“Please help share!”: Security and Privacy Advice on Twitter during the 2022 Russian Invasion of Ukraine

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Abstract—The Russian Invasion of Ukraine in early 2022 resulted in a rapidly changing (cyber) threat environment. This changing environment incentivized the sharing of security advice on social media, both for the Ukrainian population, as well as against Russian cyber attacks at large. Previous research found a significant influence of online security advice on end users.

We collected 8,920 tweets posted after the Russian Invasion of Ukraine and examined 1,228 in detail, including qualitatively coding 232 relevant tweets and 140 linked documents for security and privacy advice. We identified 221 unique pieces of advice which we divided into seven categories and 21 subcategories, and advice targeted at individuals or organizations. We then compared our findings to those of prior studies, finding noteworthy similarities. Our results confirm a lack of advice prioritization found by prior work, which seems especially detrimental during times of crisis. In addition, we find offers for individual support to be a valuable tool and identify misinformation as a rising threat in general and for security advice specifically.

1. Introduction

In the early hours of 24th February 2022, Russian President Vladimir Putin announced a “special military operation”, launching a large-scale military invasion of neighboring Ukraine. Following cruise and ballistic missile strikes directed at Ukrainian airfields, military headquarters, and military depots, Russian troops entered Ukraine from four main directions: north from Belarus, northeast from Russia, east from the Donetsk People’s Republic (DPR) and Luhansk People’s Republic (LPR), and south from the annexed region of Crimea. Russia’s invasion follows the 2014 annexation of the Crimean peninsula, which was itself followed by eight years of support for separatist rebels in eastern Ukraine.

This change in the global threat environment was accompanied by a sudden change in the cyber threat environment: the invasion was preceded and accompanied by intensified cyber attacks, some of which had physical consequences. For instance, in early February malware targeting several Ukrainian Government and IT organizations was detected and a distributed denial-of-service (DDoS) attack made multiple government and banking websites inaccessible for hours. These attacks impacted Ukraine’s energy, media, financial, and business sectors. Furthermore, several cyber threats and attacks continued after the invasion as well, impacting the distribution of food, medicines, and supplies. During this period, other malicious activities like disinformation through deep fake technology, phishing emails, use of surveillance software and data-wiper malware, etc., were detected [1].

The invasion resulted in a heightened threat environment for companies outside of Russia and Ukraine, as well. This change in threat level was also highlighted by a number of advisories by national agencies, including from the US, UK, Germany, Canada, and Australia [2]–[6]. The advisories warn that Russian state-sponsored threat actors and aligned cybercrime groups might be targeting critical industries and organizations in the United States and other Western nations.

One example of an attack such adversaries carried out in the past is the SolarWinds incident which was one of the most detrimental attacks on the supply chain network. It was found that advanced persistent threat (APT) actors created a backdoor hidden in a software update of SolarWinds’ Orion system of. This attack affected almost 18,000 customers worldwide [7]. The NotPetya attack in 2017 which had an impact globally is another example of a supply chain attack. A backdoor was planted in an accounting software mostly used by Ukrainian accounting firms [8].

Following these incidents and attacks, many instances of security-related advice were shared on news sources and social networks like Twitter. In some cases, security-related advice and information online were conflated with misinformation. For instance, rumors about Signal, an instant messaging platform, being hacked were widespread. This was in fact dismissed by Signal as a part of a coordinated misinformation campaign to encourage users to use less secure methods for communication [9].

In this paper, we examine the security and privacy advice provided around Russia’s 2022 Invasion of Ukraine on the social media platform Twitter. This is especially relevant given the connection of cyber attacks, the success of their mitigation, and global physical consequences of the
invasion. We base our research approach on the following research questions:

RQ1. “What security and privacy advice was shared on Twitter related to the 2022 Russian Invasion of Ukraine?” We are interested in what security and privacy advice was shared on Twitter between February and May 2022, especially in relation to the heightened cyber threat resulting from the invasion. We are interested in the tweets as well as resources provided such as linked documents and websites, and the targets of the advice such as companies or individuals, including those in Ukraine as well as other directly or indirectly affected people.

RQ2. “How does the advice compare to security and privacy advice shared in other contexts?” We explore if the advice around the invasion resembles or differs from security and privacy advice collected at different times and in different contexts. To this end, we compare our data to that of previous studies. Additionally, we investigate the relationship between advice and its frequency in our data, and evaluation and prioritization of advice in prior work. As far as possible, we seek to understand if and how the advice was tailored to the situation at hand.

For this, we create a taxonomy of 221 pieces of advice during the invasion. In seven main categories, we find a wide range of advice including messaging & social media, organizational policies, and meta advice on sharing security advice. The majority of the advice was rather generic, leading to a low correlation with Redmiles et al.’s user priority ranking, which was based on actionability among other criteria [10]. By contrast, we find some significant correlation with their expert priority ranking, as well as advice frequency in the advice for non-tech-savvy users collected by Reeder et al. [11].

This work is structured as follows: After this general introduction (Section 1), we discuss related work in the areas of security perceptions & behavior, social media & information sharing in crises, as well as security & privacy advice (Section 2). We describe our approach (Section 3) and highlight the findings (Section 4). Finally, we discuss our findings (Section 5) and draw a conclusion (Section 6).

2. Related Work

We present and discuss previous work in three related fields: investigations into security-related user perceptions and behavior, research involving content on social media and information sharing in crises, and security or privacy advice for users. In this section, we also put our work into context and highlight some novel contributions of our research.

Influences on Security Behavior. Prior work has investigated how security behavior is influenced both in general and in vulnerable populations. Previous studies established connections between user behavior and the user’s perception of risk [12]–[14], (security) fatigue [15], and social influence effects [16]–[19]. Howe et al. performed a literature review of studies investigating factors that influence security decisions, finding delivery of security measures to users as an important factor [20]. In the context of scams and vulnerable populations, Vitak et al. conducted interviews with 52 families from high-poverty communities, finding a complex relationship between participants’ negative experiences, their perceptions and their general mistrust of sharing data through online channels [21]. Further research into methods for influencing security behavior includes nudges and warnings. Previous studies include a literature assessment [22], experiments reminding users of updates and two-factor authentication (2FA) [23], and security dialog attractors [24], [25]. Vulnerable persons and helpers are often the target of scams and phishing attacks during crises. Egelman et al. examined in a lab study with 60 participants the effectiveness of phishing warnings, finding that 97% participants fell for at least one of the phishing messages [26]. These prior studies on how security behavior is influenced inform our view on and discussion of the advice we collected.

