidental affect induction. Fear and happiness were assigned in random order. The participants' privacy behavioural intentions (PBI) were measured followed by a Positive and Negative Affect Schedule (PANAS-X) manipulation check on self-reported affect. The PBI and PANAS-X were compared across treatment conditions.

**Results.** We observed a statistically significant difference in PBI and Protection Intention in neutral-fear and neutral-happy comparisons. However across fear and happy conditions, we did not observe any statistically significant change in PBI scores.

**Conclusions.** We offer the first systematic analysis of the impact of incidental affects on Privacy

Behavioral Intention (PBI) and its sub-constructs. We are the first to offer a fine-grained analysis of neutral-affect comparisons and interactions offering insights in hitherto unexplained phenomena reported in the field.

## 1 Introduction

Online privacy behaviors, though not limited to requesting for personal contact information to be removed from mailing lists, keeping passwords safe, use of strict privacy settings [1] such as can be observed as users take deliberate steps to protect their personal details while browsing on the Internet. Despite the best intentions to avoid sharing personal information, users still get influenced by different factors to disclose same. These factors include incentives, loyalty points, privacy concerns to mention a few. There is sparse information on the effect of emotion on privacy behavior despite existing literature in psychology and economics highlighting the role of emotion in human behavior [2] and decision making [2]. Though preliminary studies [3, 4] have been conducted on the effect of fear, happy, anger affect states on privacy behavioral intentions, however no comprehensive study has been conducted to investigate the effect of the relationship between neutral, fear and happy affect states on privacy behavioral intentions. Researchers such as Wakefield [4], Li [5] or Coopamootoo and Groß [6] have called for further investigation to extend the

\*Open Science Framework Pre-Registration: <https://osf.io/c3jy8/>. This is the technical report version of a paper to appear in proceedings of the 9<sup>th</sup> International Workshop on Socio-Technical Aspects in Security (STAST'2019). LNCS 11739, Springer Verlag, 2019, pp. 181–204.

existing knowledge on the effect of fear and happy affect states on privacy behavioural intentions.

In this paper we contribute a comprehensive study which systematically compares PANAS-X and PBI scores across neutral, fear and happy conditions and explores the relationship between affect states and privacy behavioral intentions.

Given that measurement of actual privacy behavior is difficult to achieve within a laboratory setting, privacy behavioral intentions are frequently used as a proximal measure [7, 8]. Hence in our user study we will measure privacy behavioral intentions instead of privacy behavior. The aim of the user studies discussed in this paper is to investigate the effect of incidental affect states of induced fear and happy affect states on privacy behavioral intention. This will contribute towards bridging the highlighted research gap, extend the existing research knowledge and provide empirical evidence that would be useful for further research.

## 2 Background

### 2.1 Affect, Emotion, and Mood

The terms mood, emotion and affect have been used interchangeably in literature in the past, however referred to a range of emotional intensity and also reflect fundamental differences including duration, frequency, intensity and activation pattern. The terms *affect* or *affective states* are often used to describe the experience of emotion or feeling, in general, going back to an early definition attempt of Scherer [9]. The terms *core affect*, *emotion* and *mood* have been differentiated further in subsequent years. Ekkekakis [10] made one of the most recent attempts to summarize the emergent consensus of the field as well as the differences between these constructs (cf. [10, Ch. 7] for a detailed analysis).

We note that the impact of affect on another task led to a classification of *incidental affect*, that is, affect independent from the task at hand, and *integral affect*, that is, affect related to the task at hand. The differences between incidental and integral affect have received attention in psychology research [11, 12, 13].

Let us consider these terms and converge on a definition for this paper.

#### 2.1.1 Core Affect.

Following the discussion by Ekkekakis [10], we perceive core affect is a broader concept than mood or emotion. Russell [14] defined (core) affect as the specific quality of goodness or badness experienced as a feeling state (with or without consciousness). We include his circumplex model of affect in Figure 1. Affect states can be triggered spontaneously by memories, exposure to stimuli, perception of one’s immediate environment [15, 11, 16]. Subsequently, Russell and Feldman Barrett [17] offered an updated definition “core affect is defined as a neuro-physiological state consciously accessible as a simple primitive non-reflective feeling most evident in mood and emotion but always available to consciousness” also consulted by Ekkekakis [10]. The feeling being non-reflective has been pointed out as a critical attribute.

#### 2.1.2 Emotion.

Lazarus [18] defined *emotion* “as a complex reaction of a person arising from appraisals and outcomes of self-relevant interactions with the environment, which could result in states of excitement, direction of attention, facial expressions, action tendencies, and behavior.” Ekkekakis [10, Ch. 7] points out elaborating on the discussion by Lazarus that: “Because emotions are elicited *by* something, are reactions *to* something, and are generally *about* something, the cognitive appraisal involved in the person-object transaction is considered a defining element.” (emphasis by the Ekkekakis).

#### 2.1.3 Mood.

Mood is typically differentiated from emotion by intensity and duration. Lazarus [18] discussed *mood* as follows: “While moods are usually less anchored to specific stimulus conditions and perhaps of longer duration and lesser intensity than emotions, may also be distinguished in terms of specific

content.” Similarly, Ekkekakis [10, Ch. 7] discusses that moods are “diffuse and global.”

## 2.2 Affect Elicitation

This refers to the process of engaging study participants in specific tasks with the sole purpose of drawing out the required affect state of interest from individuals. Given the brief span associated with affect states it is difficult to determine how long a treatment should be in order to obtain and ascertain the affect’s intensity and sustained effect throughout the user study duration. Emotion researchers have recommended that the inducement process should not last longer than minutes [20].

The methods used to elicit or induce affect states include the use of standardized stimulus in form of audio, video, autobiography recall, vignettes and pictures [21]. These methods are not used isolation rather the authors recommend to use a combination of techniques. They proposed that different affect inducing methods have different success rates with evoking different affect states within the laboratory’s setting [21]. The methods are further discussed below.

### 2.2.1 Visual Stimuli.

This refers to the use of visually stimulating images such as video clips as stimuli. These materials can contain either evocative or non evocative elements which can induce specific affect states. Types of visual stimuli include pictures (e.g., gruesome images, a sunset over a calm sea) or films (e.g., defined scenes from horror or comedy films).

To induce fear, psychologists [15] have established standardized scenes from “*The Shining*” or “*The Silence of the Lambs*.” To induce happiness, similarly, the restaurant scene from “*When Harry meets Sally*” was evaluated. As a standard procedure, these stimuli videos are precisely defined and systematically evaluated for their impact on the participants’ affective state. In the studies discussed later in this chapter, we selected the use of standardized stimulus video films. This technique was considered the most effective in inducing affect states

with large effect sizes.

### 2.2.2 Autobiographical Recall.

Participants are requested to recollect (and at times write) about real life evoking events from their past when they experienced a particular affect state the researchers are interested in. The researchers expect participants to relive the affect state felt at the time of the event or incident. Studies which involved the use of this method have recorded noticeable change in emotional effect in self reported responses and increased physiological responses such as heart rate, skin conductance [22].

## 2.3 Affect Measurement.

The methods and tools used in measuring affect states can be classified into two categories, namely psychometric self-report instruments and psycho-physiological measurements.

