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SUBJECT MATTER EXPERTS' FEEDBACK ON EXPERIMENTAL PROCEDURES TO MEASURE USER'S JUDGMENT ERRORS IN SOCIAL ENGINEERING ATTACKS

Abstract

Distracted users can fail to correctly distinguish the differences between legitimate and malicious emails or search engine results. Mobile phone users can have a more challenging time identifying malicious content due to the smaller screen size and the limited security features in mobile phone applications. Thus, the main goal of this research study was to design, develop, and validate a set of field experiments to assess user's judgment when exposed to two types of simulated social engineering attacks: phishing and Potentially Malicious Search Engine Results (PMSER), based on the interaction of the environment (distracting vs. non-distracting) and type of device used (mobile vs. computer). In this paper, we provide the results from the Delphi methodology research we conducted using an expert panel consisting of 28 cybersecurity Subject Matter Experts (SMEs) who participated, out of 60 cybersecurity experts invited. Half of the SMEs were with over 10 years of experience in cybersecurity, the rest around five years. SMEs were asked to validate two sets of experimental tasks (phishing & PMSER) as specified in RQ1. The SMEs were then asked to identify physical and Audio/Visual (A/V) environmental factors for distracting and non-distracting environments. About 50% of the SMEs found that an airport was the most distracting environment for mobile phone and computer users. About 35.7% of the SMEs also found that a home environment was the least distracting environment for users, with an office setting coming into a close second place. About 67.9% of the SMEs chose "all" for the most distracting A/V distraction level, which included continuous background noise, visual distractions, and distracting/loud music. About 46.4% of the SMEs chose "all" for the least distracting A/V level, including a quiet environment, relaxing background music, and no visual distractions. The SMEs were then asked to evaluate a randomization table. This was important for RQ2 to set up the eight experimental protocols to maintain the validity of the proposed experiment. About 89.3% indicated a strong consensus that we should keep the randomization as it is. The SMEs were also asked whether we should keep, revise, or replace the number of questions for each mini-IQ test to three questions each. About 75% of the SMEs responded that we should keep the number of mini-IQ questions to three. Finally, the SMEs were asked to evaluate the proposed procedures for the pilot testing and experimental research phases conducted in the future. About 96.4% of the SMEs selected to keep the first pilot testing procedure. For second and third pilot testing procedures, the SMEs responded with an 89.3% strong consensus to keep the procedures. For the first experimental procedure, a strong consensus of 92.9% of the SMEs recommended keeping the procedure. Finally, for the third experimental procedure, there was an 85.7% majority to keep the procedure. The expert panel was used to validate the proposed experimental procedures and recommended adjustments. The conclusions, study limitations, and recommendations for future research are discussed.

Keywords

Cybersecurity, social engineering, judgment error in cybersecurity, phishing email mitigation, distracting environments

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INTRODUCTION

Phishing and malware/ransomware infection from emails, along with Potentially Malicious Search Engine Results (PMSER), inflict significant financial losses to individuals and organizations (Anderson et al., 2013; Choo, 2011; Wright & Marett, 2010). Cybercriminals use increasingly ingenious schemes to take advantage of users' judgment errors when dealing with phishing emails and PMSER (Dhamija et al., 2006; Leontiadis et al., 2014). Phishing is a subcategory of Social Engineering and is "a type of cyber attack that sits at the intersection of social engineering and security technologies" (McElwee et al., 2018, p. 1). The Federal Bureau of Investigation (FBI)'s Internet Crime Complaint Center (IC3) (2020) phishing campaign when "the cybercriminal sends an email containing a malicious file or link" (p. 14). These phishing schemes often use official-looking logos to distract the target from the spelling inconsistencies or embedded fake links in the email (Dhamija et al., 2006; Wright & Marett, 2010). Phishing continues to be an invasive threat to computer and mobile device users (McElwee et al., 2018; FBI, 2020). Cybercriminals continuously develop new phishing schemes using email, and malicious search engine links to gather the personal information of unsuspecting users (Anderson et al., 2013). This information is used for financial gains through identity theft schemes or draining the financial accounts of victims (Anderson et al., 2013; Marett & Wright, 2009; Moody et al., 2017).

Deceptive search engine results pose a significant cybersecurity threat because cybercriminals often manipulate the results algorithms through search poisoning techniques, which promote malicious links to the first page of the search engine results (John et al., 2011; Leontiadis et al., 2014). Recently due to the COVID-19 pandemic, such search engine results were increasingly used to attack individuals and organizations. Superficially, the FBI (2020) noted that among the victims of such cyberattacks are "medical workers searching for personal protective equipment, families looking for information about stimulus checks to help pay bills, and many others" (p. 3). Users of mobile phones, in particular, are more vulnerable to phishing attacks than those who use Personal Computers (PCs) due to poor fraudulent website detection of some mobile browsers along with the limitation of the smaller screen (Mavroeidis & Nicho, 2017; Tsalis et al., 2015; Virvilis et al., 2014). Mobile phone apps such as Quick Response (QR) code readers also pose a phishing attack vector because of the difficulty differentiating an actual QR code from a hijacked one (Dabrowski et al., 2014; Focardi et al., 2018; Mavroeidis & Nicho, 2017). Mobile phones are often the primary platform users utilize nowadays to access various web-based platforms, exposing them to phishing and clickbait schemes (Frauenstein & Flowerday, 2016). Users tend to take their mobile phones with them everywhere, which poses a situation for making judgment errors in distracting environments (Karakasiliotis et al., 2006). The term judgment error refers to individuals making a wrong or bad decision that usually involves calculated risks, evaluating options, and executive decision making (Chowdhury, 2016, p. 42). Even in non-distracting environments such as a business office or home-office setting, it was indicated in prior research that users still having a hard time judging the legitimacy of emails and web links on their PC, being a desktop or laptop (Furnell, 2007).