Social Media & Information Sharing in Crises. Social media reactions to the events around the 2014 Russian annexation of the Crimea peninsula have been extensively investigated in research [27], [28], specifically, topics [29], hashtags [30], images [31], and memes [32]. Twitter and other social media are a common data source for research, including newcomers’ experiences [33], audience perceptions [34], information sharing [35], [36], and rumors [37]. This includes specific user types such as journalists [38] or government departments [39]. Sit et al. introduce a labeled dataset of disaster-related tweets and present a series of deep learning and machine learning methods for a binary classification of disaster relatedness [40]. Imran et al. surveyed the state of the art regarding computational methods to process social media messages and highlight both their contributions and shortcomings [41]. In the area of crisis research, multiple publications systematize previous work based on social media data [42]–[44]. Works specifically investigated information aggregation on Reddit [45], and Twitter posts around crises [46] and their comprehension [47]. Specific cases discussed include 2012 Hurricane Sandy [48], the 2013 Gezi Park protests in Turkey [49], and the 2015–2016 Zika virus outbreak [50]. The spread of misinformation during crises was studied in relation to the emotional proximity of users [51], and with regard to Russian influence operations within #BlackLivesMatter [52].

The 2022 Russian Invasion of Ukraine went hand-in-hand with surveillance and censorship by the Russian state. Specifically for Russian internet infrastructure, prior research considered internet governance [53], [54], throttling of Twitter domains [55], and deployed traffic filtering solutions [56]. Ermoshina et al. analyzed internet censorship-resistance tactics by Russian users, content produces, and service providers [57]. More recently, Gabdulhakov investigated a wave of social media user arrests in Russia in semi-structured in-depth interviews with lawyers, rights defenders, academics, non-government organizations (NGOs), and law enforcement authorities [58]. Akbari et al. present an analysis of the challenges faced by the Telegram messenger in Russia and Iran [59].
Security & Privacy Advice. Previous research investigated security advice in the context of experts vs. users [60], [61], and for older adults [62]. Multiple publications investigated the adoption and impact of security practices [63]–[65]. Respondents’ security advice sources were investigated in interviews [66] and surveys [67], [68], as well as specific advice for developers [69]. Herley postulates that by evaluating (security) advice solely on benefit, we have implicitly valued user time and effort at zero [70]. This becomes and important aspect in the light of recent studies, which find a large number of advice pieces.

Tahaei et al. qualitatively analyzed 119 privacy-related accepted answers on Stack Overflow, extracting 148 pieces of advice [71].

Redmiles et al. collected 152 pieces of advice by asking security experts for the top three recommendations they would give to non-tech-savvy users [11]. Redmiles et al. conducted a measurement study to identify 374 unique recommended behaviors contained within 1,264 documents of online security and privacy advice and evaluated the security advice in a user-study with 1,586 users and 41 professional security experts [10]. Boyd et al. collected 41 safety guides distributed during Black Lives Matter (BLM) protests and surveyed 167 protesters, finding that many were unaware of key advice like using end-to-end encrypted messengers [72].

We compare our collection of pieces of advice and online documents shared on Twitter during the 2022 Russian Invasion of Ukraine to these prior studies, and provide novel insight on what security and privacy advice is distributed during crises that directly impact the cyber threat environment.

3. Methodology

In this section, we provide an overview of our methodology for assessing online security and privacy advice related to the 2022 Russian Invasion of Ukraine, including data collection from Twitter and documents linked on Twitter between February and May 2022. We also detail our qualitative codebook and coding process, highlight our ethical considerations, and discuss the limitations of our work.

3.1. Study Setup

To gain insight into security and privacy advice shared around the 2022 Russian Invasion of Ukraine, we collected and analyzed 8,920 tweets for their relevance and examined 232 posts in detail for security and privacy advice. As we were especially interested in widely shared advice and resources, we decided to study public data on Twitter. Twitter had been successfully used to analyze the spread of information during crises in several prior studies [46], [50], [52], [72], [73].

Data Collection. We collected security and privacy advice and resources shared on Twitter during the 2022 Russian Invasion of Ukraine from February to May 2022. The tweets were collected using the official Twitter API for Academic Research and Twitter Streams using the Python library Tweepy. The results were further enhanced by using the unofficial Twitter API and the Python library Twint, which allows scraping by hashtags. We used a list of keywords aiming to cover and gather all relevant tweets. This resulted in 8,920 tweets that could possibly be relevant. Following this, we applied a manual filtering process: In a first round, each tweet was marked as security/privacy advice if at least one of two coders deemed it relevant. Tweets that did not include or refer to security and privacy advice were discarded. In a second round, one coder verified if the remaining tweets mentioned Ukraine or the 2022 Russian Invasion of Ukraine in any way. A second coder crosschecked >10% of the tweets that the first coder had categorized as non-related to ensure that no relevant data was missed, finding no additional relevant data points. After this manual filtering process, we had 232 tweets remaining. From these tweets, we additionally collected any links to external documents, which resulted in a total of 140 documents. Both the tweets and the documents (denoted with prefixes T and D, respectively) were then analyzed as detailed below and as depicted in Figure 1. We make no further distinction between the two and collectively call them resources in our results.

Ethical Considerations & Data Protection. Our institutions did not require Institutional Review Board (IRB) approval for this type of public information measurement study.

When working with data during a crisis, ethical considerations are essential to the study design, analysis, and reporting. Due to the potential of targeted threats from sophisticated attackers, our focus was on ensuring that reporting in this study would not harm the population as a whole or particular individuals more. As such, we do not report potentially compromising data. Out of ethical concerns, we decided against contacting people who live in a war zone or had recently fled one for interviews or other direct interaction to avoid bothering potentially traumatized people and focused on publicly available data instead [74]. We stored all data protected from unauthorized access by encryption and access control. While all data was public at the time of collection, we refrain from republishing it alongside this work to preserve people’s privacy and control over how their identifiable data is shared, as well as their ability to delete their data.

3.2. Data Analysis

We outline our data analysis pipeline below and in Figure 1. Our goal in analyzing the security and privacy advice was to create a taxonomy of the different types of advice shared during the invasion and to compare it to types of advice that prior work has found.

1. https://developer.twitter.com/en/products/twitter-api/academic-research
2. https://developer.twitter.com/en/docs/tutorials/stream-tweets-in-real-time
3. https://github.com/tweepy/tweepy
4. https://github.com/twintproject/twint
For our study with advice and resource artifacts, we evaluated both qualitative and quantitative data points. We analyzed all collected tweets and documents in an iterative open coding approach [75]–[77]. All researchers together created an initial codebook based on previous work that collected pieces of advice from Twitter data as well as other sources ([10], [11], [65], [67]). Tweets and linked documents were then coded by seven coders, resolving conflicts by consensus decision or by introducing new (sub)codes. This approach does not necessitate the reporting of intercoder agreement, because each conflict is resolved as it emerges, resulting in a hypothetical final agreement of 100% [78]. Our final codebook consisted of 451 unique codes. Seven codes served to distinguish sources and targets of advice. Of the 444 codes referring to pieces of advice, 221 were assigned at least once. Unused codes from prior work were kept at count zero for the comparison.

