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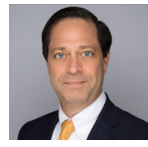
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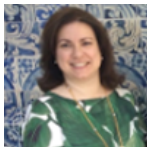
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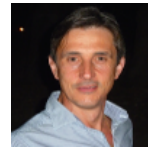
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Towards assessing the role of persuasion principles and cybersecurity skills training on senior citizens' SMiShing susceptibility

[Research-in-Progress]

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Abstract

In recent years, senior citizens have fallen victim to phishing attacks and collectively lost many millions of dollars each year. One attack vector for committing phishing is SMiShing, where the attacker sends a Short Message Service (SMS) communication that often contains operationalized principles of persuasion to execute an attack. Prior research has shown persuasion principles can improve phishing attacks' success. However, it appears that limited research has been done regarding senior citizens' susceptibility to SMiShing and the use of persuasion principles. The main goal of this work-in-progress study is to empirically evaluate the influence of the five principles of persuasion on senior citizens' susceptibility to SMiShing attacks using simulated SMS messages that will be validated initially by Subject Matter Experts. Also, it will seek to empirically evaluate whether senior citizens' susceptibility to SMiShing is reduced after attending a novel hands-on Security, Education, Training, and Awareness (SETA) session. Data from the simulated SMiShing attack results and demographic information will then be compared. In conclusion, the novel SETA program may help reduce senior citizens' susceptibility to SMiShing and help secure senior citizens' accumulated wealth.

Keywords: Persuasion, SETA, seniors, decision-making, phishing, SMiShing.

Introduction

Social engineers manipulate people by exploiting their vulnerabilities and influencing them to take actions that may leave them vulnerable to the social engineer's malicious actions (Hadnagy, 2011). Social engineers have used different mediums to deliver their attacks, such as Short Message Service (SMS) messages, voice, and email (Alabdan, 2020). Phishing attacks are used to fraudulently acquire a person's credentials, steal personal information, deliver malware, and direct unsuspecting victims to phishing websites (Jain & Gupta, 2021; Stone-Gross et al., 2009). In 2022,

persons aged 60 years or more lost more than \$14 million to cyber-attacks. Phishing attacks have been performed through different mediums, including SMS messages, which were originally limited to 160 characters but can be extended to much more (Dryburgh & Hewett, 2004). Phishing attacks performed via SMS messages are called SMiShing attacks (Alabdan, 2020). The ability to send and receive SMS messages is available to 97% of Americans and 92% of senior citizens aged 65 years or more (Dryburgh & Hewett, 2004; Pew Research Center, 2021).

The persuasive effect of phishing attacks has been increased with the inclusion of the different principles of persuasion identified by Cialdini (2007), Ferreira et al. (2015), Gragg (2003), as well as Stajano and Wilson (2011). Persons have also been shown to be more susceptible to phishing attacks when they use heuristics or System 1 to make decisions regarding phishing attacks (Butavicius et al., 2015; Kahneman, 2011; Parsons et al., 2019). Kahneman (2011) explained that System 1 is a system in a person's mind that often makes decisions with limited conscious effort and makes them quickly. Prior research has shown that the success rate of phishing attacks on mobile device or cellphone users, such as SMiShing attacks, has been enhanced by the exploitation of various mobile device or cellphone affordances (Felt & Wagner, 2011; Goel & Jain, 2018; Mishra & Soni, 2019). Security, Education, Training, and Awareness (SETA) programs have been shown effective at reducing people's susceptibility to phishing and SMiShing attacks (Alwanain, 2020; Blackwood-Brown et al., 2021; Kumaraguru et al., 2009). Specifically, prior research has shown that senior citizens who attended a SETA program improved their cybersecurity skills and fell victim less often to phishing attacks (Alwanain, 2020; Blackwood-Brown et al., 2021; Kumaraguru et al., 2009). The main Research Question (RQ) that this study will address is: Does attending a training program that includes principles of persuasion affect senior citizens' susceptibility to SMiShing? This study has one RQ and eight hypotheses. The RQ is: What are the specific Subject Matter Experts (SMEs) identified set of SMiShing messages and legitimate SMS messages that can be used to judge participants' susceptibility to SMiShing? The eight hypotheses will be the direct effect of each principle of persuasion on senior citizens' susceptibility to SMiShing, their intercorrelations, and comparisons based on demographic indicators.