While logical thinking provides the ability to make logical choices in decision making, it often fails due to errors in judgment (Kahneman, 2011). Cybercriminals continue to take advantage of mobile phone or PC user's judgment errors to enrich themselves. A users' vulnerability to phishing attempts is affected by their ability to keep their information secure (Chin et al., 2012; Fette et al., 2007; Li et al., 2014). While there is plenty of literature and training materials on ways to avoid falling for phishing scams, there is also evidence in the literature that users tend to be unmotivated or ignore the visual cues in emails or web links due to security not being their primary concern (Kumaraguru et al., 2007; Williams et al., 2018). Moreover, it was indicated that "environmental distractions can have an impact on cognitive performance, whether this concerns solving a mathematical problem, maintaining a conversation, or retrieving an experienced event from memory" (Vredeveldt & Perfect, 2014, p. 1).

A distracting environment can occur in any setting with constant interruptions from background noise and music (Dalton & Behm, 2007; Larsby et al., 2008; Sanders & Baron, 1975). This distraction will lead to increased vulnerabilities to personal devices and PCs both in public and at work (Halevi et al., 2013; Kallinen, 2004). With the added distractions causing judgment errors in the workplace and social environments, due to an ever-increasing reliance on connected devices, it appears that there is a need to assess the role of environment and device type on the success of social engineering attacks (Karakasiliotis et al., 2006; Mansi, 2011; Williams et al., 2018). Thus, the main goal of this research study was to design, develop, and validate a set of experiments using an expert panel as a first step, while later in future research, empirically testing the validated set of experiments with participants to assess if there are statistically significant mean differences in users judgment, when: exposed to two types of simulated social engineering attacks (phishing & Potentially Malicious Search Engine Results (PMSER)), based on the interaction of the kind of environment (distracting vs. non-distracting) and type of device used (mobile vs. computer). The two Research Questions (RQs) that this paper addressed are:

RQ1. What are the specific Subject Matter Experts (SMEs') identified two sets of validated *experimental tasks* to assess users' judgment when exposed to two types of simulated social engineering attacks (phishing & PMSER)?

RQ2. What are the specific SMEs' identified *eight experimental protocols* to assess the measures of users' judgment when exposed to two types of simulated social engineering attacks (phishing & PMSER), in two kinds of environments (distracting vs. non-distracting) and two types of device (mobile phone vs. computer)?

LITERATURE REVIEW

The nexus of this research builds on prior literature by hypothesizing that differences in the level of distracting environments when it comes to judgment errors in users exposed to two types of simulated social engineering attacks (phishing & PMSER) may be dependent on the kind of environment (distracting vs. non-distracting) and type of device used (mobile phone vs. computer). Users that habitually share web links on their devices tend to have low-security awareness, potentially opening them up to more vulnerabilities that cause significant cybersecurity damage to themselves and the organizations they are working for (Halevi et al., 2013; Levy & Gafni, 2021). Mobile phone usage proves to be too much of a temptation for some people during work and social times, distracting them from whatever tasks that they are performing causing detrimental effects on performance, also known as cyberslacking (Alharthi et al., 2019; Brooks, 2015; Hernández et al., 2016). The use of mobile phones in the working or learning environment poses a risk of multiple distractions that may affect the ability of users to perform assigned tasks (Drew & Forbes, 2017; Khaddage et al., 2015; Nicholson et al., 2005). These distractions pose an attention conflict that can overload cognitive function, which reduces performance, leading to difficulty completing tasks (Groff et al., 1983; Kahneman, 1973; Sanders et al., 1978). Interruptions caused by distractions force people to focus elsewhere instead of the task they need to perform (Speier et al., 1999, 2003). The time to complete tasks can be significantly affected by interruptions in the work environment (Bailey et al., 2006; Mansi & Levy, 2013; Zijlstra et al., 1999). Distractions from environmental factors are comparable to person-based interruptions due to work time lost from the disturbance (Sanders et al., 1978; Sanders & Baron, 1975).

Phishing

Phishing scams are among the oldest and widely used social engineering methods to gain personal information and infiltrate organizational systems, mainly for financial gain (Anderson et al., 2013; Marett & Wright, 2009; Moody et al., 2017). "Social engineering consists of persuasion techniques to manipulate people into performing actions or divulging confidential information" (Ferreira et al., 2015, p.