To investigate emerging themes and directions in our codes, we used the affinity diagramming method [79] on the codes we had assigned at least once. We conducted a collaborative affinity diagramming session with five researchers and iteratively established seven categories and 21 subcategories. An overview is presented in Table 4. Finally, in order to compare our findings with prior work, we manually matched our codebook to theirs. We qualitatively analyzed the top ten corresponding codes from each data set and computed correlation using Spearman’s correlation coefficient [80]. Frequencies of advice were normalized for the number of resources that were coded in each data set, and advice not present in at least one codebook was omitted.

### 3.3. Limitations

Our work includes a number of limitations typical for this type of measurement study and should be interpreted in context. Given our method of data collection, it is possible that we have missed some advice or types of advice. Even though Twitter data is commonly used during crises around the world [46], [50], [52], [72], [73] and gave us rich insights into advice targeted at those affected by the invasion, data obtained from Twitter may not be representative of all available advice sources, meaning that our data set may not fully represent the entirety of advice given in the context of the Ukraine war. To mitigate this risk, we only applied very broad filters to our initial data collection, and thereafter manually coded data points for their relevance. Additionally, we followed links to advice sources outside of Twitter and included these documents in our data set. As none of us speak Ukrainian, we may have encountered a language barrier. We did, however, include translated search terms during data collection and received useful results from automated translation tools, which allowed us to code tweets in various languages. Finally, errors or misunderstandings may have occurred during our manual coding process. We minimized this risk by having independently coded each tweet and document by at least two researchers and resolving any emerging conflicts.

### 4. Results

In this section, we present the results of our analysis of the final corpus of 232 coded tweets and 140 coded documents. The set of coded tweets has a median number of likes of 56 (sd: 5,151) and a median number of retweets of 30 (sd: 2,468). We first report on the taxonomy of the advice we created, detailing what advice was shared in connection to the invasion by and for whom (Subsection 4.1). Secondly,
we describe the results of comparing our data to previously collected security and privacy advice and its evaluation (Subsection 4.2). While we do give indications how many resources contained advice, our findings are qualitative in nature.

4.1. Analysis of Advice

In our analysis, we identified five types of advice sources and distinguished between advice targeted at individuals and organizations. We present an overview in Table 1.

Below, we present our findings in detail. The reporting is structured following the categories and subcategories of advice we identified through the affinity diagramming of our codes (see Table 4). For each category, we analyze advice for individuals as well as recommendations made to companies and organizations. Figure 2 shows an overview of the counts of assigned codes. In cases where the advice for both target groups was very similar, we merge the reporting to avoid repetition. In addition, we provide noteworthy insights on advice sources where appropriate.

| Source      | Individuals | Organizations | Total |
|-------------|-------------|---------------|-------|
| Company     | 221         | 135           | 372   |
| NPO         | 42          | 26            | 57    |
| Government  | 36          | 8             | 44    |
| News        | 19          | 47            | 57    |
| Individual  | 91          | 41            | 116   |

**TABLE 1: Overview of sources and targets of advice.**

**4.1.1. Messaging & Social Media.** The largest portion of advice (101 resources) targeted individuals and dealt with their social life online. We identified three key areas of advice on this topic: recommendations regarding secure instant messaging, advice on social media profiles and sharing practices, and pointers regarding misinformation. While some of the resources also addressed organizations, none of them directed this type of advice towards them.

**Secure Messaging.** Recommendations regarding (secure) instant messaging were focused around which applications one should or should not use, with a total of 36 resources advocating for or against the use of at least one specific application. They mostly originated from nonprofit organizations (NPOs), news outlets, and individuals and mentioned 13 distinct applications. Six resources warned that phone and SMS services were insecure and not private. Signal (9 times) and WhatsApp (7 times) were generally endorsed as secure, but there were also claims of insecurities that both companies called out as false. One individual tweeted that “@WhatsApp seems to be monitored by Russians,” (T2745) to which WhatsApp said in their Twitter thread on the Ukraine war that “As always, your personal messages and calls are protected with end-to-end encryption by default so they cannot be intercepted by any government.” — T4048

Similarly, there were claims that “Signal Russia has been breached.” (T2766) Signal promptly refuted this: “This is false. Signal is not hacked. We believe these rumors are part of a coordinated misinformation campaign meant to encourage people to use less secure alternatives.” — T2763

Telegram was the most discussed application (15 resources). All advice related to Telegram mentioned risks associated with the default settings of the application, which do not enable encryption of messages. Several also pointed out prevalent user misconceptions regarding this setting, e.g., that through “misleading marketing and press, most people [in Ukraine] believe it’s an encrypted app,” (T2757) with one person taking it one step further claiming “that branding may literally cost lives.” (T2745) Outside of highlighting the risks of using Telegram, a few news resources discussed the importance of the app in the distribution of information in Ukraine, both from individuals and government channels, stating that the uses may outweigh security concerns. Unfortunately, only one document provided a step-by-step guide to turning on encryption for chats in Telegram.

In general, the most frequently (11 times) recommended feature for secure instant messaging was (end-to-end) encryption, followed by self-destructing messages (7 times),

![Heatmap of Advice Categories and Targets](image-url)
for which some companies specifically posted guides on how to turn them on. Peer-to-peer messaging applications were promoted as a means of communications in case of internet shut-downs or outages (7 times).

Advice for Social Media. The advice around social media profiles and sharing practices centered on privacy and controlling what information people shared to whom. Individuals and social media companies were the main sources for this type of advice; the latter predominantly shared feature descriptions and usage guides for their own products. 14 resources recommended that people should review their privacy settings or tighten visibility on their content. To this end, Meta introduced a region-bound new feature for locking Facebook profiles and hiding their content from the public that was recommended seven times. For Twitter users, deactivating their profile to hide old content was suggested four times. The measures were recommended to anyone in contact with people “in Ukraine to help protect people from being targeted.” (T4053) and revealed a general concern that private information already available online may now lead to physical harm.

Advice on sharing practices called for being aware of what is shared (5 times). It extended from cautioning against posting sensitive information (6 times) to war-related specifics, e.g., location information and its potentially damaging role to military strategies was a focus. “Everyone is a target. DO NOT share locations of military operation in #Ukraine in real time.” (T8925) Accordingly, people were asked not to add meta data to posts (7 times), to remove meta data from previous posts (4 times), and not to live-tweet (4 times). One news article as well as one individual warned people against sharing videos or pictures of prisoners of war, “which some experts have argued violates the Geneva Conventions.” (D112)

Bewareing of Misinformation. Related to war news and information shared online, misinformation was a common topic. A total of 44 resources warned that wrong information was frequently shared and must be watched out for, with 16 specifically mentioning Russian disinformation. While most resources left it at this rather generic warning, some questions for spotting fake claims, such as “Does it look like Ukraine? Does it look like February time?” (T1004) could be found, along with the advice to not share anything one had not verified (4 times). Two resources recommend reverse image searches to quickly find out if material had been put online previously in other contexts, and two resources recommended reporting accounts that shared fake information to combat its spread.