Self report tools involve the use of scales, such as PANAS-X, which require input from the subject, reporting how he or she feels with respect to a defined timeframe (e.g., in this moment). In this study, we have selected the Positive and Negative Affect Schedule (PANAS-X) [23] as manipulation check of choice. While largely considered an effective measurement instrument [24, 25], Ekkekakis [10, Ch. 12] pointed out that the PANAS-X items include core affects, emotions, as well as moods in the terminology set out above. We also note that the sub-scales on *fear* and *joviality* we use in this study would be considered an emotion in this terminology, infused with high negative and positive core affect, respectively. We note that in recent years, there was further criticism of the factorial structure and theoretical underpinnings of PANAS-X, especially when it comes to measuring low-activation states (outside of the scope of this study).

Psycho-physiological measurement tools do not require any subjective input rather it involves the measurement of physiological responses after exposure to a given stimulus. These responses could be facial expressions, heart beat, skin conductance, pupil movement to mention a few. While there has

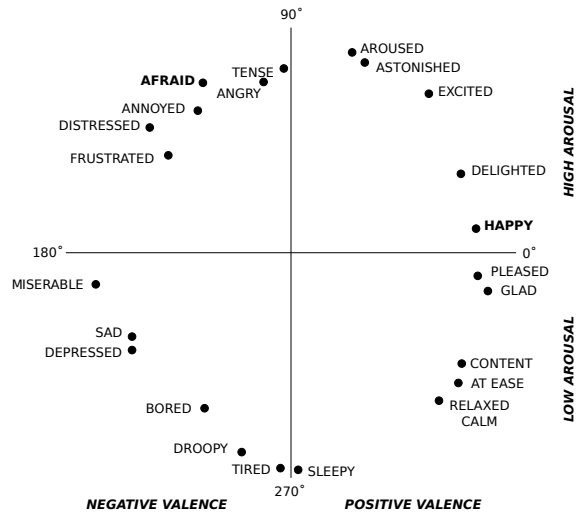


Figure 1: Circumplex model of affect, adapted from Russel [19]. Note that fear is classified as negative-valence/high-arousal (110°, labeled by Russel as “afraid”) and happiness is classified as positive-valence/high-arousal (10°, labeled as “happy”). PANAS-X includes the high-arousal items delighted (30°) and excited (50°) in its joviality scale.

been supportive evidence for those tools, there is also criticism in constructivist views on emotions that physiological states are not necessarily indicative of specific emotions.

### 3 Related Work

To the best of our knowledge, we were the first to present an affect induction experiment designed to explore the effect of affect states on privacy behavioral intention (PBI) [26]. Our paper reports pilot studies and describes a design template to investigate the impact of happy and fear affect states on PBI. Subsequently, Coopamootoo [3] and Fordyce et al. [27] adopted said template in their research. So do we. Fordyce et al. applied the method to password choice.

The closest work to this study is Coopamootoo’s work-in-progress (WIP) paper [3]. Both experiments are measuring incidental affect as proposed by Nwadike et al. [26] initially. for which we notice a number of differences: (i) While this study is only concerned with the impact of affect on PBI,

the study by Coopamootoo also considered general self-efficacy as a human trait. (ii) While we induced incidental affects with standardized stimuli films, Coopamootoo used autobiographical recall of emotive events. (iii) While Coopamootoo uses tone analysis of participant-written text as predictor, we use PANAS-X as psychometric instrument. Our impression is that the tone analysis only measures the tone of a text input, but does not constitute a psychometric measurement of the current affective state of a participant.

We noticed that the correlations reported in the WIP paper [3, §5.3.4] are trivial to small ( $r \leq 0.3$ ), with Protection Intention (PI) having the greatest reported correlation with self-efficacy ( $r = 0.3$ ).

Coopamootoo’s causal hypothesis  $H_{C,1}$  was declared as “emotion [fear/happiness] and self-efficacy impact privacy intentions.” The relations reported are (i) emotions impact trait self-efficacy (negatively) and (ii) self-efficacy impacts PI (positively). Strikingly, for relation (i) the corresponding study [3, Study 2, §4.2] administered the trait self-efficacy questionnaire in Step (b) *before*

the affect induction protocol (Step (c)). Hence, the induced emotion could *not* have *caused* self-efficacy changes. Thus, we need to assume that Coopamootoo tried models with a number of sub-scales of PBI (4), different emotion scales (4) and with different SEM path models while not correcting for these multiple analyses. We consider the reported causal relation a false positive.

## 4 Aims

**Impact of Affect.** The study seeks to make a comparison of the influence of affect states on Privacy Behavioral Intention (PBI) [28].

**RQ 1 (Impact of affect on PBI)** *To what extent does Privacy Behavioral Intention (PBI) [28] in the form of Information Disclosure Intention (IDI), Transaction Intention (TI) and Protection Intention (PI) change depending on induced incidental happy and fear states?*

This research question decomposes into multiple statistical hypotheses iterated over dependent variables (idi, ti, pi) pair-wise compared across conditions (neutral, happy, fear). Hence, we obtain nine null and alternative hypotheses pairs for comparisons on: neutral–happy (nh), neutral–fear (nf), happiness–fear (hf). In addition to that, we investigate the pair-wise comparison of the combined pbi scores across conditions.

As primary analysis, we are most interested in, we consider the combined Privacy Behavioral Intention (PBI) pbi in the comparison between the happy–fear conditions.

$H_{hf,pbi,0}$  There is no difference in privacy behavioural intention (pbi) between cases with induced happiness and induced fear.  $H_{hf,pbi,1}$  Privacy behavioural intention pbi differs between the conditions happy and fear (hf).

The hypotheses are obtained iterating over

1. Conditions Comparisons  $CC :=$ 
  - (a) neutral–happy (nh),
  - (b) neutral–fear (nf),
  - (c) happy–fear (hf)
2. Dependent Variables  $DV :=$

- (a) pbi: Combined Privacy Behavioral Intention (PBI) score,
- (b) idi: PBI Information Disclosure Intention (IDI) sub-scale score,
- (c) ti: PBI Transaction Intention (TI) sub-scale score,
- (d) pi: PBI Protection Intention (PI) sub-scale score.

$H_{CC,DV,0}$  There is no difference in privacy behavioural intentions scores of scale  $DV$  between conditions specified in comparison  $CC$ .  $H_{CC,DV,1}$  Privacy behavioural intention scores of scale  $DV$  differ between the conditions specified in comparison  $CC$ . Note that  $CC$  and  $DV$  are variables that take values (nh, nf, hf) and (pbi, idi, ti, pi) as specified above. They thereby define a test family of 12 alternative and null hypothesis pairs.

**Manipulation Check.** We use the Positive and Negative Affect Schedule (PANAS-X) [23] as joint manipulation check  $MC$  across the three studies..

A manipulation is considered successful if the following null hypotheses can be rejected.  $H_{MC,jov,0}$  There is no difference in  $MC$ -measured joviality between happy and fear conditions.  $H_{MC,jov,1}$  The  $MC$ -measured joviality differs between happy and fear conditions.

$H_{MC,fear,0}$  There is no difference in  $MC$ -measured fear between happy and fear conditions.  $H_{MC,fear,1}$  The  $MC$ -measured fear differs between happy and fear conditions. The pre-registration defined the PANAS-X (px) measurement as authoritative.