36). Phishing attempts often are email-based attacks but can also occur through spoofed website links (Vishwanath et al., 2011; Zhao et al., 2017). PCs are not the only devices susceptible to phishing; mobile phones are also being targeted (Enck, 2011; Goel & Jain, 2018; Vidas et al., 2013). Mobile phones are rich targets for phishing attempts because users take them everywhere and often store personal and financial data (Li et al., 2014; Mylonas et al., 2013). These attempts are becoming more sophisticated using distracting features and persuasive elements (Chiew et al., 2018; Kim & Kim, 2013). The content of these messages is often disguised as legitimate companies. It contains rational, emotional, and motivationally appealing elements that tempt users to click on links to gain their personal information to steal their identity or financial assets (Kim & Kim, 2013).

Cybercriminals often design phishing schemes to victimize vulnerable targets (Zhao et al., 2017). Some users are more susceptible to phishing attacks than others (Alarm & El-Khatib, 2016; Moody et al., 2017; Oliveira et al., 2017). Some demographic groups, such as children, teens, and senior citizens, are more susceptible to phishing attacks (Flores et al., 2015; Oliveira et al., 2017; Sheng et al., 2010). Users are targeted at work and private on their computers and mobile phones to gain personal information (Virvilis et al., 2014; Williams et al., 2018). Even with proper training, research provides strong evidence that users still are fall victim to phishing attacks (Albladi & Weir, 2018; Kim & Kim, 2013; Moody et al., 2017). Even corporate controls for phishing prevention often fail (Levy & Gafni, 2021; McElwee et al., 2018; Silic & Back, 2016).

Environmental Factors

Environmental factors affect how users perform tasks in the workplace, at home, and in public (Dalton & Behm, 2007; Kallinen, 2004; Vredeveldt & Perfect, 2014). Background noise negatively affects task performance because it distracts and interrupts users (Dalton & Behm, 2007; Larsby et al., 2008). However, the use of background music has mixed results (Dalton & Behm, 2007; Kallinen, 2004). Instant Messaging (IM) apps in the workplace also pose a distraction in the working environment (Garrett & Danziger, 2007; Mansi, 2011; Mansi & Levy, 2013). These distractions have a negative effect on users' psychological state, causing mental fatigue and reduced working memory capacity (Conway et al., 2001; Zijlstra et al., 1999). When the working memory is overloaded, the decision-making process of users, causing judgment errors (Gómez-Chacón et al., 2014; Speier et al., 2003).

Distracting environments can have a negative effect on working and attentional memory (Awh & Jonides, 2001; Rodrigues & Pandeirada, 2015). Lapses of attention caused by external distractions interrupt task performance by inhibiting the attentive processes of working memory (Berti & Schröger, 2001; Christophel et al., 2017). Rodrigues and Pandeirada (2015) tested the working memory in 40 elderly research participants in distracting and non-distracting environments and found that they performed the tasks better in the non-distracting environment. The use of irrelevant stimuli has been found to distract someone from focusing on a task by disrupting attentional awareness (Forster & Lavie, 2008; Steinkamp, 1980; Unsworth & Robison, 2016). Many of these irrelevant stimuli are used in phishing emails to distract the recipient from other details that may give away the true nature of the email (Ferreira et al., 2015; Ferreira & Teles, 2019; Pearson, 2019). These irrelevant distractors can create involuntary shifts in spatial attention, affecting reaction times by adding a filtering cost to information processing (Folk & Remington, 1998, 1999).

Judgment Errors

Many researchers have studied why humans make choices when faced with decisions often under uncertain terms (Fox & Tversky, 1998; Kahneman & Tversky, 1982; Tversky & Kahneman, 1992). Some of these choices are reason-based, belief-based, and can involve bias (Ayton & Pascoe, 1995; Fox & Tversky, 1998; Shafir et al., 1993). Human error has been researched for decades by several researchers that have made extensive contributions to the field (Cohen, 1981; Reason, 1990; Tversky & Kahneman, 1974, 1983). Tversky and Kahneman (1974) began researching human judgment when presented with uncertain choices. In the process of this research, they developed System 1 (intuitive) and System 2 (analytical) thinking in the decision-making process (Tay et al., 2016; Tversky & Kahneman, 1983). System 1 and System 2 thinking work hand in hand in human judgment, with analytical thinking either confirming or overriding the intuitive thinking (Evans, 2003; Frankish, 2010). Judgments are often made from multiple cues provided by the information being processed. These judgments, however, can be affected by subconscious cognitive biases (Evans, 2003, 2008; Evans et al., 2003; Fisk, 2002).

Users are subjected to various distractions when interacting with mobile phones and computers; often, these distractions cause errors in judgment (Ayton & Pascoe, 1995; Chowdhury, 2016; Funder, 1987). Mobile phones cause many distractions by inhibiting the working memory of users (Nicholson et al., 2005). Many users do not understand the risks of using computers and mobile phones (Schneier & West, 2008). Security tends to be a low priority for users unless a problem arises (Schneier & West, 2008). Security is a low priority because users do not fully understand the losses involved (Schneier & West, 2008; Tversky & Kahneman, 1983). Users will often develop anxiety and develop coping mechanisms when dealing with potential phishing scams (Wang et al., 2017; P. Wright, 1974). Distracted users often have a hard time detecting the elements of phishing emails leading to potential judgment errors (Furnell, 2007; Karakasiliotis et al., 2006). Many users make a judgment on visual and technical cues in phishing emails and will often not be able to detect phishing attempts (Karakasiliotis et al., 2006). Habitually reading emails while distracted by various environmental factors can increase users' susceptibility to phishing scams (Vishwanath et al., 2011). Errors of judgment often have real consequences involved with them, depending on the context (Chowdhury, 2016; Funder, 1987).