4.1.2. Safe Online Behavior. At 84 resources, a significant portion of advice was on safe online behaviors and being careful with trust online. We divided this advice into the three major subcategories phishing, malware, and connections and anonymity. Most of this advice (71 resources) targeted individuals, while 26 resources addressed organizations and companies.

Phishing. Phishing was widely considered to be a significant threat that would become more prevalent as scammers tried to profit from the war, with 54 resources calling for heightened vigilance of people (42 times) and organizations (23 times). The advice for both target groups was very similar, with companies being additionally told to spread the advice to their employees. Most advice came from government institutions (13 resources), companies (11 resources), and news outlets (11 resources).

The most general pieces of advice included to think before clicking (7 times), to not click links from unknown sources (3 times), to watch out for phishing (8 times), and to be suspicious of, e.g., unknown people, popups, requests, and things that are too good to be true (7 times). Seven resources advised to report any phishing attempts to authorities, and six resources cautioned against revealing personal information unless one was certain who was receiving them.

Many resources (35) regarded emails as the most likely medium for phishing. Of these, 19 generally said to be alert to phishing emails. More specifically, 10 resources noted that one should be suspicious of emails asking one to click links, with three resources going as far as saying one should not click links in emails at all. The sender was another aspect that advice focused on, recommending to be wary of false or unusual emails from trusted institutions (7 times), to verify suspicious senders and not trust sender addresses (2 times), and to not open emails from unknown senders (1 time).

Aside from email, resources also warned about phishing through instant messages (6 times) and social media platforms (3 times).

Malware. We found that a rise in the threat of malicious software was widely reported as a consequence of the war (47 resources). Both individuals (23 times) and organizations (32 times) were warned about this threat in very similar ways, and a majority of the warnings originated from news articles (18 resources) and government institutions (9 resources), with the latter mainly targeting organizations and companies.

Of the 47 resources, 14 only generally talked about malware as a risk to be aware of, without providing mitigation strategies. The others focused on two main vectors through which malware could be introduced to a system: installing software, and email attachments. Regarding email attachments, 12 resources advised varying degrees of cautiousness, ranging from being suspicious of email attachments (11 times) over not opening attachments from unknown senders (5 times) to not opening any unnecessary attachments (1 time). For installing software (21 resources), the general advice of only installing software from trusted sources (11 resources) was extended in multiple ways specific to the

Key Insights: Messaging & Social Media.
- Secure messaging advice focused on the usage of specific applications.
- Social media advice focused on features to protect private information.
- Warnings about misinformation were common but often generic.
Two resources asked people to beware of offers providing free software, like VPN services, pointing out that scammers may exploit people’s acute need for such services to plant malicious software. One news article described how scammers also exploited people’s wishes to help Ukraine by “promot[ing] a fake DDoS tool on Telegram that installs a password and information-stealing trojan.” (D9) Both this article and one Twitter user generally discouraged people from participating in any cyber attacks, as they are illegal and can be a big risk, especially to non-experts.

Connections & Anonymity. Advice regarding the safety of internet connections and being anonymous on the network appeared in 35 resources, of which 34 targeted individuals. Only six of the resources directed advice at organizations, with no remarkable differences in the advice for individuals.

A majority (27 resources) recommended using specific types of software to secure connections and preserve privacy. The most common were VPN services (17 resources). Six of these were advertisements from a company providing VPN services. The others originated from NPOs, news outlets, and individuals. They described two different use cases of VPNs. One was to circumvent local censorship, telling people to “set up VPN services to help you access blocked sites during a partial [internet] shutdown.” (D129) One person explained how they used “a VPN to a Western State to avoid Russian censorship.” (T2893) The other was to secure communications and preserve anonymity, explaining that “When configured correctly, a VPN will secure all of your communications from local interception,” (D140) and “It hides your IP address and your location. It also encrypts your data after leaving your device and traveling to whatever website you’re visiting.” — D69

Another software that NPOs, news outlets, and individuals commonly recommended for online anonymity was the TOR browser (12 resources). It was seen as a tool to circumvent censorship, with one user tweeting “Tor is a mean of accessing truth safely. Tor is the equivalent of hidden atenas [sic] in the WWII.” (T6901) Six tweets drew attention to a special project offering an uncensored and privacy protected way to browse Twitter using Tor. Next to the software recommendations, there was also some general advice reminding people that internet connections could be a security risk (10 resources). Specifically, they said to not trust open networks (2 times) and to only use trusted networks (2 times). Additionally, it was recommended to turn off network features including WiFi, mobile internet, and Bluetooth whenever they were not used (3 times), as they may still disclose one’s location. A very situation-specific advice that appeared twice was to hide Star Link ground stations Ukrainians received to ensure internet access and to use them sparingly, as they might become targets for military attacks.

Key Insights: Safe Online Behavior.
- There were many warnings about intensified phishing and malware distribution but few actionable imperatives.
- To preserve confidentiality and anonymity, VPNs and Tor Browser were common suggestions.

4.1.3. Authentication. In 59 resources talking about authentication, we identified three subcategories of security advice: advice regarding account credentials, recovery, and multi-factor authentication (MFA). Individuals (39 times) and organizations (31 times) were targeted by this advice alike, mostly by government agencies (17 times), companies (10 times), and individuals (10 times).

Passwords. Security advice on credentials was mostly focused on passwords, with 34 resources advocating the use of strong passwords. Specific criteria as to what constitutes a strong password were rarely given. The resources mentioned randomness, length, and including a combination of letters, numbers, and special characters. Using unique passwords for each account was mentioned a total of 18 times across our dataset, while fewer resources (11) recommended the use of a password manager. Of those recommending a password manager, eight emphasized that choosing strong passwords was still vital: “Have a strong, unique password that you store in a password manager.” (D124)

The documents targeted at companies and organizations included policy directives such as ensuring that password policies are in place and being enforced: “Ensure you have a strong password policy that is policed and maintained.” (D20) Updating or resetting employees’ passwords frequently was among the least frequently shared pieces of advice, with two documents mentioning it. In both cases, the advice was motivated in the context of possibly exposed credentials through security breaches via known vulnerabilities.

Recovery. One company shared advice to their users on how to make account recovery more resilient to attacks by enabling a setting which requires either the associated email address or phone number to be entered on password reset attempts, whereas usually the username suffices.

In an attempt to thwart brute-force attacks and in response to a recent Russian state-sponsored attack on an NGO, a government institution recommended the use of time-outs for repeated failed login attempts (D99).