**Regression Model.** We are interested in the relation between Privacy Behavioral Intention (pbi, idi, ti, pi) and measured affect PANAS-X (pxjov and pxfear).

**RQ 2 (Relation of measured affect and PBI)** *To what extent is there a linear relationship between the reported affect state (PANAS-X) and the PBI scales.*

We consider the following hypotheses for an overall model, with canonical hypotheses for the respective predictors.  $H_{px,pbi,0}$  There is no linear relationship between measured affect and PBI scores.

$H_{p_x, p_{bi}, 1}$  There is a systematic linear relationship between measured affect and PBI scores. We note that the overall PBI score relation is designated as primary hypothesis and the PBI-sub-scale relations designated as secondary hypotheses.

## 5 Method

The studies had been pre-registered at Open Science Framework<sup>1</sup>. The tables and graphs were produced directly from the data with the R package KnitR.

The statistical inferences conducted are two-tailed and operate on a significance level of  $\alpha = .05$ . We consider the per-condition pair-wise Wilcoxon Signed-Rank tests for Privacy Behavior Intention (PBI) and its sub-scales IDI, PI, and TI as a test family with 12 elements. A Bonferroni-Holm multiple-comparison correction (MCC) is applied directly to the  $p$ -values reported, indicated as  $p_{MC(12)}$ .

Even though the differences between DVs are at times not normally distributed, we use Hedges  $g_{av}$  as unbiased dependent-samples effect size and its corresponding confidence interval for estimation purposes.

The three studies were conducted within online and offline settings: one laboratory and two online studies. We chose to run these studies in a combination of offline and online settings for two main reasons: because we wanted to measure facial expressions, which at the time could be done only within a lab setting; and also have access to a larger sample size.

### 5.1 Experiment Design Evaluation

We developed the experiment design in a series of pretests, which established the validity and reliability of the overall design as well as the procedure and instruments used therein. Figure 2 contains a flowchart depicting the development process in its entirety.

---

<sup>1</sup><https://osf.io/c3jy8/>

### 5.2 Sampling

Using flyers, and adverts on the crowdsourcing platforms- the participants involved in the user studies were recruited from different locations and at different time frames. The participants consist of institution's staff, students, workers on crowdsourcing platforms - Amazon Mechanical Turk and Prolific Academic. We adopted a simple sampling method based on participants' availability. The sample size were determined in an *a priori* power analysis using G\*Power.

### 5.3 Ethics

The studies reported here adhered to the institution's ethics guidelines and an ethics approval was obtained before the studies were conducted.

**Affect Elicitation.** The affect induction techniques used were not expected to adversely affect the participants' affect states. Stimulus video clips which have been tested in psychological studies and considered as standardized clips [15] were used. These clips were considered suitable for use in user studies which involve emotion [15]. The participants were not expected to experience any discomfort different from that encountered in daily life activities. At the end of the online user studies, the participants were provided with links to free online counseling services and advised to contact the researcher if they were agitated by contents of the user study.

**Informed Consent and Opt-Out.** During the recruitment process, participants were informed about the duration and requirements for the user studies. Participants were given an information sheet and a consent form which contained details about information that will be collected during the user studies. On the consent sheet they were presented with an opportunity to opt out at any stage without any penalties. All participants were given the opportunity to exercise informed consent.



Table 1: Operationalization: Effect of Fear on Privacy Behavioral Intention.

	Levels	Instrument	Intervention/Variable
IV: Affect	Fear Happiness	Stimulus Video [29]	<i>The Shining</i> <i>When Harry Met Sally</i>
IV Check	Fear Happiness	PANAS-X [23]	fear joviality
DV: Privacy Behavioral Intention		PBI [28]	pbi
<i>Sub-Scales:</i>			
Information Disclosure Intention			idi
Transaction Intention			ti
Protection Intention			pi

**Deception.** The true purpose of the user studies was not disclosed to the participants; rather they were informed that the aim of the user studies was to assess their opinions about online information management. They were presented with questions on privacy concerns, personality traits, privacy behavioral intentions and demographics. At the end of the user study, the real aim of the user study was explained during the debriefing session.

**Compensation.** All participants who completed either one or both parts of the user studies were duly compensated either with Amazon vouchers in person or cash using the provided payment platform.

**Data Protection.** We followed the institution’s data protection policy. Participants personal information were anonymized and stored on an encrypted hard drive.

## 5.4 Procedure

We offer a comparison of the three studies conducted in Appendix 7. The overall procedure for the within-subjects experiment is as follows:

First the participants indicated their interest in a registration(pre task) form containing questions on privacy concerns, personality traits; The study was spread over two days; in the first day, the participants carried out the following steps, i.e. 2–3. On the second day, the participants were first induced to a neutral state and then they completed steps 4 and 5. The reason for this was to minimize the carryover

effects of the video stimuli and effect of questionnaire fatigue.

The procedure consists of the following steps, where Fig. 2 illustrates the key elements of the experiment design:

1. Completion of pre-task questionnaire on demographics, alcohol/recreational drug use, IUIPC and CFIP surveys.
2. Neutral state.
  - (a) Induction of a neutral baseline affect state,
  - (b) DV questionnaires on privacy behavioral intentions,
  - (c) Manipulation check with PANAS-X,
  - (d) (Offline only) Manipulation check: Emotional Recognition (ER) and Facereader (FR) from video recording of the participant’s face geometry.
3. Affect State 1: Either happy or fear, determined by random assignment.
  - (a) Show video stimulus to induce affect.
  - (b) DV questionnaire on privacy behavioral intentions,
  - (c) Manipulation check with PANAS-X.
  - (d) (Offline only) Manipulation check: Emotional Recognition (ER) and Facereader (FR) from video recording of the participant’s face geometry.



4. Affect State 2: Complement of Affect State 1.
  - (a) Show video stimulus to induce affect.
  - (b) DV questionnaire on privacy behavioral intentions,
  - (c) Manipulation check with PANAS-X.
  - (d) (Offline only) Manipulation check: Emotional Recognition (ER) and Facereader (FR) from video recording of the participant’s face geometry.
5. a debriefing questionnaire, used to check for missed or misreported information, subjective thoughts during study session.

## 5.5 PBI Measurement

We used the self-report PBI scale by Yang and Wang [28] to measure the participants’ privacy behavioral intentions. The reason for choosing this tool is because it considers privacy behavioral intention as a multi-dimensional construct, providing an all encompassing assessment of PBI. This tool is made up of 14 questions which assess sub-scales: information disclosure intention (IDI), protection intention (PI) and transaction intention (TI). We have previously validated this tool in comparison with IUIPC [31] considering dimensions of the Theory of Planned Behavior (TPB) [32]. In our evaluation, we found that the privacy concern measured in IUIPC [31] has characteristics of a long-term subjective norm. PBI on the other hand seemed more aligned with a short-term behavioral intention.

## 5.6 Manipulation

In the three studies, all participants were required to watch standardized stimulus videos that induce neutral, fear and happy affect states. The three stimulus videos were selected from a list of stimulus videos recorded in the *Handbook of emotion elicitation and assessment* [15]. As recommended in the Handbook, participants were asked to watch a scene from *Alaska’s Wild Denali*, to elicit a neutral affect state. To elicit happy, and fear affect states, participants were exposed to specified scenes from

*When Harry met Sally* and *The Shining* respectively. These stimuli have been precisely defined and validated as standard measures to induce affect, as documented by Ray and Gross [29].