METHODOLOGY

This study is experimental field research and documents the Expert Panel phases conducted with SMEs to validate the set of experiments. The Expert Panel Research Design Process's proposed model is based on the work of Tracey and Richey (2007), which uses the Delphi technique that uses a panel of SMEs analysis and feedback (See Figure 1). The Delphi technique is a fundamental methodology in situations where accurate information is not available, and expert judgment is needed (Ramim & Lichvar, 2014). The SME panel was used to determine if the two sets of tasks and eight experimental protocols meet understandability, answerability, and readability standards (Ramim & Lichvar, 2014).

SMEs were asked to validate two sets of experimental tasks (phishing & PMSER) as specified in RQ1. This was important to finalize the questions being developed for the mini-IQ tests for the phishing and PMSER experiments. The SMEs were then asked to identify physical and Audio Visual (A/V) environmental factors for distracting and non-distracting environments. This was important towards RQ2 for setting the environment for the questions developed for the mini-IQ tests from RQ1. The SMEs were then asked to evaluate a randomization table, as shown in Figure 1. This was important for RQ2 to set up the eight experimental protocols to maintain the validity of the proposed experiment. Finally, the SMEs were asked to evaluate the proposed procedures for the pilot testing and experimental research phases that will be conducted in the future. This was important to both RQ1 and RQ2 as it incorporates the validated questions from this research study for use in future experimental research.

Data Analysis and Results

Invitation emails to participate in the Subject Matter Expert (SME) survey was sent to about 60 cybersecurity experts along with a social media post on LinkedIn with a goal of 25 respondents. An SME panel of 28 cybersecurity experts participated in this Delphi study, and a consensus was met on the survey questions. Table 1 provides the descriptive statistics of the 28 respondents during the SME responses, which took place from March to May of 2021. The cybersecurity experts ranged from cybersecurity practitioners including network security engineers, Information

Technology (IT) security analysts, information security managers, information technology auditors, cybersecurity administrators, cybersecurity consultants, cybersecurity architects, and senior IT executives. Additionally, professors and researchers in the areas of cybersecurity were among the participants. Over 57.1% of the respondents had over 10 years of experience in cybersecurity and/or information security, followed by 25% at five to 10 years of cybersecurity or information security experience. The rest fell into the five years or less category. While most of the cybersecurity SMEs in senior positions previously worked in various positions in cybersecurity, the SMEs were limited to only entering one current profession for the survey.

Table 1

Descriptive Statistics of SMEs (N=28)

Survey Question	Frequency	Percentage
Professional role:		
Network Security or Cybersecurity Engineer	3	10.7
Cybersecurity, Information Security, or Information Technology Security Analyst	8	28.6
Information Security Manager	3	10.7
Information Technology Auditor	1	3.6
Cybersecurity Administrator	0	0
Cybersecurity Consultant	0	0
Cybersecurity Architect	0	0
Other	10	35.7
Experience in Information Security:		
10 years or more	16	57.1
At least five years, but less than 10 years	7	25
At least three years, but less than five years	2	7.1
At least one year, but less than three years	1	3.6
Less than one year	1	3.6
No Experience	1	3.6
Number of cybersecurity certifications:		
None	15	53.6
One	4	14.3
Two	4	14.3
Three	2	7.1
Four or more	3	10.7

As shown in Appendix A, the SMEs were asked to evaluate 12 sample emails for use in the mini-IQ tests for the proposed experimental research. They were asked to evaluate each email sample and answer, as shown in Table 2, if the email sample was legitimate, phishing, or unsure. The sample emails were a mixture of legitimate and various degrees of difficulty levels for the phishing emails (easy, medium, and hard). As indicated in Table 2, some of the email samples had a higher level of unsure responses as the difficulty increased.

Table 2

SME Feedback on Email Samples for Proposed IQ Testing (N=28)

Email Phishing Sample	Frequency	Percentage
Please identify the sample email above as one of the following: Legitimate, Phishing, or Unsure		
Sample 1		
Legitimate	1	3.6
Phishing	27	96.4
Unsure	0	0
Sample 2		
Legitimate	13	46.4
Phishing	12	42.9
Unsure	3	10.7
Sample 3		
Legitimate	10	35.7
Phishing	4	14.3
Unsure	14	50
Sample 4		
Legitimate	1	3.6
Phishing	24	85.7
Unsure	3	10.7
Sample 5		
Legitimate	2	7.1
Phishing	24	85.7
Unsure	2	7.1
Sample 6		
Legitimate	18	64.3
Phishing	3	10.7
Unsure	7	25
Sample 7		
Legitimate	17	60.7
Phishing	6	21.4
Unsure	5	17.9
Sample 8		
Legitimate	8	28.6
Phishing	18	64.3
Unsure	2	7.1
Sample 9		
Legitimate	9	32.1
Phishing	7	25
Unsure	12	42.9
Sample 10		
Legitimate	0	0
Phishing	28	100

Email Phishing Sample	Frequency	Percentage
Unsure	0	0
Sample 11		
Legitimate	6	21.4
Phishing	16	57.1
Unsure	6	21.4
Sample 12		
Legitimate	5	17.9
Phishing	18	64.3
Unsure	5	17.9

The SMEs were also asked to provide feedback on whether to keep, revise, or replace the sample emails they evaluated from Table 2. As shown in Table 3, most of the SMEs chose to keep all of the email samples. The SMEs were also asked to provide feedback on why they chose the revise or replace options and any additional feedback that might improve the email samples. Some vital feedback on the revisions came from the over 60 age group on adjusting the image quality on two samples to be more readable for all participants.