Literature Review

Social Engineering

Previous studies have indicated that incorporating the principles of persuasion can enhance the efficacy of a social engineering attack (Abass, 2018; Algarni et al., 2017; Bullée et al., 2018; Cheung et al., 2015; Jain et al., 2016; Wang et al., 2021). For example, Algarni et al. (2017) investigated the *authority* and *reciprocation* principles on persons' susceptibility to social engineering attacks and mediated by the perceived worthiness of the social engineering attacker. They found that the *authority* principle of persuasion was found to be more influential during these attacks. Algarni et al. (2017) and Cheung et al. (2015) both showed that *liking* and *social proof* principles have increased the likelihood of disclosing personal information to attackers while they use social networking platforms. Moreover, Workman (2008) emphasized that a social engineer

may attempt to gain trust by getting the victim to like them by establishing a friendly rapport and appearing similar to the victim. Prior research has further shown that the effectiveness of social engineering attacks depends on how the would-be victim processes the attacker's information (Antonucci et al., 2022; Gragg, 2003; Jain et al., 2016). For example, Jain et al. (2016) highlighted that social engineering attacks that invoke the use of System 1 can help the attacker "bypass logical argument and counterargument" or the use of System 2 (p. 95). Antonucci et al. (2022) discovered that delaying access to a phishing email's link by three seconds and displaying a red warning message can engage System 2 and decrease the chances of the link being clicked or a malicious attachment being downloaded. In addition, the success rates of social engineering attacks have been decreased due to SETA programs (Gragg, 2003; Jain et al., 2016; Mensch & Wilkie, 2011; Salahdine & Kaabouch, 2019).

Cybersecurity Threats

Prior research has shown that the quality of senior citizens' decisions may diminish as they age (Gregory & Samanez-Larkin, 2013). For example, Gregory and Samanez-Larkin (2013) highlight that older persons make more mistakes when making financial decisions. In addition, research has further shown that older people's decision-making competence declines with age and when retention demands increase (Bruine de Bruin et al., 2012; Del Missier et al., 2010, 2012; Freitas et al., 2007; Rosi et al., 2019). Additionally, Rosi et al. (2019) found that the application of decision rules deteriorated with age, resulting in poorer performance among older adults. However, some studies have shown that applying decision rules and the speed in making decisions may not decline with age (Bruine de Bruin et al., 2012; Dror et al., 1998; Lizarraga et al., 2007). In addition, prior research has shown that older adults have a diminished sensitivity to deception and lying, along with an increased tendency to trust others, which has been shown to increase their vulnerability to fraud (Castle et al., 2012; Ruffman et al., 2012).

Principles of Persuasion

Cialdini (2007) identified six principles of persuasion, which are commonly known as "weapons of influence." These principles are *consistency*, *reciprocation*, *social proof*, *authority*, *liking*, and *scarcity*. *Reciprocation* is the feeling of obligation or indebtedness that one person may feel towards another. *Consistency* is the desire to be and appear consistent. *Social proof* or social validation refers to people looking to others to help them make decisions. The *authority* principle asserts influence or persuasion when the requestor is perceived as an authority figure. *Liking* is when a person is more likely to agree with someone they like. Finally, the *scarcity* principle relies on the time or supply of something being perceived as limited quantities. Each of the principles of persuasion can cause a System 1 response to a stimulus or at least reduce the involvement of System 2 (Cialdini, 2007). According to Gragg (2003), social engineers rely on several psychological principles during social engineering attacks. Moreover, Stajano and Wilson (2011) discovered several human weaknesses that scammers take advantage of during real-world scams. Ferreira et al. (2015) synthesized the doctrines of the weapons of influence, psychological principles, and real-world scam weaknesses identified by Cialdini (2007), Gragg (2003), as well

as Stajano and Wilson (2011), respectively. Ferreira et al. (2015) synthesized a list of principles of persuasion including *authority; social proof; liking, similarity, and deception; commitment, reciprocity, and consistency; and distraction.*