## 5.7 Manipulation Check

We used a 15-item Positive and Negative Affect Schedule (PANAS-X) self-report questionnaire with a designated time horizon “at this moment”) as main instrument to assess the manipulation success. For PANAS-X, we select the sub-scales fear and joviality to assess the affect states fear and happiness, respectively. According to Watson and Clark [23], the joviality scale is “the longest and the most reliable of the lower order scales, with a median internal consistency estimate of  $\alpha_{jov} = .93$ .” The fear lower order scale is reported a median consistency of  $\alpha_{fear} = .87$ .

While we also used psycho-physiological tools (Microsoft Emotional Recognition (ER) and Noldus FaceReader [30]) in the lab, we report only the PANAS-X results in this paper as all the participants were assessed with this instrument.

## 6 Results

### 7 Sample

The sample was combined from three studies with different properties but same methodology: (i) Offline, (ii) AMT, and (iii) Prolific.

**Study 1: Offline Lab study.** The participants were recruited through flyers and emailing lists within the faculties of Social Sciences, Medical Sciences and Computer Science at the host university. 95 participants from Newcastle University registered online to participate in the study. Of those 95 participants,  $N_L = 60$  participants completed the study by physically visiting the lab twice. In terms of ethnicity, 54% of the participants were Caucasian, 26% Asian and 20% were African. In terms of classification of studies, 56.7% of the participants were studying for a postgraduate degree, 37.7% were studying for an undergraduate degree,

3.3% of the participants had secondary school education and the remainder did not report their education background. Table 3 summarizes the descriptive statistics of this sub-sample.

**Study 2: Online AMT study.** The study was conducted in a series of sessions on Amazon Mechanical Turk. Out of 100 registrations, a total of 70 AMT workers completed both sessions of our study. However, 31 responses were found to be unsuitable, by which retained a sub-sample of  $N_M = 39$  observations, described in Table 4.

**Study 3: Prolific Academic study.** The same experiment was conducted on Prolific with a considerably greater completion rate than in the AMT Study. In the first session of affect study we conducted on Prolific 50 submissions were made; out of which 39 completed the study. A second batch requesting for 200 participants was conducted. 217 completed the first part of the study; 211 returned and completed the study. 15 incorrectly completed surveys were excluded. 235 observations were included in this sub-sample, its descriptives being summarized in Table 5. Table 2 shows the demographics distribution in this sub-sample.

Table 2: Demographics of Study 3 on Prolific

Age		Gender	
18-23	46.4%	Female	39.1%
24-29	28.1%	Male	60.9%
30-35	12.8%		
36-41	6.4%		
42-47	2.9%		
48-53	1.3%		
54+	2.1%		

We offer the descriptive statistics for the conditions happy and fearful across the three samples (Lab, MTurk, and Prolific) in Tables 3, 4, and 5, respectively.

Table 3: Descriptives of the lab experiment ( $N_L = 60$ )

	Condition Fear			Condition Happiness		
	PX Fear	PX Joviality	PBI	PX Fear	PX Joviality	PBI
m	1.55	2.71	3.94	1.13	3.27	4.01
sd	0.84	1.23	0.93	0.26	1.18	0.89

Table 4: Descriptives of the MTurk experiment ( $N_M = 39$ )

	Condition Fear			Condition Happiness		
	PX Fear	PX Joviality	PBI	PX Fear	PX Joviality	PBI
m	1.43	2.37	4.32	1.53	2.23	4.31
sd	0.80	1.16	1.08	0.78	1.28	1.10

Table 5: Descriptives of the Prolific experiment ( $N_M = 226$ )

	Condition Fear			Condition Happiness		
	PX Fear	PX Joviality	PBI	PX Fear	PX Joviality	PBI
m	1.59	2.09	4.23	1.25	2.40	4.20
sd	0.75	1.02	0.85	0.46	1.07	0.86

## 7.1 Manipulation Check: PANAS-X

**Assumptions.** Both the differences between happy and fearful conditions on PANAS-X joviality and fear were not normally distributed,  $W = 0.94, p < .001$  and  $W = 0.83, p < .001$  respectively. We thereby choose to use a Wilcoxon Signed-Rank test.

**Success of the Fear/Happiness Manipulations.** The fear reported by participants was statically significantly greater in the fearful condition ( $M = 1.57, SD = 0.77$ ) than in the happy condition ( $M = 1.26, SD = 0.49$ ),  $V = 18286, p < .001$ ,

The joviality of participants was statistically significantly less in the fearful condition ( $M = 2.24$ ,

$SD = 1.1$ ) than in the happy condition ( $M = 2.54$ ,  $SD = 1.17$ ),  $V = 10398.5$ ,  $p < .001$ , Hedges'  $g_{av} = -0.26$ , 95% CI  $[-0.36, -0.17]$ .

Hence, we reject the null hypotheses  $H_{MC,fear,0}$  and  $H_{MC,jov,0}$  and, thereby, consider the affect manipulation with the chosen video stimuli successful.

Figure 3 contains a trigraph overview of all effects between all conditions, for joviality and fear respectfully.

## 7.2 Privacy Behavioral Intention

**Assumptions.** The differences between happy and fearful conditions on Privacy Behavioral Intention (PBI) were not normally distributed,  $W = 0.94$ ,  $p < .001$ . We made the same observation for affect-neutral comparisons as well as sub-scales. We will use a Wilcoxon Signed-Rank test for the comparisons between conditions.

**Differences Between Conditions.** The PBI of the fearful condition ( $M = 4.18$ ,  $SD = 0.9$ ) was significantly greater than in the neutral condition ( $M = 4.1$ ,  $SD = 0.85$ ),  $V = 28284.5$ ,  $p_{MC(12)} < .001$ , Hedges'  $g_{av} = 0.1$ , 95% CI  $[0.04, 0.16]$ .

Similarly, the PBI of the happy condition ( $M = 4.18$ ,  $SD = 0.9$ ) was significantly greater than in the neutral condition ( $M = 4.1$ ,  $SD = 0.85$ ),  $V = 29363.5$ ,  $p_{MC(12)} < .001$ , Hedges'  $g_{av} = 0.09$ , 95% CI  $[0.03, 0.16]$ .

However, PBI was *not* statistically significantly different between fearful condition ( $M = 4.18$ ,  $SD = 0.9$ ) and happy condition ( $M = 4.18$ ,  $SD = 0.9$ ),  $V = 23314.5$ ,  $p_{MC(12)} = 1.000$ , Hedges'  $g_{av} = 0.01$ , 95% CI  $[-0.05, 0.06]$ .

Consequently, we reject the null hypotheses  $H_{nf,PBI,0}$  and  $H_{nh,PBI,0}$ . However, we were not able to reject the null hypothesis  $H_{hf,PBI,0}$ .

We report the difference between conditions first in the trigraph plot of Figure 4 on PBI and its sub-scales. Then we offer a traditional forest plot on the same data, with effect sizes grouped by DV scale (Figure 5).