Table 3

SME Feedback on Email Sample Edits (N=28)

Email Phishing Sample	Frequency	Percentage
Please provide your expert opinion about the email sample above by indicating: Keep, Revise, or Replace		
Sample 1		
Keep	21	75
Revise	6	21.4
Replace	1	3.6
Sample 2		
Keep	23	82.1
Revise	2	7.1
Replace	3	10.7
Sample 3		
Keep	20	71.4
Revise	7	25
Replace	1	3.6
Sample 4		
Keep	25	89.3
Revise	1	3.6
Replace	2	7.1
Sample 5		
Keep	22	78.6
Revise	3	10.7
Replace	3	10.7
Sample 6		

Email Phishing Sample	Frequency	Percentage
Keep	25	89.3
Revise	2	7.1
Replace	1	3.6
Sample 7		
Keep	22	78.6
Revise	5	17.9
Replace	1	3.6
Sample 8		
Keep	21	75
Revise	6	21.4
Replace	1	3.6
Sample 9		
Keep	14	50
Revise	8	28.6
Replace	6	21.4
Sample 10		
Keep	26	92.9
Revise	1	3.6
Replace	1	3.6
Sample 11		
Keep	23	82.1
Revise	2	7.1
Replace	3	10.7
Sample 12		
Keep	26	92.9
Revise	1	3.6
Replace	1	3.6

The SMEs were asked to evaluate 12 PMSER samples as shown in Appendix B for future experimental research use in the mini-IQ tests. They were asked to evaluate whether each PMSER sample and answer, as shown in Table 4, if the PMSER was legitimate, potentially malicious, or if they were unsure. The PMSER samples were a mixture of legitimate and various degrees of difficulty levels for the PMSER samples (easy, medium, and hard).

Table 4

SME Feedback on PMSER Samples for Proposed IQ Testing (N=28)

PMSER Sample	Frequency	Percentage
Please identify the sample PMSER above as one of the following: Legitimate, Potentially Malicious, or Unsure		
Sample 1		
Legitimate	3	10.7
Potentially Malicious	22	78.6
Unsure	3	2.7
Sample 2		

PMSER Sample	Frequency	Percentage
Legitimate	13	36.4
Potentially Malicious	12	42.9
Unsure	3	10.7
Sample 3		
Legitimate	8	28.6
Potentially Malicious	14	50
Unsure	6	21.4
Sample 4		
Legitimate	21	75
Potentially Malicious	5	17.9
Unsure	2	7.1
Sample 5		
Legitimate	6	21.4
Potentially Malicious	16	57.1
Unsure	6	21.4
Sample 6		
Legitimate	7	25
Potentially Malicious	20	71.4
Unsure	1	3.6
Sample 7		
Legitimate	22	7.8
Potentially Malicious	4	14.3
Unsure	2	7.1
Sample 8		
Legitimate	5	17.9
Potentially Malicious	20	17.9
Unsure	3	10.7
Sample 9		
Legitimate	21	75
Potentially Malicious	6	21.4
Unsure	1	3.6
Sample 10		
Legitimate	21	75
Potentially Malicious	4	14.3
Unsure	3	10.7
Sample 11		
Legitimate	25	89.3
Potentially Malicious	2	7.1
Unsure	1	3.6
Sample 12		
Legitimate	10	35.7
Potentially Malicious	15	53.6
Unsure	3	10.7

The SMEs were also asked to provide feedback on whether to keep, revise, or replace the PMSER samples they evaluated from Table 4. As shown in Table 5, most of the SME’s chose to keep all of the PMSER samples. The SMEs were also asked to provide feedback on why they chose the revise or replace options and any additional feedback that might improve the PMSER samples. As with the sample email feedback on the revisions, we will adjust the image quality on all samples to be more readable for all participants.

Table 5

SME Feedback on PMSER Sample Edits (N=28)

PMSER Sample	Frequency	Percentage
Please provide your expert opinion about the PMSER sample above by indicating: Keep, Revise, or Replace		
Sample 1		
Keep	26	92.9
Revise	1	3.6
Replace	1	3.6
Sample 2		
Keep	23	82.1
Revise	3	10.7
Replace	2	7.1
Sample 3		
Keep	25	89.3
Revise	2	7.1
Replace	1	3.6
Sample 4		
Keep	25	89.3
Revise	1	3.6
Replace	2	7.1
Sample 5		
Keep	19	67.9
Revise	7	25
Replace	2	7.1
Sample 6		
Keep	25	89.3
Revise	2	7.1
Replace	1	3.6
Sample 7		
Keep	24	85.7
Revise	3	10.7
Replace	1	3.6
Sample 8		
Keep	25	89.3
Revise	2	7.1
Replace	1	3.6
Sample 9		
Keep	27	96.4
Revise	0	0

PMSER Sample	Frequency	Percentage
Replace	1	3.6
Sample 10		
Keep	27	96.4
Revise	0	0
Replace	1	3.6
Sample 11		
Keep	27	96.4
Revise	0	0
Replace	1	3.6
Sample 12		
Keep	25	89.3
Revise	1	3.6
Replace	2	7.1

The SMEs were asked to evaluate the topmost and least distracting environments for mobile phone and computer users. Table 6 indicates that about 50% of the SMEs found that an airport was the most distracting environment for mobile phone and computer users. About 35.7% of the SMEs also found that a home environment was the least distracting for mobile phone and computer users, with an office setting coming into a close second place.