Multi-Factor Authentication. Advice around enabling MFA was prevalent with 30 occurrences across all resources. While the authors mentioned hardware tokens a few times, most chose to recommend 2FA without going into further detail. Companies themselves recommended that their users enable MFA for their services nine times, notable examples
being Twitter and WhatsApp (Meta), while government institutions recommended it in a more general sense, mostly to businesses (14 times). A notable exception is the following tweet that is targeted at the broader population: “Implementing multi-factor authentication on your accounts makes it 99% less likely you’ll get hacked.” (T1183) In this case, the exaggerated claim of effectiveness might be an attempt to increase adoption, although it is supported by data from Microsoft [81].

We identified 16 resources that mentioned enforcing MFA for (privileged) accounts as a security measure for companies, while 20 mentioned it in total. A majority of these resources (10) was documents shared by government institutions. One individual on Twitter suggested an initial “crash deployment” of MFA that would begin a staggered roll-out for privileged accounts and then extend it to accounts with access to confidential data as well as to employees who may be targeted by phishing attacks (T564).

Key Insights: Authentication.
- Choosing strong passwords was the most common advice but mostly lacked specific criteria.
- MFA was ascribed a very high effectiveness in securing accounts.

4.1.4. Hardware & Software. Advice regarding device security, mainly related to hardware and software, was split into three categories, namely: updating software and systems, using security software, and bolstering device and hardware security. The three categories of advice we found are discussed below.

Software & System Updates. Updating software and devices regularly were some of the common pieces of advice that we encountered. Advice regarding updates for individuals included keeping general software and devices up-to-date (17 resources). Additionally, individuals were advised to install updates for friends and families (1 resource).

“Update your own software on your phones, laptops, desktops, smart devices. Updates patch known security flaws. Once you've updated your own software, do it for your parents, aunts, uncles. This is actual self-defense.” — T4098

Keeping systems and software updated and patched, and updating devices and device firmware was mentioned for organizations as well (10 resources). For instance, some of the advice indicated a sense of urgency in their messaging:

“I cannot emphasize enough. Everyone, all your companies, all your phones, everything, update your virus protection and download your security patches IMMEDIATELY.” — T4064

Additionally, using automatic updates for devices and software was mentioned in six resources, and considering the availability of automatic updates when buying a new device was mentioned two times. A majority of the advice was also about reminding individuals and organizations to keep their security software like antivirus up-to-date (19 resources).

Security Software. In order to bolster the security of companies and individuals, three resources focused on advice to developers. This advice included building security into products from the ground-up, conducting regular penetration tests and audits, and minimizing the complexity of systems and services used.

“Build security into your products from the ground up — “bake it in, don’t bolt it on” — to protect both your intellectual property and your customers’ privacy.” — D116.

In addition to advice provided to organizations, eight resources mentioned changing settings of anti-virus and anti-malware software to run periodic scans, checking for anti-virus signatures and patches, and disabling Microsoft macros (two resources each).

“Implement mitigations against phishing and spear phishing attacks. Disable Microsoft Office macros by default and limit user privileges. Ensure that staff report all suspicious emails received, links clicked, or documents opened.” — D31

Additionally, a majority of the advice (21 resources) was also directed at individuals installing and using security software. Two resources mentioned use security software without adding any further details. However, using anti-virus software (10 times), anti-malware software (5 times), firewalls (8 times), vulnerability scanning software (3 times), spam-filtering services (3 times), integrity monitoring software (1 time), and a virtual machines (1 time) were specifically mentioned in the context of security software to strengthen individuals’ security.

Device & Hardware Security. In terms of device and hardware security, some of the advice for individuals mentioned locking their devices. Locking devices without any further mention of the best practices or methods surfaced three times. Locking smartphones using a passcode or touch ID appeared two times. Furthermore, individuals were advised to set up auto-lock timers for their smartphones (1 resource). While some advice focused on using passcodes and touch IDs, we also found one resource catered to journalists that talked about disabling biometrics on devices:

“I can tell you that independent Russian newsrooms all instruct their employees in Russia to disable all biometrics on their smart devices, to prevent the cops from smashing your finger on Touch ID or holding your phone in front of you for Face ID.” — T972

Enabling biometrics for software access appeared once. Additionally, a facet of advice about being careful while plugging external devices into computers appeared in 10 resources. This advice further included scanning external devices before plugging them into personal computers (1 resource). Two resources also mentioned avoiding plugging external devices into computer systems altogether. Finally, one resource also mentioned using a data blocker before using USB charging ports. Other advice targeted towards...
individuals included discarding devices with security weaknesses (2 resources), factory resetting devices to remove malware (2 resources), factory resetting cellphones (1 resource), and keeping work and personal devices separate (2 resources). We encountered one resource from a news agency that provided advice for protecting devices in case people are arrested or detained and in case their devices may be “confiscated and searched.” (D133) They specifically mentioned not using devices that are no longer supported by the manufacturer, using devices that support setting passwords, and enabling remote wiping of devices.

Some of the resources (10) also advised turning off location services on devices to disable tracking. Additionally, one resource from an individual advised people to not use cell phones in safe houses.

Key Insights: Hardware & Software.
- Software advice focused on using security software such as antivirus and on making regular software secure from the beginning or through updates.
- Device security was centered around preventing unwanted access and tracking.

4.1.5. Storing Data. Advice regarding what data to store and how appeared in 44 resources. It targeted both individuals (24 resources) and organizations (30 resources). We divided the advice into three distinct categories: backups, logging, and preventing unwanted access.

**Backups.** A total of 30 resources advised individuals (16 resources) and organizations (23 resources) about backing up their data. Most prevalent was the general recommendation to have backups (22 resources), which was similar for both target groups. Contrastingly, the more specific advice differed. Organizations received recommendations tailored to professional data handling, such as testing the backup and restore process (12 resources) and isolating backups from their network (6 resources), e.g.

> “Test backup procedures to ensure that critical data can be rapidly restored if the organization is impacted by ransomware or a destructive cyberattack; ensure that backups are isolated from network connections.” — D89

Advice for individuals was more diverse and often focused on specific actions rather than a broader strategy. Examples include “Scan or take photos of all important docs and send them to your own email account.” (T343) and “Back up all your devices to an external hard drive or to the cloud.” (D43)

**Logging.** Advice to store logging data was mainly given to organizations and companies (14 resources) and mostly originated from government institutions (11 times). The general advice to verify that logging was done and how and for how long the logs were stored (7 resources) was supplemented with pointers on what to log. Recommendations included key functions (4 resources), network activity (4 resources), authentication activity (2 resources), access to personnel information (1 resource), and changes to security-enabled groups (1 resource).