## 7.3 PBI Sub-Scales

We focus our attention on the PBI sub-scale comparisons that are likely statistically significant based on the effect sizes and confidence intervals reported in Figure 5.

The protection intention (PI) of the fearful condition ( $M = 4.28$ ,  $SD = 1$ ) was significantly greater than of the neutral condition ( $M = 4.15$ ,  $SD = 0.92$ ),  $V = 26202.5$ ,  $p_{MC(12)} < .001$ , Hedges'  $g_{av} = 0.13$ , 95% CI  $[0.06, 0.2]$ .

PI of the happy condition ( $M = 4.27$ ,  $SD = 1$ ) was significantly greater than of the neutral condition ( $M = 4.15$ ,  $SD = 0.92$ ),  $V = 25749.5$ ,  $p_{MC(12)} < .001$ , Hedges'  $g_{av} = 0.12$ , 95% CI  $[0.05, 0.19]$ .

Hence, we reject the null hypotheses  $H_{nf,PI,0}$  and  $H_{nh,PI,0}$ , but failed to reject the null hypothesis  $H_{hf,PI,0}$ .

Finally, the significance of the IDI difference between neutral and fearful condition is in question (especially after MCC). And, indeed, we did not find a statistically significant difference between the IDI scores of these conditions,  $V = 9504.5$ ,  $p_{MC(12)} = .975$ ,  $g_{av} = -0.08$ , 95% CI  $[-0.16, 0]$ .

For null hypothesis  $H_{nf,IDI,0}$  as well as the remaining sub-scale null hypotheses, we consider them as not rejected.

## 7.4 Interactions

It deserves closer attention why the main condition (happiness-fear) is shows a lower effect size than comparisons between the neutral and affect-induced states. To shed light on this situation we compute interaction plots on dichotomized PX fear and happiness scores (high/low).

**PBI Interactions.** Figure 6 considers the interactions for the main DV pbi. Sub-Figure 6a clearly shows the cross-over interaction between happiness and fear condition on the experienced fear in high or low levels of PX fear. Joviality (6b) does not show any interaction.

Whereas participants with high fear in the fear condition exhibit a lower PBI score, participants

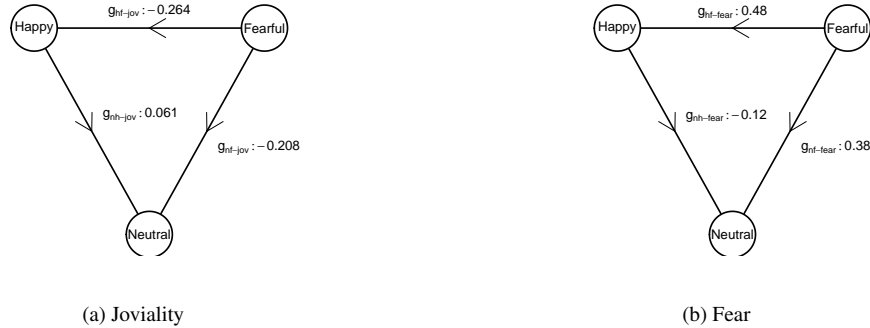


Figure 3: Comparison of Hedges  $g$  of manipulation checks wrt. joviality and fear.

with high fear in the happiness condition show a higher PBI score. Vice versa, participants with low fear show a higher PBI score in the fear condition and show a lower PBI score in the happiness condition.

**Sub-Scale Interactions.** We face a complex situation in the interactions on sub-scales, displayed in Figure 7. There are varying degrees of interactions.

Information Disclosure Intention (IDI) is impacted by interactions in opposing directions, yet not crossing over (7a and 7d).

Fear yields a cross-over interaction on Protection Intention (PI) (7b). The impact of joviality on PI yield no interaction (7e). This sub-scale shows the clearest difference between impact of fear and joviality on sub-scale.

Fear has a cross-over interaction on Transaction Intention (TI) (7c). Joviality shows a milder interaction on TI in the same direction (7f).

## 8 Discussion

### 8.1 Incidental affect impacts PBI and Protection Intention.

We found that both fear and happy affect states caused an increase of Privacy Behavioral Intention as well as the sub-construct Protection Intention.

The magnitude of the effect of fear and happy states is roughly equal.

In the comparison between fear and happy affect states themselves, we did *not* find a significant effect. More to the point, we found that the effects between neutral and the fear/happy were 20-fold the size of the effects between fear and happy condition. Similarly, Coopamootoo [3] and Fordyce et al [27] observed non-significant effects of happiness and fear on privacy behavioral intentions and password choice, respectively, without having provided a plausible explanation.

Furthermore, we observed a cross-over interaction in the fear measurements, but not in the joviality measurements, shedding further light on the low effect between fear and happy conditions.

### 8.2 PBI sub-constructs are affected differently.

While Protection Intention was significantly affected by fear as well as happy conditions, we found much smaller and, then, non-significant effects on Information Disclosure Intention and Transaction Intention. That these emotions act on the Protection Intention, but not on IDI or TI yields further evidence for the complex influence of incidental affect on PBI. These observations are again substantiated by observed interactions on sub-constructs. Mus-

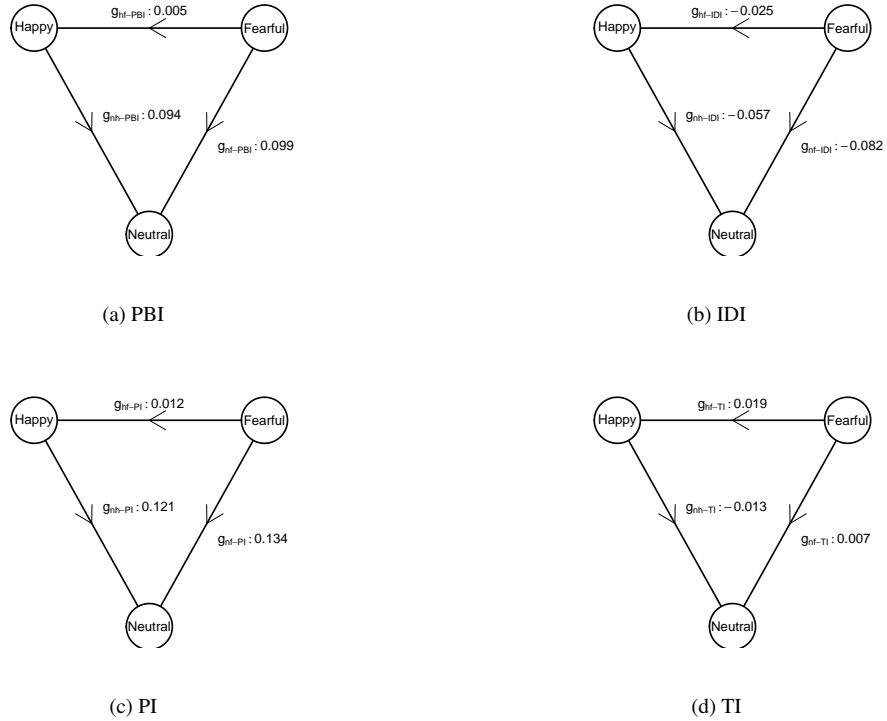


Figure 4: Comparison of Hedges  $g$  of PBI and its sub-scales Information Disclosure Intention (IDI), Protection Intention (PI), and Transaction Intention (TI).

ingly, we could say: “It’s complicated.”