Table 6

SME Feedback of Physical Distracting Environments (N=28)

Environment	Frequency	Percentage
Which physical environment provides the most distracting environment for Mobile Phones and Computers?		
Airport	14	50
Coffee Shop	5	17.9
Lecture Hall	0	0
Meeting	9	32.1
Which physical environment provides the least distracting environment for Mobile Phones and Computers?		
Office Setting	8	28.6
Home	10	35.7
Hotel room	6	21.4
Library/Bookstore	4	14.3

The SMEs were asked to evaluate the topmost and least Audio/Visual (A/V) distraction levels for mobile phone and computer users. Table 7 shows that about 67.9% of the SMEs chose all of the above for the most distracting A/V distraction level, including continuous background noise, visual distractions, and distracting/loud music. About 46.4% of the SMEs chose all of the above for the most distracting A/V distraction level, including a quiet environment, relaxing background music, and no visual distractions.

Table 7

SME Feedback of A/V Distraction Levels (N=28)

A/V Distraction Level	Frequency	Percentage
Which audio/visual distraction level is best for a distracting environment for Mobile Phones and Computers?		
Continuous Background Noise	3	10.7
Visual Distractions	4	14.3
Distracting/Loud Music	2	7.1
All of the above	19	67.9
Which audio/visual distraction level is best for a non-distracting environment for Mobile Phones and Computers?		
A Quiet Environment	7	25
Relaxing Background Music	5	19.9
No visual distractions	3	10.7
All of the above	13	46.4

The SMEs were asked to evaluate the randomization table in Figure 1 and provide feedback on whether to keep, revise, or replace the randomization. About 89.3% indicated that we should keep the randomization as it is. The SMEs were also asked whether we should keep, revise, or replace the number of questions for each mini-IQ test to three questions each. About 75% of the SMEs responded that we should keep the number of mini-IQ questions to three. As with the email and PMSER sample questions, the SMEs were asked to provide feedback on why they chose the revised or replace options and any additional feedback that might improve the randomization and question size.

Table 2

SME Feedback on Mini IQ Test Randomization (N=28)

Question	Frequency	Percentage
Please provide your expert opinion about the randomization table above by indicating:		
Keep	25	89.3
Revise	1	3.6
Replace	2	7.1
The proposed mini-IQ tests will consist of three questions, each using the randomization table above. Please provide your expert opinion about the randomization and size of the mini-IQ tests by indicating:		
Keep	21	75
Revise	6	21.4
Replace	1	3.6

Figure 1 indicates the proposed question randomization for the email and PMSER questions given to the pilot study participants and the main research study participants. Randomization was necessary to maintain the quality and the validity of the research study. The difficulty of the phishing and PMSER questions is evenly distributed to reduce the chance that all easy questions are asked in non-distracting environments and all hard questions being asked in distracting environments.

Figure 1

Social Engineering Attack Type Randomization Table

Social Engineering Attack Type

Phishing

		Environment	
		Distracting	Non-Distracting
Device	Mobile Phone	Distracted via Mobile Phone • Phishing Hard • Legitimate • Phishing Easy	Not Distracted via Mobile Phone • Legitimate • Phishing Easy • Phishing Medium
	Computer	Distracted via Computer • Phishing Easy • Phishing Medium • Phishing Hard	Not Distracted via Computer • Phishing Medium • Phishing Hard • Legitimate

PMSER

		Environment	
		Distracting	Non-Distracting
Device	Mobile Phone	Distracted via Mobile Phone • Legitimate • PMSER Easy • PMSER Medium	Not Distracted via Mobile Phone • PMSER Easy • PMSER Medium • PMSER Hard
	Computer	Distracted via Computer • PMSER Medium • PMSER Hard • Legitimate	Not Distracted via Computer • PMSER Hard • Legitimate • PMSER Easy

The SMEs were asked to provide feedback on the pilot and experimental testing procedures, as shown in Table 9, whether to keep, revise, or replace each procedure. For the pilot-testing procedures, 96.4% of the SMEs selected to keep the first pilot testing procedure. For the second and third pilot testing procedures, the SMEs responded with an 89.3% majority to keep the procedures. For the first experimental procedure, 92.9% of the SMEs chose to keep the procedure. The second experimental procedure had an 89.3% majority for keeping the procedure. Finally, for the third experimental procedure, there was an 85.7% majority to keep the procedure. The SMEs that chose to revise or replace asked to provide feedback on why they chose to revise or replace options on all of the procedures and any additional feedback that might improve the testing procedures.