**Preventing Access.** Of the nine resources giving advice on how to prevent unwanted access to data, all targeted individuals, and one also targeted organizations. A majority of them (6) came from NPOs. There were two strategies, minimizing how much data was stored and thus available (7 resources) and encrypting the data that was stored (7 resources). For data minimization, recommendations were to remove sensitive files from devices, not to store data unnecessarily, and to disconnect from accounts (4 resources each). Less common were pointers to rename contacts to hide their identity (2 resources) and to regularly delete one’s browser history (1 resource). Advice on encryption focused on what to encrypt and named device data (7 resources), backups (4 resources), hard drives (2 resources), and cloud data (2 resources). One resource recommended to “activate the protocol to delete the information after a few wrong [decryption attempts].” (T3033)

Key Insights: Storing data.
- Advice focused on preserving data and preventing unwanted access.
- There was a stark contrast between professional strategies recommended to organizations and singular quick-and-easy actions recommended to individuals.

4.1.6. Organizational Policies. We found 25 resources giving advice about policies that only applied to organizations and grouped them into the two categories incident response and recovery plans as well as access and network policies. About two thirds (15) of the resources gave advice coming from government organizations.

**Incident Response & Recovery Plans.** A vast majority of resources that dealt with organizational policies (23) contained information about responding to security incidents and having plans for recovery from such incidents. Of these, 11 recommended developing an incident response plan, while nine advised to verify that a plan existed and was up to date. Regarding the content of the plan, six resources said it should be known and actionable, and six stressed the importance of having contact information for essential personnel available. Three resources mentioned that routes of an incident response plan should be accessible even if systems had been shut down. Another three resources suggested practicing the response plan in the organization, i.e., the US agency CISA recommended to “Conduct a tabletop exercise to ensure that all participants understand their roles during an incident.” (D89)

**Access & Network Policies.** A majority of resources (16) made recommendations regarding access control and network policies. For internal access, eight resources advised that the principle of least privilege access should be followed. Keeping track of authorization and timely removing accounts of leavers and unused accounts was recommended by eight resources as well. Two resources mentioned that next to digital access control, preventing unauthorized physical access to systems was an important measure. For networks, six resources advised to isolate them, and four resources recommended to disable any unused ports and
protocols on the network. In addition to general network security measures, the US agency CISA included isolation and extra careful inspection of traffic from Ukrainian organizations and blocking activity from VPN or Tor connections into their situation-specific recommendations.

Key Insights: Organizational Policies.

- Advice focused on up-to-date, properly communicated plans for incident response and recovery.
- Isolating networks and strict authorization were recommended defenses.

4.1.7. Learning & Teaching. Finally, advice on usage and distribution of security information, learning, and teaching was prevalent in our data collection, as various entities offered, referenced, and commented on advice resources. We collected 92 resources with such content, targeted at individuals (50 times) and organizations and companies (64 times). They had diverse sources, the most common being government agencies (24 resources) and individuals (21 resources), followed by NPOs (14 resources) and companies (13 resources). We identified four subcategories: meta advice about sharing security advice during crises, awareness and resources, learning, and building a threat model.

Recommendations for Sharing Advice During Crises. Some of the tweets dealt with the topic of sharing security advice during crises itself, wherein the authors gave other professionals, who may want to share advice, guidance on how to prioritize classes of advice and what topics or phrasings to avoid. Four authors of advice resources asked that the readers pass on the given advice to friends and family. Advice givers should do their due diligence and refrain from recommending single tools while drastically overstating their efficacy with respect to security or privacy, especially during the current situation in Ukraine. One Twitter user pointed out that giving digital security advice was a major responsibility and that “[one should not] encourage people to entrust their safety to one thing. Especially not in conflict.” (T504).

In line with this, three resources encouraged others to give realistic as well as actionable advice that takes into account that security and privacy priorities may be different for people in Ukraine and that is more specific than, e.g., following all the advice that has been reiterated for years. Correspondingly, one individual focused on actionable advice and called on companies to prioritize a fast roll-out of basic security measures in the face of emerging cyber threats: “We need to make things BETTER, NOW! We can tweak and harden later, when we have the basics deployed.” (D112). Nine resources, which were mostly shared by companies citing government institutions (3) or by government institutions themselves (2), also recommended that companies raise awareness for increased risks by, e.g., performing employee training. However, the resources mainly pointed to conveying current security best practices without going into further detail.

Awareness & Resources. 58 resources did not offer advice themselves but rather raised awareness for resources provided by others. 43 resources offered help in the form of technical guidance or support, often directly to Ukrainian companies. Government institutions were most notable here (14 times), followed by fellow companies and NPOs (8 times each). For the former, this took the form of, e.g., accepting forwarded websites, emails, and texts in an effort to support Ukraine by not falling victim to attacks (T8889). Companies offered free services like firewalls and VPNs. Offers for individual consulting on security were common as well. In four resources, the advice givers warned that “there’ll be well-intentioned twitter connectivity advice. Some great. Some not.” (T504) Others reported advice they had come across that may be impractical or even actively damaging to the individual’s or company’s security:

“[…] Lots of great info but please don’t follow their mitigation advice for ICS. It’s not practical & in some cases dangerous. […]” — T617

Five resources in total advocated that companies and organizations follow current best practices in security without giving specifics. Also in five cases, government institutions set up newsletters for companies to receive updates on emerging threats and advisories. In contrast to the efforts around offering support, two Twitter users told companies and organizations that the steps to protect from cybercrime had not changed:

“Contrary to the marketing emails that’ll flood your inbox in the coming days inviting you to a webcast on how to protect against Russian attacks, the measures to protect your org haven’t changed a bit since the war started.” — T3978

Learning. General advice related to learning about security appeared in nine resources in total.

Staying up-to-date with security and privacy developments and to keep learning was shared in four documents from companies, NPOs, government institutions, and news sites (1 time each). D139 as a security guide for journalists is an example of a learning resource that became highly applicable again in light of the invasion. It dedicates an entire section to technology security in conflict areas, ranging from threat modeling, secure communications, over mobile device security to malware, data integrity, and secure credentials. Written by a NPO with a target group of journalists in general, it was shared again on Twitter by the NPO, this time specifically mentioning reporters in Ukraine.

Five documents, with four being targeted at companies, endorsed learning and getting advice from security experts as well as professionals. In two, government institutions pointed to their own services, while a news site indicated urgency but stayed vague:

“If you don’t have a competent security team to help (and most don’t), you absolutely must find a reputable security partner immediately.” — D17.

Threat Modeling. Advice on building threat models as a foundation for choosing security advice to apply appeared
in 28 resources and was a category with notable distinctions between advice targeted at individuals and advice for organizations.

Of the advice targeting individuals (14 resources), the majority (7 resources) generally recommended thinking about threats when making security choices and came from individuals (4 times) and NPOs (3 times). More specific pointers such as that average people may be targeted by advanced persistent threats or scammers and bots were rare (3 and 2 times) and came mostly from news outlets and government institutions. One individual stressed: “To a human scammer or a bot, they/it don’t care who you are, you’re just a vulnerable victim. Practice safe computing.” (T4098)

Organizations and companies were targeted in 23 resources. For them, general pointers to think about threats were less prevalent (6 resources). Instead, most of the resources were more specific, with 10 referring to advanced persistent threats, three to the software supply chain as a potential attack vector, two to scammers and bots, and one to overseas attackers. Most of this information originated from government institutions (7 times) and was shared by news (4 times), individuals, NPOs, and the government itself (1 time each).