The situation certainly calls for further investigation to ascertain how affect states impact security-relevant intentions and behaviors. From our analysis so far we conclude that simple comparisons of just two affects while ignoring the neutral state do not cut the mustard.

### 8.3 Consulting the circumplex model for a hypothetical explanation: Arousal.

We consider Russel’s circumplex model of affect (cf. Figure 1, [19]), acknowledging that it is not without contention [33]. We find fear classified as negative-valence/high-arousal and happiness classi-

fied as positive-valence/high-arousal. Both emotions have the high arousal in common. We have not anticipated this effect before this study and can only offer a declared *post-hoc* hypothesis: “Arousal itself has a positive impact on Protection Intention and, hence, on Privacy Behavioral Intention.”

Is this hypothesis plausible? Groß et al. [34] proposed Selye’s arousal curve as an alternative explanation for the impact of cognitive effort and depletion on password choice they observed. Hence, arousal was considered a plausible explanation in affective-cognitive effects on security and privacy before. While Fordyce et al [27] explicitly investigated this problem by analyzing the impact of stress on password choice, the question of arousal itself was not settled. To the best of our knowledge, there

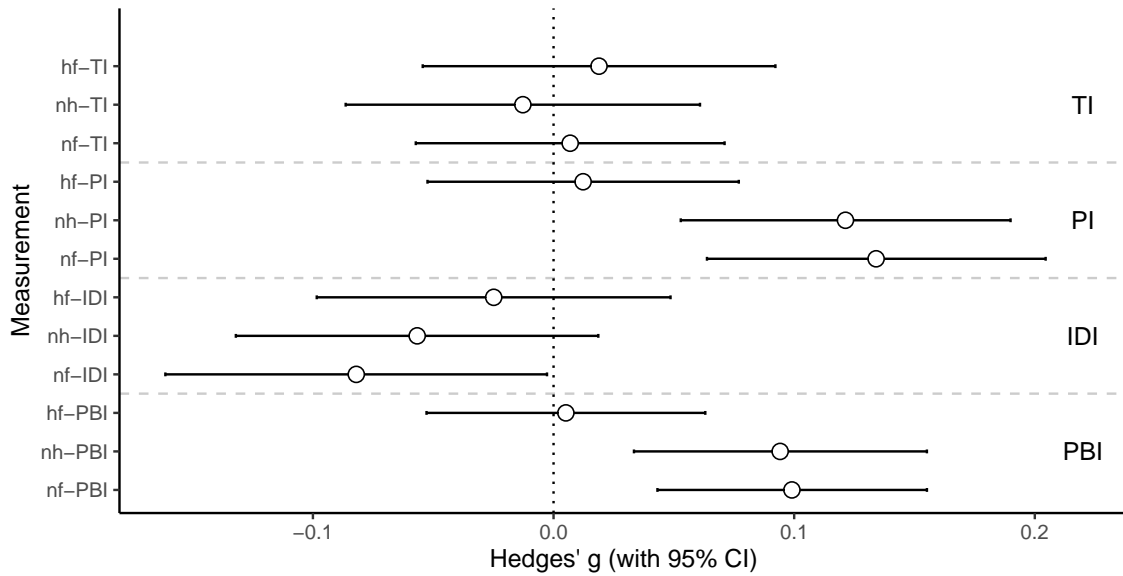


Figure 5: Forest plot on PBI and its sub-scales for the combined dataset.

has been no such investigation in online privacy, yet. However, given the results of this study we opine that arousal can no longer be ignored in similar studies and needs to be considered as a possible confounding variable.

## 8.4 Limitations

**Sampling.** Our participants were recruited from different crowdsourcing platforms, AMT and Prolific Academic, as well as through flyers and e-mails for the lab experiment. The sampling method employed to recruit our participants was based on self-selection or availability, and not random. The participants involved in our user studies were mainly from the US, possibly a norm based effect may have had an effect on the study results.

**PBI Instrument Properties.** The questions for PBI sub-scales were not evenly distributed with two questions assessing information disclosure intentions, nine questions assessing protection intentions and four for transaction intentions [28].

**Mood Induction Properties.** Though we used standard self reporting tools to measure affect states as well as standardized tools for mood induction, the mood induction could have been more robust and consistent if further affect induction techniques were employed to reinforce the induced affect states.

The standardized stimulus videos used were produced more than 10 years ago. As a result some participants were familiar with the film scenes and knew what to expect. This raises the question if an increased effect on affect states could have been ob-

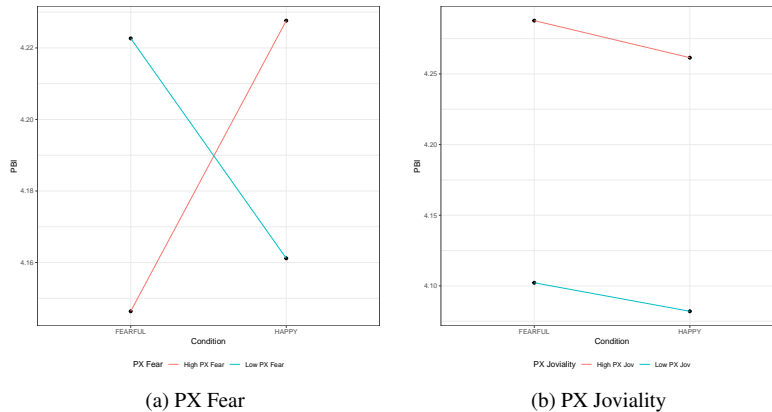


Figure 6: Interaction plots of PBI on PX Affects and Condition.

served if the films were not known.

Contrary to our expectations, we obtained reports from a small percentage of participants, who indicated that they enjoyed the fear stimulus film and reported high happiness scores after watching it. We imagine that this effect is rooted in the pop-culture co-notation of the films and personal preferences of users for certain genres.

## 9 Conclusion

We are first to offer an analysis of incidental affect on privacy behavioral intention (PBI) and its sub-constructs. Incidental affect refers to affect present in a user independent of the current task. Hence, our analysis is more general than earlier preliminary work on integral affect, that is, affect induced by the task at hand.

For the first time, our analysis contributes a systematic fine-grained comparison of neutral, happy and fear states of PBI and its sub-constructs as well as observed interactions. Our analysis offers a compelling explanation for low effect sizes observed between happy and fear states: Compared to neutral states, *both* affect states cause an increased PBI as well as an increased Protection Intention of similar magnitude. Consequently, earlier analyses that only compared fear and happy states ended up with only registering tiny non-significant effects.

Our research raises further questions on a wider range user studies with mood/affect induction and binary comparisons between affect conditions, incl. work-in-progress papers on integral affect [3] and contributions on the impact of fear on password choice [27].

## Acknowledgments

This study benefited from Newcastle University’s psycho-physiological eye tracking lab. We are indebted to the Newcastle University’s School of Computing for the offering the funds for the participant compensation. Thomas Groß was supported by the ERC Starting Grant CASCade (GA n°716980).

## References

- [1] D. McGuinness and A. Simon, “Information disclosure, privacy behaviours, and attitudes regarding employer surveillance of social networking sites,” *IFLA journal*, vol. 44, no. 3, pp. 203–222, 2018.
- [2] G. Loewenstein, “Emotions in economic theory and economic behavior,” *American economic review*, vol. 90, no. 2, pp. 426–432, 2000.