Table 3

Pilot Testing and Experimental Testing Procedures

Experimental Testing Procedure	Frequency	Percentage
Pilot Experimental Procedure 1: Post invitation on social media such as LinkedIn		
Keep Revise Replace	27 0 1	96.4 0 3.6
Pilot Experimental Procedure 2: Email interested pilot testing participants a zoom meeting link to conduct pilot testing and assign each a participant ID.		
Keep Revise Replace	25 2 1	89.3 7.1 3.6
Pilot Experimental Procedure 3: Pilot test participants will be given links to the mini-IQ tests to complete while in a monitored simulated environment (distracting or non-distracting) via Zoom. Each participant will be asked to enter their assigned participant ID for each IQ test for data tracking purposes.		
Keep Revise Replace	25 2 1	89.3 7.1 3.6
Main Experimental Procedure 1: Post invitation on testing site organizational website and via organizational email.		
Keep Revise Replace	26 0 2	92.9 0 7.1
Main Experimental Procedure 2: Email interested experimental testing participants a zoom meeting link to conduct experimental testing and assign each a participant ID.		
Keep Revise Replace	25 2 1	89.3 7.1 3.6
Main Experimental Procedure 3: Experimental test participants will be given links to the mini-IQ tests to complete while in a monitored simulated environment (distracting or non-distracting) via Zoom. Each participant will be asked to enter their assigned participant ID for each IQ test for data tracking purposes.		
Keep Revise Replace	24 2 2	85.7 7.1 7.1

CONCLUSIONS AND DISCUSSIONS

This study presents the results of SMEs validation process of two sets of validated experimental tasks to assess users' judgment when exposed to two types of simulated social engineering attacks (phishing & PMSER), and eight experimental protocols to assess the measures of users' judgment when exposed to two types of simulated social engineering attacks (phishing & PMSER), during two kinds of environments (distracting vs. non-distracting), and two types of devices (mobile phone vs. computer). This study is relevant, as it seeks to identify the vulnerabilities of information systems users exposed to two types of simulated social engineering attacks (phishing & PMSER), used to gain access to an individual's personal or organizational accounts, mainly for monetary gain (Anderson et al., 2013; Leontiadis et al., 2014). With the widespread use of mobile phones with Internet-connected applications, phishing attempts have increased through social engineering through scams and clickbait links (Frauenstein & Flowerday, 2016; Halevi et al., 2013; Marett & Wright, 2009). Frauenstein and Flowerday (2016) stated that users pick up bad habits by using link-sharing applications that leave them vulnerable to phishing attacks. These bad habits make it harder for a person to discern between genuine and malicious links making them more susceptible to phishing attacks (Frauenstein & Flowerday, 2016; Vishwanath et al., 2011). Moreover, the significance of this research is in its potential to advance the current research in cybersecurity by increasing the body of knowledge regarding users' judgment when exposed to two types of simulated social engineering attacks (phishing & PMSER). Distracting environments at work and in public make it easier for a user to have errors in judgment when performing tasks (Groff et al., 1983; Reason, 1995; Sanders & Baron, 1975). Attackers craft phishing attacks to try and distort the mental model that users form in interacting with online transactions and distract them from the visual cues they usually pick up on (Downs et al., 2006). As the number of distractions increases, cognitive cues decrease, affecting decision-making due to cognitive overload (Groff et al., 1983; Kahneman, 1973; Speier et al., 1999). We feel that the results of this study will provide significant input to the body of knowledge of users' susceptibility to social engineering attacks in distracting environments while using mobile phones and computers.

Like any research study, this study has several limitations. The main limitation of this expert panel research study is relying on the SME opinions provided during the Delphi technique. SME panel participants are often volunteers who can withdraw from the study for many reasons, negatively impacting the research (Ellis & Levy, 2010). By combining the Delphi technique with a review of the literature, we mitigated such limitations. Our recruitment of SMEs from varying industries and academia also helped mitigate this limitation.

Future research will use the validated set of experiments to collect and analyze data to find if any significant mean differences exist in users' judgment when exposed to two types of simulated social engineering attacks (phishing & PMSER) and the two types of distracting environments while using mobile phones or desktop/laptop computers. Prior literature indicated that various demographic indicators such as age, gender, education, and level of social media usage, also play a role in phishing judgemental errors (Frauenstein & Flowerday, 2016; Sheng et al., 2010). Thus, additional assessments of the experimental data with the interaction of the different demographic indicators may help further uncover potential groups that are more susceptive to social engineering attacks.