Security, Education, Training, and Awareness (SETA) Programs

Prior research has shown that SETA programs have increased people's cybersecurity skill levels and have reduced susceptibility to cyber-attacks (e.g., phishing) (Alwanain, 2020; Blackwood-Brown et al., 2021; Burns et al., 2019; Kumaraguru et al., 2008, 2009; Zwilling et al., 2022). Cybersecurity skills have been defined as "a combination of knowledge, experience, and ability that enables end-users to perform well" (Carlton & Levy, 2015, p. 2). Carlton and Levy (2017) found that individuals with cybersecurity skills play a crucial role in minimizing the losses caused by cyber-attacks. Zwilling et al. (2022) showed that Internet users with a greater security awareness incorporated more cyber-secure behaviors. Burns et al. (2019) showed that the benefits of SETA training in a corporate environment improved the phishing awareness of those who attended the SETA program and even those who did not participate in the training program. Alwanain (2020) and Kumaraguru et al. (2008) both found that attending a SETA program reduced the number of times their participants clicked on malicious links included in phishing and SMiShing attacks. While prior research has shown that SETA programs reduce people's susceptibility to cyber-attacks, their effectiveness can decrease over time (Bullée et al., 2016; Kumaraguru et al., 2008; Sikolia et al., 2023).

Mobile Device Affordances

Research has identified several cellphone affordances contributing to a user's susceptibility to phishing (Felt & Wagner, 2011; Goel & Jain, 2018; Mishra & Soni, 2019). One of the affordances identified by the research is the relatively small size of a cellphone's screen (Felt & Wagner, 2011; Goel & Jain, 2018; Kim & Sundar, 2014; Shahriar et al., 2015; Vishwanath, 2016; Wu et al., 2016). Felt and Wagner (2011) and Goel and Jain (2018) found that small cellphone screens can hide malicious Universal Resource Locators (URLs). Another consequence of a cellphone's small screen is the limited space for its keyboard, which can make it difficult to type and can lead to typos (Wu et al., 2016). This difficulty in typing may encourage the user to rely on links in SMS messages, which can expose them to malicious content, such as SMiShing messages (Wu et al., 2016). Moreover, cellphones contain large amounts of personal data that may be used to victimize the owner or increase susceptibility to phishing attacks (Burns et al., 2019; Goel & Jain, 2018). Hur and Shamsi (2017) showed that cellphones running the Android operating system were susceptible to attacks that could compromise the privacy and security of the user (due to its open-source nature). However, people still fall victim to SMiShing on iOS devices (Mylonas et al., 2011). In addition, prior research has shown that attackers can trick the cellphone user into believing they are on a legitimate website but are actually on a malicious website and can be tricked into entering login credentials due to the lack of details within the mobile login interface (Goel & Jain, 2018; Niu et al., 2008; Shahriar et al., 2015).

Kahneman's System 1 and System 2

Kahneman (2011) adopted the monikers System 1 and System 2 to represent the intuitive and reasoning paths of information processing, respectively. System 1 is vulnerable to persuasion primarily due to its reliance on heuristics and subsequent biased decisions derived from using heuristics (Kahneman, 2011; Tversky & Kahneman, 1974). Nonetheless, despite System 1 being vulnerable to persuasion, it can develop a resistance to persuasion via training or developing skills and proficiency from System 2 (Kahneman, 2011; Kahneman & Frederick, 2013). System 2 may also be vulnerable to persuasion due to confirmation bias or the need for consistency (Ajzen, 1996; Kassin et al., 2013). Tversky and Kahneman (1974) described three heuristics that are used to render intuitive judgment under uncertainty: (1) representativeness, (2) availability, as well as (3) anchoring and adjustment. Kahneman (2011) defined a heuristic as "a simple procedure that helps adequate, though often imperfect, answers to difficult questions" (p. 98). Heuristics can be used by System 1 to quickly assess often imperfect information where the assessment of this information occurs regardless of motives or incentives (Gilovich & Griffin, 2013; Kahneman & Frederick, 2013; Tversky & Kahneman, 1974). The affect heuristic is another mental shortcut based on feelings of goodness or badness towards an object or stimulus. It often involves automated choices based on liking or fondness (Slovic et al., 2013).