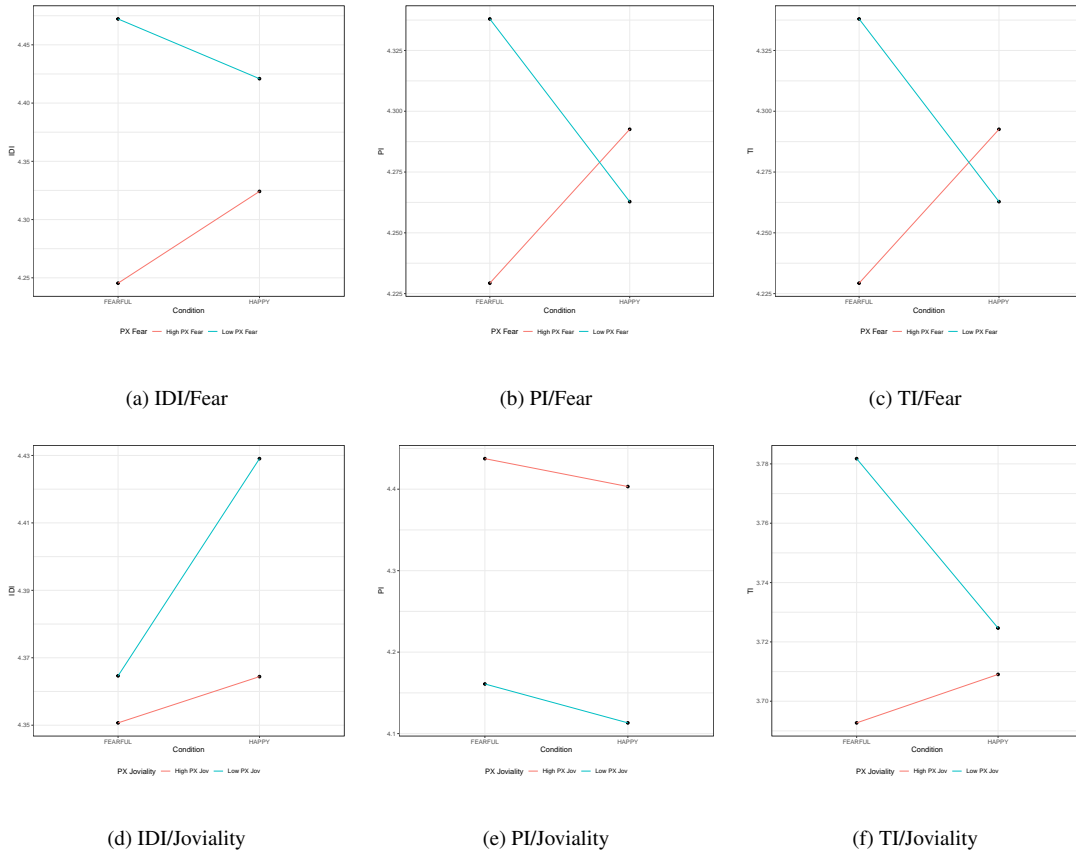


Figure 7: Interaction plots of PBI Subscales (IDI, PI, TI) on PX Affects and Condition.

- [3] K. Coopamootoo, “Wip: Fearful users’ privacy intentions-an empirical investigation,” in *7th Workshop in Socio-Technical Aspects in Security and Trust*. Newcastle University, 2017.
- [4] R. Wakefield, “The influence of user affect in online information disclosure,” *The Journal of Strategic Information Systems*, vol. 22, no. 2, pp. 157–174, 2013.
- [5] H. Li, R. Sarathy, and H. Xu, “The role of affect and cognition on online consumers’ decision to disclose personal information to unfamiliar online vendors,” *Decision Support Systems*, vol. 51, no. 3, pp. 434–445, 2011.
- [6] K. P. Coopamootoo and T. Groß, “Why privacy is all but forgotten: An empirical study of privacy & sharing attitude,” *Proceedings on Privacy Enhancing Technologies*, vol. 2017, no. 4, pp. 97–118, 2017.
- [7] N. Gerber, P. Gerber, and M. Volkamer, “Explaining the privacy paradox-a systematic review of literature investigating privacy attitude and behavior,” *Computers & Security*, 2018.
- [8] H. Li, X. R. Luo, J. Zhang, and H. Xu, “Resolving the privacy paradox: Toward a cognitive appraisal and emotion approach to online privacy behaviors,” *Information & Management*, vol. 54, no. 8, pp. 1012–1022, 2017.



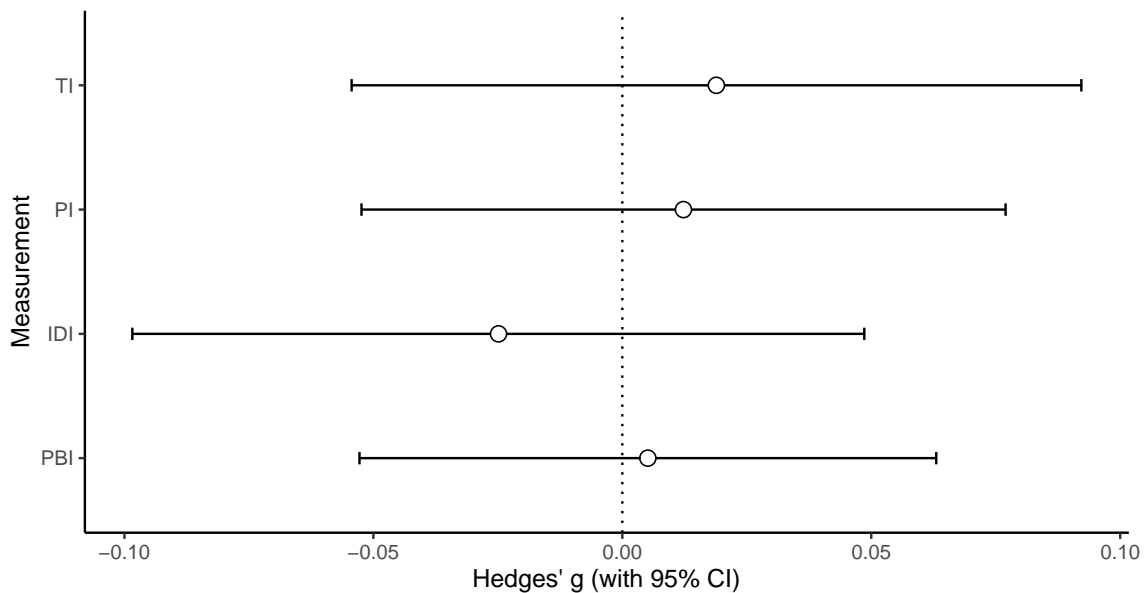


Figure 8: Forest plot on PBI and its sub-scales for the combined dataset.