Key Insights: Learning & Teaching.
- Several resources called for giving advice responsibly and making it actionable.
- Offers for free individual support and consulting were extended to affected people and organizations.
- There was a disagreement between people calling for immediate measures and people saying the measures to take had not changed at all.
- Having a threat model was sometimes recommended, but there was no actionable guidance on prioritizing advice.

4.2. Comparison with Prior Work

To answer our second research question, we compare our findings for advice targeting individuals to those of two other papers that have investigated this kind of advice sharing. While Reeder et al. collected advice by asking experts to name the top three pieces of advice they would give non-tech-savvy users in 2017 [11], Boyd et al. investigated advice shared on Twitter in the context of the BLM protests in 2020 [72]. Additionally, we evaluate the advice from our data collection that was targeted at individuals using data from Redmiles et al. on advice priority as well as uselessness and harmlessness of advice [10].

4.2.1. Comparing Data Collections. In this section, we present the comparison of our data to that of prior work. The top ten most frequent pieces of advice from each data set can be found in Table 2.

Advice for Non-tech-savvy Users. In their analysis of advice for non-tech-savvy users, Reeder et al. collected and coded 231 expert responses for the advice they contained, using 152 unique codes. Of these, 56 match codes from our codebook. The frequencies with which advice appeared in their and our data collection were moderately correlated (Spearman, \( r = 0.44, p = 0.004 \)), with notable similarities in the most frequent advice. Of their top ten, all pieces of advice were present in our data collection. Our top ten pieces of advice included their top four as well as one other of their pieces of advice. Of our top ten pieces of advice, those on the topic of misinformation, pointers to support with cyber security, insecurity of Telegram messenger, and VPN usage were not part of the data collected by Reeder et al.

Advice Shared in the Context of BLM Protests. Of the 193 unique codes Boyd et al. assigned, only 26 matched codes in our codebook, which in part stems from them coding specifically for rationales of advice, while we did not. Of the matching advice, the frequencies in our data collection do not correlate with those in their collection in a statistically significant way (Spearman, \( r = 0.278, p = 0.16 \)). Of our top ten pieces of advice, only two occurred in their data. Of the advice that matched, all that belonged to the top ten during the BLM protests were present in our data collection, but only one was also among our top ten most frequent pieces of advice, with the others having low counts in our data collection.

4.2.2. Evaluation of Advice. In their paper “A Comprehensive Quality Evaluation of Security and Privacy Advice on the Web”, Redmiles et al. provide detailed insights into how end users and security experts evaluate security advice for end users from internet sources [10]. We mapped 241 pieces of advice from their data set to 451 of our own unique codes. 102 of their advice imperatives matched one of our 221 assigned codes that refer to advice content. Additionally, we analyze the overlap and differences in the top ten advice pieces from each of the rankings and our data (see Table 3).

We find that the expert priority ranking moderately correlates with the number of times advice was present in our data (Spearman, \( r = 0.424, p < 0.0005 \)). Nine out of the top ten advice pieces from the expert ranking were present in our data collection. Two of them, namely “Use different passwords for each account” and “Use strong passwords”, were among our top ten most frequently shared advice.

The user priority ranking of advice only very weakly correlates with the frequencies in our data collection (Spearman, \( r = 0.181, p = 0.004 \)). Of the top ten advice pieces, seven occurred in our data collection, albeit in overall much
smaller quantities than those from the expert rankings. None could be found in our top ten most frequent pieces of advice.

In our top ten advice pieces, six were rated by users and experts. As expected given the correlations described before, they have rather high ranks in the expert ranking with the highest being first and the lowest at rank 53. By contrast, they are spread out through the user ranking with the highest at 22 and the lowest at 190. The other four top pieces of advice deal with misinformation, instant messenger recommendations, and pointers to sources of support. These topics are notably absent from the data Redmiles et al. collected via user search queries and expert recommendations for advice sources in 2017. The low correlation with the user ranking, which Redmiles et al. based partly on user-perceived actionability of advice, aligns with our general finding that advice we collected was often very generic.

Useless or Harmful Advice. Next to the priority rankings, Redmiles et al. also provide data on which advice was deemed useless or harmful by at least one of the security experts they asked. Of the 25 pieces of advice labeled useless, only “shut down your computer” was part of our data collection (1 resource). Of the advice categorized as harmful, four pieces can be found in our data: “Use Tor” (12 resources), “don’t open attachments from unknown senders” (5 resources), “change passwords frequently” (1 resource), and “buy devices with passwords” (1 resource). This shows that usefulness is a debated topic. To some extent, advice that some experts have deemed harmful or useless will continue to be circulated.

Key Insights: Evaluation of Advice.
- Advice frequently shared during the invasion was given high priority by experts in the study of Redmiles et al. [10].
- Much of the very frequent advice scored low on a user priority ranking based on i.a. perceived actionability and time consumption [10].

5. Discussion

We analyzed 232 tweets and 145 linked documents shared around the 2022 Russian Invasion of Ukraine regarding the security and privacy advice they contained. In 221 unique pieces of advice, we find a large variety of recommendations that five different types of sources gave to individuals and organizations. In addition, we find noteworthy similarities to the advice for non-tech-savvy users by Reeder et al. [11], and significant differences to advice collected in the context of BLM protests by Boyd et al. [72]. We note a stronger correlation of advice frequency to the priority ranking of experts than to that of users presented by Redmiles et al. [10]. From our findings, we derive the following main insights.

The lack of prioritization becomes even more apparent and detrimental during a crisis. The 221 unique pieces of advice in our data collection show that the security advice shared around the invasion lacks focus. A plethora of companies, NPOs, government agencies, news outlets, and individuals shared advice they believed relevant, resulting in a large amount of advice without any obvious way to prioritize. The various sources failed to find a consensus or rally behind a common set of measures to take. Frequently, they stressed the importance of following their advice immediately to counter the threat, contributing to an abundance of advice marked as high priority. Much of this advice is too generic to be actionable and a reiteration of long-established security measures that have been shown to struggle with adoption in the past [68]. In this, the advice shows similarities to that collected by Reeder et al. [11] and Redmiles et al. [68]. Both find a need for a clear, consistent set of advice to provide to end users [10], [11]. We find that advice for organizations could similarly profit from consistency and prioritization.

In the face of an acute crisis, it seems even more detrimental to overload advice recipients, as the additional pressure during a crisis can be expected to make it much harder to deal with. We argue that in a war zone and during other crises, the amount of time and resources that can be spent on the implementation of measures is even more constrained than usual for both individuals and organizations. Being overwhelmed is not helpful and may add additional pressure. We suggest the involvement of people with relevant experiences in the development of guidelines to giving advice during crises, to account for the special circumstances recipients of the advice might face.