Proposed Methodology

Overview of Research Design

This study will use a quantitative research method that will utilize a true experimental design – a pretest-posttest Control group design – to determine the effectiveness of a treatment (Creswell, 2014; Sekaran & Bougie, 2016). This study will include three phases to evaluate this study's main goal. During phase one, an expert panel will be used to produce a validated set of SMiShing messages and a validated set of legitimate SMS messages. When experts' consensus is achieved on the content of the sets using the Delphi methodology, the results will address this study's one research question. During phase two, a pilot study will be utilized to help ensure the different strategies (i.e., pretest, posttest, and training) are understandable and achievable for the senior citizen participants (Kraemer & Blasey, 2016). Phase three will be the main study, where pretest data collection, training, posttest data collection, and pre-analysis data screening will occur. Also, during this phase, the final data analysis will be completed, thereby addressing all of this study's hypotheses. During phases two and three, the training content will be delivered via the Basic Skills Training (BST) methodology, which consists of four phases (i.e., instruction, modeling, rehearsal, and feedback). The training will be led by an instructor, and the session will last no longer than 30 minutes. This study's participants will be drawn from South Florida (i.e., City of Fort Lauderdale Community Centers). To ensure ethical standards are met, we obtained an Institutional Review Board (IRB) review for this study (Kite & Whitley, 2018).

Newly SMiShing Hands-On SETA Program

This study will use the Behavioral Skills Training (BST) methodology to bring SETA training to the participants. The BST methodology includes four phases: (1) instruction, (2) modeling, (3) rehearsal, and (4) feedback. O'Connell (2016) found that the components of BST, especially modeling, worked best for training Facebook skills to senior citizens versus instruction alone. An instructor will be present during training and run in small groups of less than 20. During the first phase of the BST methodology, instruction will cover social engineering, phishing, SMiShing, and descriptions of the principles of persuasion. In the second phase, participants will be presented with simulated SMiShing messages that illustrate the principles of persuasion and help them recognize as well as respond to the persuasive tactics employed in the SMiShing messages. In the third and fourth phases, participants will be given two SMiShing examples for each operationalized principle of persuasion and asked to evaluate the likelihood (via the 7-point Likert Scale) that the example is a SMiShing message and identify which persuasion principle was used. After answering, the participant will be given feedback on their answers.

Instrument Development

Instrument development will be conducted in three phases. During phase 1, the goal will be to identify and validate a set of messages that SMEs identify as SMiShing and legitimate SMS messages. The Delphi methodology will be employed to select validated SMiShing and legitimate SMS messages for assessing senior citizens' susceptibility to SMiShing attacks. Delphi methodology is a method for achieving a reliable consensus among experts (Dalkey & Helmer, 1963). Arithmetic means of the quantitative assessments by the SMEs will be used to determine when there is an acceptable consensus amongst the experts (Gafni & Levy, 2023). Phase 2 includes a pilot study to help ensure the validity and reliability of the instrument's set of measures identified by the SMEs (Creswell, 2014; Straub, 1989). Creswell (2014) explained that a pilot study can help ensure an instrument's content validity and possibly improve its questions. Straub (1989) showed that an instrument's pretest can help establish its measures' reliability, construct validity, and content validity. Phase 3 will be the main data collection phase of this study. The data collected during this phase of this study will be used to determine if the threats to internal and external validity have been addressed. For example, this study will implement several mitigations for reducing the possible negative effects on internal and external validity, such as keeping the participants' ages as close as possible and ensuring a minimum number of participants.

Conclusions and Discussions

This study aims to reduce senior citizens' susceptibility to SMiShing attacks and help prevent the financial losses associated with falling victim to these attacks. This study will create a novel SETA program that intends to improve senior citizens' knowledge of SMiShing messages and the principles of persuasion operationalized in these messages, as well as investigate whether the knowledge and identification of these principles improve System 1's decisions about their response to SMiShing messages. All of this while potentially being distracted and using a cellphone that has

affordances that may work against making a correct decision. By providing senior citizens with the knowledge, awareness, and skills necessary to identify and potentially avoid SMiShing messages, this study could positively impact the lives of many senior citizens.

Future Research

Future research could investigate how the different principles of persuasion and this study's novel training program impact other age groups' susceptibility to SMiShing. In addition, future research could investigate whether SETA programs incorporating the principle of persuasion improve System 1's ability to make correct decisions while distracted and using a cellphone. Finally, it could be beneficial to investigate the effectiveness of messages operationalizing the principles of persuasion used in other phishing attack vectors or sent on the social media platform X (formally Twitter). The X platform enforces a 280-character limit per message (i.e., via a free account), which falls between an SMS message's original and the extended character limit (Dryburgh & Hewett, 2004; Twitter, 2024).

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