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AI-Powered Social Engineering

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Tiivistelmä — Referat — Abstract

This thesis explores the evolving landscape of social engineering (SE) in the age of modern artificial intelligence (AI). While AI offers modern opportunities for enhancing cybersecurity measures, it simultaneously empowers malicious actors with sophisticated tools for crafting highly targeted and effective social engineering attacks.

Delving into the various ways AI is being exploited to augment social engineering tactics, including the creation of highly believable synthetic media like deepfake images, videos and real-time voice morphing, the generation of personalized phishing messages through natural language processing.

Conversely, the thesis also explores how AI can be harnessed to bolster countermeasures by enabling real-time threat detection, identifying potential vulnerabilities and facilitating comprehensive employee training programs. By analyzing the dual-faceted impact of AI on SE, this thesis aims to provide a comprehensive understanding of the emerging challenges and opportunities in this domain.

Given the rapidly evolving nature of AI and its expanding capabilities, much of the content presented is speculative.These projections are grounded in analysis of established social engineering attacks and observed trends in AI development.

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Contents

1 Introduction

The widespread adoption of information technology (IT) technologies and services has transformed every aspect of human life, from personal communication to business operations, and this reliance on devices and technologies is ever expanding. Although this digital revolution has opened up many opportunities, it has also brought about considerable vulnerabilities. One of the most dangerous threats to security and privacy is social engineering. Social engineering (SE) is the art of manipulating people into performing actions or divulging confidential information. Rather than looking for technical vulnerabilities, SE relies on human interaction and exploits weaknesses in human psychology (Wang et al., 2020).

Certain social engineering attacks that are of particular interest when it comes to advanced AI were chosen for more in-depth analysis, such as phishing, automated open-source intelligence gathering and deepfake-generated content, while leaving other attacks with less focus, such as dumpster diving, shoulder surfing and baiting. Countermeasures that are especially covered are AI-based detection systems and how current cybersecurity training programs need to be augmented for the modern threat of AI.s

This thesis is organized into five chapters, each focusing on a specific aspect of social engineering and AI-augmented attacks. Chapter 1 provides an overview of social engineering, including its definition and historical context. Chapter 2 delves into the various stages of a social engineering attack, highlighting the tactics and strategies employed by attackers. Chapter 3 examines common attack methods, such as pretexting, phishing, and tailgating, and explores how modern artificial intelligence (AI) capabilities amplify their effectiveness. Chapter 4 discusses AI-powered countermeasures and their potential to detect and prevent social engineering attacks. Finally, Chapter 5 concludes the thesis, summarizing the key findings and implications for the future of social engineering defense.

2 Definition of Social Engineering

The term *social engineering* is perhaps overused and is certainly misused, and for clarity, in this chapter a clearer definition is formed and some history reviewed. For the purpose of this thesis, we'll use the definition for SE given by Wang et al., 2020: "social engineeing is a type of attack wherein the attacker(s) exploit human vulnerabilities by means of social interaction to breach cybersecurity, with or without the use of techincal means and technical vulnerabilities."

The term *social engineering* seems to have first appeared in an article titled "More on Trashing", which was published in September, 1984 on one of the earliest hacker magazines, The Hacker's Quarterly (Wang et al., 2020), but the broader concepts of human exploitation date back much farther than this (Qin and Burgoon, 2007). For as long as humans have partaken in communication and trade, there have been those that have tried to exploit the system in their own favor, in an unethical and selfish way.

For as long as there has been social contracts, both written and oral or implied, there have been those that try to get away with cheating. Social engineering, thus, is not a new concept. In 19xx people who partook in actions akin to SE were called confidence men or con artists. They manipulated their victim to be complacent in the act.

In this thesis, social engineering as a field is divided into two categories:

- Old-school social engineering, where the use of modern AI does not play a significant role, and
- AI-powered social engineering, where modern AI is used to augment, or fully execute, the attacks and countermeasures

As described by **abiteboul**, the term *social engineering* is perhaps overused and is certainly misused. What exactly constitutes social engineering? In this thesis, SE is defined as "social engineering is the deliberate act of convincing a victim, usually though the use of technology, to perform an action that may or may not be in their best interest". A definition of social engineering by Hadnagy has become quite popular "may or may not be in their best interest". HADNAGY

Some scholars have included acts like shoulder shurfing and dumpster diving as social engineering attacks (**abiteboul**), even though they do not rely on the manipulation of individuals. However, since they don't fall neatly into the typical category of "hacking attacks", they fall into a gray area in between. Since user education and awareness programs should include training the user against discarding important documents without shredding them first or by putting them into boxes designated "secure documents", and people need to be on the lookout for people gazing over their shoulders, especially when entering sensitive information such as usernames, passwords and other access codes, they are included in this thesis.