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Appendix A

SME Survey Phishing Email Samples

<table>
<tr><td>Legitimate (Sample 3 Table 2)</td><td>Phishing Easy (Sample 10 Table 2)</td></tr>
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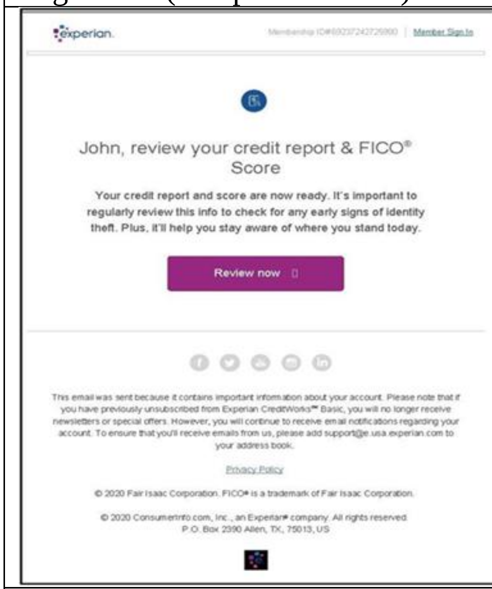

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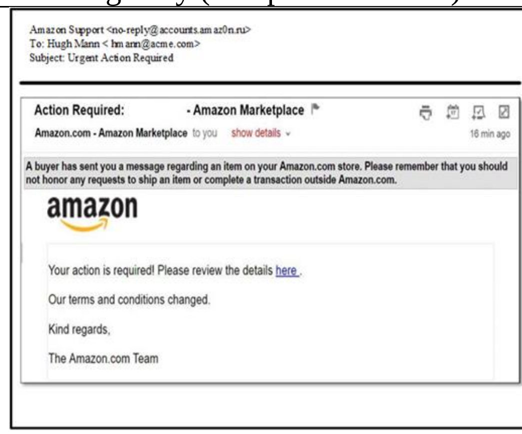

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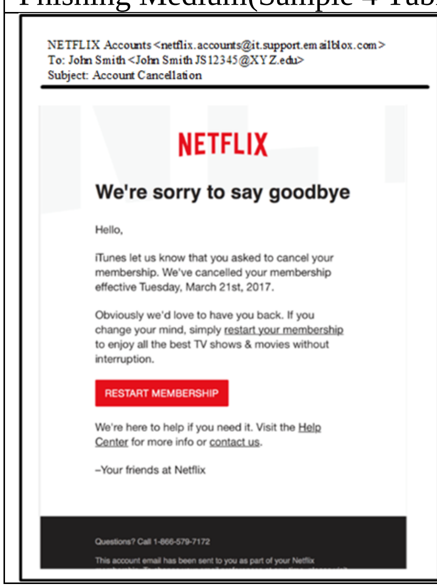

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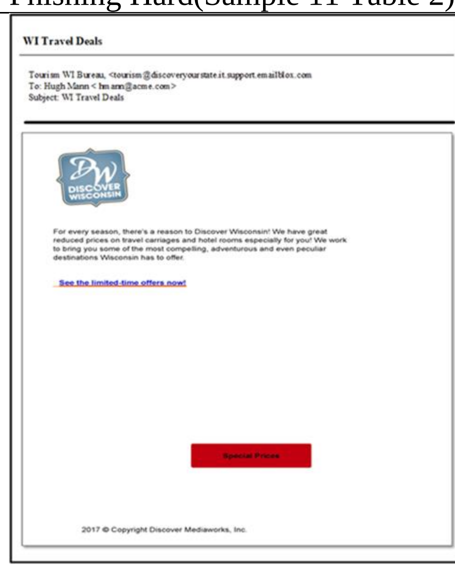

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Appendix B

SME Survey PMSER Samples

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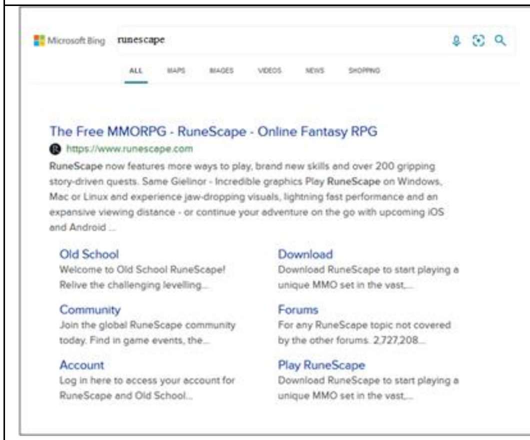

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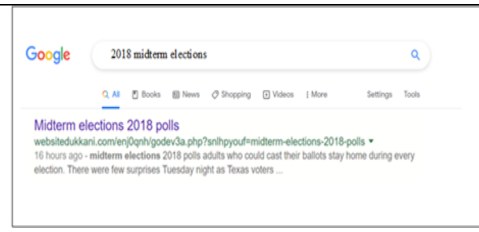

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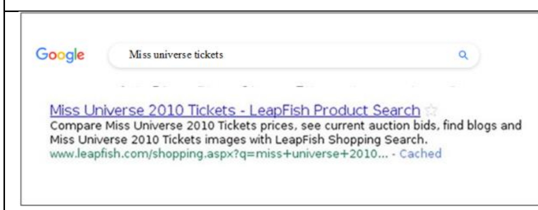

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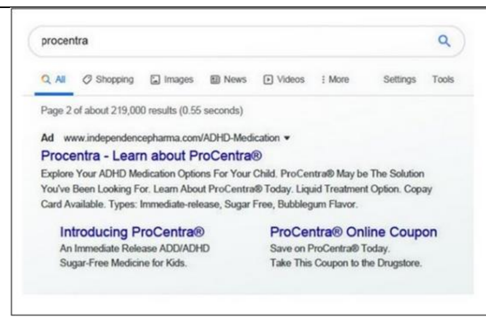

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