- [9] K. R. Scherer *et al.*, “On the nature and function of emotion: A component process approach,” *Approaches to emotion*, vol. 2293, p. 317, 1984.
- [10] P. Ekkekakis, *The measurement of affect, mood, and emotion: A guide for health-behavioral research*. Cambridge University Press, 2013.
- [11] D. Västfjäll, P. Slovic, W. J. Burns, A. Erlandsson, L. Koppel, E. Asutay, and G. Tinghög, “The arithmetic of emotion: Integration of incidental and integral affect in judgments and decisions,” *Frontiers in Psychology*, vol. 7, p. 325, 2016.
- [12] J. S. Lerner and D. Keltner, “Beyond valence: Toward a model of emotion-specific influences on judgement and choice,” *Cognition & Emotion*, vol. 14, no. 4, pp. 473–493, 2000.
- [13] S. Han, J. S. Lerner, and D. Keltner, “Feelings and consumer decision making: The appraisal-tendency framework,” *Journal of consumer psychology*, vol. 17, no. 3, pp. 158–168, 2007.
- [14] J. A. Russell, “Core affect and the psychological construction of emotion,” *Psychological review*, vol. 110, no. 1, p. 145, 2003.
- [15] J. A. Coan and J. J. Allen, *Handbook of emotion elicitation and assessment*. Oxford university press, 2007.
- [16] P. Slovic, E. Peters, M. L. Finucane, and D. G. MacGregor, “Affect, risk, and decision mak-

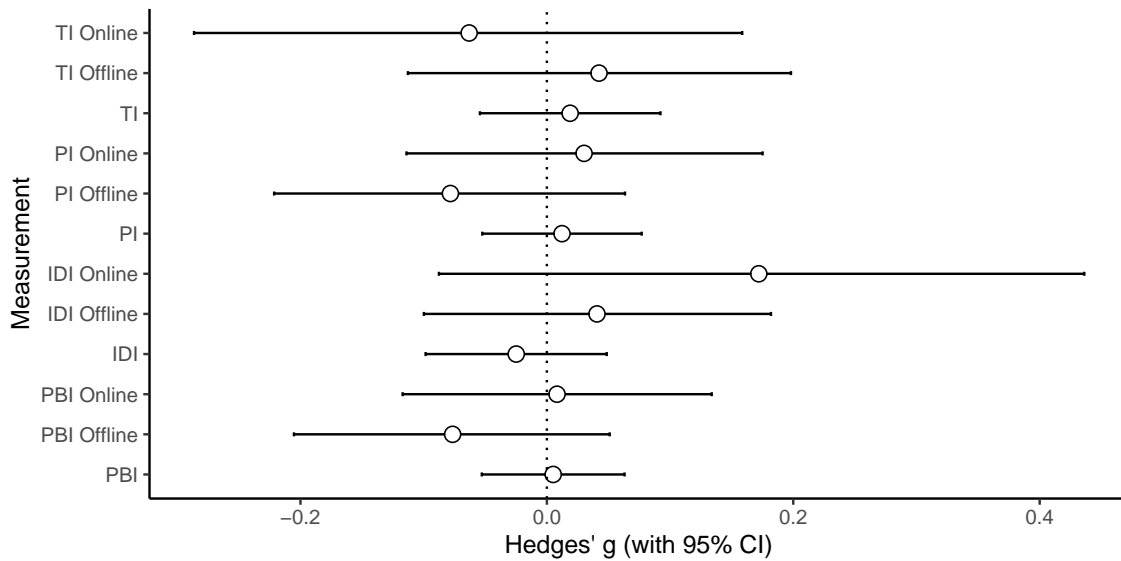


Figure 9: Forest plot on PBI and its sub-scales for the combined dataset.

- ing.” *Health psychology*, vol. 24, no. 4S, p. S35, 2005.
- [17] J. A. Russell and L. F. Barrett, “Core affect, prototypical emotional episodes, and other things called emotion: dissecting the elephant.” *Journal of personality and social psychology*, vol. 76, no. 5, p. 805, 1999.
- [18] R. S. Lazarus and R. S. Lazarus, *Emotion and adaptation*. Oxford University Press on Demand, 1991.
- [19] J. A. Russell, “A circumplex model of affect.” *Journal of personality and social psychology*, vol. 39, no. 6, p. 1161, 1980.
- [20] E. Qiao-Tasserit, M. G. Quesada, L. Antico, D. Bavelier, P. Vuilleumier, and S. Pichon, “Transient emotional events and individual affective traits affect emotion recognition in a perceptual decision-making task,” *PloS one*, vol. 12, no. 2, p. e0171375, 2017.
- [21] E. Siedlecka and T. F. Denson, “Experimental methods for inducing basic emotions: A qualitative review,” *Emotion Review*, p. 1754073917749016, 2018.
- [22] C. D. Marci, D. M. Glick, R. Loh, and D. D. Dougherty, “Autonomic and prefrontal cortex responses to autobiographical recall of emotions,” *Cognitive, Affective, & Behavioral Neuroscience*, vol. 7, no. 3, pp. 243–250, 2007.
- [23] D. Watson and L. A. Clark, “The PANAS-X: Manual for the positive and negative affect schedule – expanded form,” University of

- Iowa, Department of Psychology, Tech. Rep., 1999.
- [24] D. Watson, L. A. Clark, and A. Tellegen, "Development and validation of brief measures of positive and negative affect: the panas scales." *Journal of personality and social psychology*, vol. 54, no. 6, p. 1063, 1988.
- [25] J. R. Crawford and J. D. Henry, "The positive and negative affect schedule (panas): Construct validity, measurement properties and normative data in a large non-clinical sample," *British journal of clinical psychology*, vol. 43, no. 3, pp. 245–265, 2004.
- [26] U. Nwadike, T. Groß, and K. P. Coopamootoo, "Evaluating users' affect states: towards a study on privacy concerns," in *IFIP International Summer School on Privacy and Identity Management*. Springer, 2016, pp. 248–262.
- [27] T. Fordyce, S. Green, and T. Groß, "Investigation of the effect of fear and stress on password choice," in *Proceedings of the 7th Workshop on Socio-Technical Aspects in Security and Trust*. ACM, 2018, pp. 3–15.
- [28] S. Yang and K. Wang, "The influence of information sensitivity compensation on privacy concern and behavioral intention," *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, vol. 40, no. 1, pp. 38–51, 2009.
- [29] R. D. Ray, "Emotion elicitation using films," *Handbook of emotion elicitation and assessment*, pp. 9–28, 2007.
- [30] M. Den Uyl and H. Van Kuilenburg, "The facereader: Online facial expression recognition," in *Proceedings of Measuring Behavior*, vol. 30, 2005, pp. 589–590.
- [31] N. K. Malhotra, S. S. Kim, and J. Agarwal, "Internet users' information privacy concerns (iuipc): The construct, the scale, and a causal model," *Information systems research*, vol. 15, no. 4, pp. 336–355, 2004.
- [32] I. Ajzen, "Theory of planned behavior," *Handb Theor Soc Psychol Vol One*, vol. 1, no. 2011, p. 438, 2011.
- [33] R. J. Larsen and E. Diener, "Promises and problems with the circumplex model of emotion." *Review of personality and social psychology*, vol. No. 13. Emotion, pp. 25–59, 1992.
- [34] T. Groß, K. Coopamootoo, and A. Al-Jabri, "Effect of cognitive depletion on password choice," in *Learning from Authoritative Security Experiment Results (LASER'16)*, S. Peisert, Ed., July 2016.