It's also necessary to go over some basic terminology related to the field of SE.

Two common attack methods, namely **dumpster diving** and **shoulder surfing**, are often categorized as social engineering attacks, but do not necessarily fall under the SE category, as they do not include direct social interaction with the victim (Wang et al., 2020). In other words, the compliance of the victim is not necessary in these two types of attacks. However, since they are non-technical in that no devices or technologies need to be used, they fall in a "gray area". They require neither the use of devices or technologies nor the psychological manipulation of the user. Thus, it has been easy to refer to them as SE attacks. In this paper, they are still discussed because SE training and awareness programs should include mentioning about these.

2.1 Open-Source Intelligence, OSINT

OSINT, sometimes written as OS-INT, means open-source intelligence. Like the name implies, it involves gathering of intelligence data from publicly locatable sources, such as from the target company's website, or from the social networking profiles of an individual or from other public records.

As people have adopted to using social media as sometimes their primary means of communication, a lot of exploitable data is shared on these platforms as well.

2.2 Pretexting

Pretexting involves fabricating a story or a scenario, a **pretext**, that is plausible but fraudulent, to engage the target and extract information with (Conteh and Schmick, 2016).

This type of attack relies heavily on OSINT, or the gathered open-source intelligence, in assisting with the creation of the story. Modern AI can assist in the OSINT process.

Pretexting is examined here and not in the attacks section since it's a precursor to the attacks, used as the "background" of other attack methods, even though some literature lists pretexting as an attack method itself.

3 Stages of Social Engineering Attacks

Social engineering attacks are usually deployed in multiple stages, with each stage building on the previous stages. These stages can also loop cyclically, where multiple rounds of various stages are used to attack an organization or an individual. Various scholars define these stages in different ways (Mouton et al., 2016), but they generally follow a 4-stage process. Mitcnick, for example, categories them as ABCD.

The 4-stage process used on this thesis is:

1. Collect information about the target
2. Develop a relationship with the target
3. Exploit the gathered information and the built relationship by executing the attack
4. Exit having cleaned any traces

An attack against an individual or a corporation can happen in multiple iterations, with subsequent iterations building on from the information and resources (such as passwords, access badges) gathered from the previous.

Next, each of these four stages is examined in detail. Special emphasis is placed on how the emergence of modern AI technologies could impact, or has already impacted, these stages. A subsequent chapter will go over the different attack types, followed by a chapter that examines countermeasures against them.

In this section, each of the four stages of an attack are examined from the point of view of old school SE and as well as AI-powered SE. Further analysis about the interplay of these attacks is in the last chapter.

3.1 Intelligence Gathering

First stage is research or information collection. This relies on what's known as OSINT, or open-source intelligence. OSINT is any information that is publicly available via the Internet or other means and that doesn't require any breach of security to be accessed.

This intelligence is then used to formulate an attack plan against the target individual or corporation.

3.2 Developing the Relationship

Once the attacker has gained information and formulated an attack plan based on it, he

3.3 Exploiting the Victim

3.4 The Exit

Hadnagy et al. emphasize that in whatever you do, leave your target better off for having met with. This is in stark contrast to typical SE attacks.

Any bridges should not be burned but the relationship should be exploitable in the future as well

The SE is an iterative process, use what was found from previous attacks with the next one

4 AI-Powered Attacks

Awareness of various social engineering (SE) attacks is crucial for professionals across all industries, not just those in cybersecurity. This chapter provides an overview of the most common SE attack methods.

Some attacks that are discussed here are not always considered a type of SE attack, specifically shoulder surfing and dumpster diving, as these do not require the co-operation of the victim (Wang et al., 2020). However, since they are often used in conjunction with other SE attacks, and since training for against them is often included in SE training and awareness programs, they are explained here

To better understand the threat posed by SE, it is essential to examine the diverse strategies employed by attackers. The following are some of the most common and effective SE attack methods. We'll also analyze how the emergence of modern AI technologies might, or already has, powered up these types of attacks.

The field of social engineering contains a plethora of attacks, and for the purposes of this thesis this selection had to be narrowed down. Due to their relevance, phishing it its various forms, deepfake-generated content and automated OSINT were chosen for a more in-depth analysis.

Countermeasures against these attacks are examined in a later chapter.

4.1 Phishing

As the quintessential SE attack, **phishing** is characterized by malicious attempts to gain sensitive information from unaware users, usually via email and by using spoofed websites that look like their authentic counterparts. Phishing has been around since 1996, when cybercriminals began using deceptive emails and websites to steal AOL (America Online) account information from gullible users (Wang et al., 2020).

Spear phishing is a more targeted version of phishing, where attackers customize their deceptive emails to a target individual or organization. Unlike with generic phishing attempts, this type of phishing involves gathering detailed information about the victim, via OSINT or otherwise, such as their name, position and contacts to craft a convincing and

personalized message (Salahdine and Kaabouch, 2019). This tailored approach increases the likelihood of the victim falling for the scam.

Last on the list of phishing attacks is **whaling**. Whaling, also known as CEO fraud, is a highly targeted phishing attack aimed at high-profile individuals within an organization, such as executives or senior management, "the big whales" (Abraham and Chengalur-Smith, 2010). The attackers carefully research their targets to create convincing and typically urgent messages that appear to come from trusted sources, often impersonating colleagues, business partners, or government agencies. The goal is often to authorize large financial transactions or to leverage the target's authority and access within the company.

Two additional types of phishing need to be addressed, and they are **vishing** or voice phishing and **smishing** or SMS phishing. Despite having complicated names, the idea behind them are quite simple.

Regular phishing doesn't usually require OSINT but spear phishing does.

4.2 Deepfake-augmented attacks

4.3 Automated OSINT

4.4 Other attack methods

This section covers other social engineering attacks that were not chosen for more in-depth analysis due to their weaker affinity to be amplified by modern AI. These attacks include baiting, shoulder surfing and dumpster diving. However, advancements in fields such as robotics could make these attacks more relevant in the future. All of them can be used as part of a social engineering attack chain, even if their use wouldn't rely on AI, and this is why it's important that they get mentioned in this thesis.

Tailgating, also known as **piggybacking**, is a social engineering tactic that involves following an authorized person through an access-controlled passage, such as a security gate. This type of attack exploits individuals with temporary access rights, such as delivery personnel or maintenance workers (Conteh and Schmick, 2016). The attacker may use manipulation to gain access, for instance, by carrying a heavy object and asking for assistance or pretending to be a delivery person with a forged pretext.

Observing people enter sensitive information, such as login details or financial data, without their knowledge or approval is called **shoulder surfing**. The name implies a person watching over the shoulder of someone when they are typing or viewing sensitive data, but the attack surface is actually far larger. The attacker could use cameras, either hacked, or those placed there by the attacker for this purpose, or even everyday objects such as binoculars.

As the name implies, **dumpster diving** refers to the practice of going through an organization's or an individual's trash in order find sensitive information that should have been disposed of properly (Syafitri et al., 2022). Rummaged content may yield interesting results, typically in the form of documents such as papers but also media devices such as optical discs, hard drives or USB thumbdrives, to be used as-is or as part of a future SE attack.

Table 4.1 lists some of the most common SE attacks, both in their old-school, pre-AI era and as AI-powered to give a clear overview.

Attack Type	**Pre-AI**	**AI-Powered**
Phishing	Generic emails, low personalization, easily detectable	Highly personalized, uses NLP, adaptive, real-time learning from responses
Spear Phishing	Manual research for personalization, time consuming	Automated, deep-learning based personalization, rapid deployment
Vishing	Human-driven calls, script based	AI-generated voice, dynamic script adjustments based on real-time conversation analysis
Baiting	Physical media (e.g. USB drives), opportunistic	AI-driven malware distribution through personalized and enticing digital baits
Impersonation	Human-driven calls, script based	AI-generated voice, dynamic script adjustments based on real-time conversation analysis

Table 4.1: Comparison of Social Engineering Attack Methods (Pre and Post-AI)

5 Countermeasures

In this chapter, AI-powered countermeasures against both classic social engineering and AI-powered social engineering are examined. This chapter is divided into two parts, human-oriented countermeasures such as training and awareness programs, and tech-orientend countermeasures such as deepfake detection mechanisms. The division is not always clear-cut and is made only to simplify the reading experience.

5.1 Human-oriented

Regarding bating attacks, company policy should enforce antivirus scanning of attached media, such as USB thumbdrives, before they can be accessed. Personnel should be instructed to never pick up and plug in found media (Salahdine and Kaabouch, 2019). However, if media is found that is suspected of being used as part of a baiting attack, the employee could notify the front desk or the IT services that such a media device was found within the premises, rather than just ignoring it

5.2 Tech-oriented

6 Conclusions

As we've seen, SE is still as much a threat as it has ever been, despite major efforts to the contrary.

What's certain is that we can count on AI developing, AI-based social engineering attacks evolving with it, and the need for continuous, innovative user training growing in the future. Attackers and defenders are playing a never-ending game of "cat & mouse" where nobody can rest.

X in Y references that training users effects will wear off in 3 weeks, necessiting continous retraining approaches.

I'll end with the question that I started with; what, if anything, can the end-user trust anymore? And perhaps, with the advances in AI technology, the answer is "no-one".

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