In addition, we re-emphasize the need for empirical research into the impact of security measures with the goal of establishing an agreed-upon core set of high priority security and privacy advice such as suggested by Redmiles et al. [10]. If tailored to each target group, such a core set could then serve as a baseline for advice given to both individuals and organizations.

Offers for individual support and counseling can be a valuable tool. In addition to advice imperatives, we found offers for free security support and counseling on security threats and countermeasures. In contrast to broadcast guidelines, these can take individual needs and circumstances into account and can be a highly effective method if conducted by qualified experts. We suggest investigating the adoption and effectiveness of such offers in future work and to consider funding them as long-term initiatives if proven successful. In the meantime, we encourage the security community to keep making such generous offers to people facing war and other crises.

Misinformation is a rising threat. While misinformation, and specifically misinformation on social media during crises, has been studied in various contexts [51], [82], [83], the topic was not present in any of the related work on security and privacy advice that we compared our data to. Prior work finds a lack of actionable countermeasures [82], and we argue that this is an important issue that should concern the information security community. While the focus previously appeared to lie with political opinions and real life events, the claim that Signal had been breached and the subsequent dismissal of that statement as misinformation by the company show that security advice and practices
can be influenced just as much. Misinformation pointers were a prevalent topic in our analysis and are an important factor for safe social media usage. During a war or crisis, access to information can be vital, and the ability to tell information and misinformation apart is thus critical [51], [84]. Unfortunately, actionable advice on how to do that was rare in our resources. In addition, the given measures such as verifying details and reverse image searches are time-consuming and thus unlikely to be adopted for the many posts and many pieces of advice that users see [85]. As a research community, we should contribute to combating misinformation by measuring its impact on security behaviors and developing mitigation strategies for security experts as well as users.

6. Conclusion

In this paper, we studied security and privacy advice that was shared around the 2022 Russian Invasion of Ukraine. Specifically, we analyzed 232 tweets and 140 linked documents using qualitative open coding. We distinguished advice targeted at individuals and organizations, as well as five types of sources: companies, NPOs, government agencies, news outlets, and individuals. Using affinity diagramming, we created a taxonomy containing 221 unique pieces of advice, clustered into seven categories. We then compared our findings to those of three prior studies, finding significant similarities to two of them as well as newly emerging topics. Unfortunately, we confirm previous findings that overwhelming amounts of advice are shared. Most are called high priority, leaving no pointers for effective prioritization. This appears even more detrimental in stressful and resource-constrained situations like wars and other crises. We find that in light of this, offers for individual support could be a valuable tool, the adoption, and effectiveness of which should be part of further research. In addition, we identify misinformation as a rising threat that may corrupt efforts to educate populations on security and privacy measures. As such, it should be addressed by the information security community in future research on its impact, and possible mitigation strategies and their effectiveness.

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Appendix A

Taxonomy

The table below shows the categories and subcategories of our taxonomy, as well as the two most frequently assigned codes as examples. The column count contains the total number of resources a code was assigned to. For the categories and subcategories, the count is an aggregate of all codes they contain. The columns Individuals and Organizations contain the number of resources that were assigned the respective code as well as this target.
| Category                              | Subcategory                           | Code     | Count | Individuals | Organizations |
|---------------------------------------|---------------------------------------|----------|-------|-------------|---------------|
| Messaging & Social Media              |                                       |          |       |             |               |
|                                      | Secure Messaging                       |          |       |             |               |
|                                      | Don’t use Telegram/Telegram is insecure |        | 44    | 43          | 3             |
|                                      | Use (end-to-end) encryption for communication |        | 15    | 15          | 1             |
|                                      | Advice for Social Media                |          |       |             |               |
|                                      | Review privacy settings                |          | 31    | 31          | 1             |
|                                      | Don’t post photos/test with metadata  |          | 7     | 7           | 0             |
|                                      | Misinformation                         |          |       |             |               |
|                                      | Disinformation                         |          | 44    | 42          | 6             |
|                                      | Beware of Russian disinformation       |          | 28    | 26          | 6             |
| Safe online behavior                 |                                       |          |       |             |               |
|                                      | Phishing                               |          | 84    | 71          | 26            |
|                                      | Be alert to phishing email             |          | 54    | 42          | 23            |
|                                      | Be suspicious of emails asking you to click links |        | 19    | 15          | 7             |
|                                      | Malware                                |          | 47    | 23          | 32            |
|                                      | Don’t use software from Russia         |          | 11    | 6           | 10            |
|                                      | Be suspicious of attachments           |          | 11    | 10          | 5             |
|                                      | Connections & Anonymity                |          |       |             |               |
|                                      | Use a VPN                              |          | 35    | 34          | 6             |
|                                      | Use anonymity systems (Use TOR/Psiphon)|        | 17    | 16          | 3             |
| Authentication                        |                                       |          | 59    | 39          | 31            |
|                                      | Passwords                              |          | 40    | 29          | 17            |
|                                      | Use strong passwords                   |          | 34    | 24          | 15            |
|                                      | Use different passwords for each account |        | 18    | 14          | 7             |
|                                      | Recovery                               |          | 4     | 3           | 1             |
|                                      | Require email and phone number for a password reset |        | 3     | 3           | 0             |
|                                      | Enable timeouts and lock-outs for failed log-in attempts |        | 1     | 0           | 1             |
|                                      | Multi-Factor Authentication            |          | 45    | 28          | 26            |
|                                      | Use MFA                                |          | 30    | 20          | 15            |
|                                      | Enforce MFA for privileged accounts/services/systems |        | 20    | 9           | 16            |
| Hardware & Software                  |                                       |          |       |             |               |
|                                      | Software & System Updates              |          | 66    | 42          | 37            |
|                                      | Keep systems/software up to date       |          | 42    | 22          | 31            |
|                                      | Keep anti-virus software installed and up-to-date |        | 34    | 17          | 27            |
|                                      | Security Software                      |          | 27    | 12          | 21            |
|                                      | Use anti-virus software                |          | 11    | 7           | 6             |
|                                      | Use anti-malware software              |          | 10    | 7           | 7             |
|                                      | Device and Hardware Security           |          | 5     | 3           | 4             |
|                                      | Turn off location devices              |          | 22    | 19          | 4             |
|                                      | Lock devices                           |          | 10    | 10          | 0             |
|                                      |                                        |          | 3     | 3           | 0             |
| Storing Data                         | Backup                                 |          | 44    | 24          | 30            |
|                                      | Backup your data                       |          | 30    | 16          | 23            |
|                                      | Test backup/restore                    |          | 22    | 13          | 18            |
|                                      | Logging                                |          | 17    | 4           | 14            |
|                                      | Ensure logging is done, storage, retention periods |        | 7     | 0           | 7             |
|                                      | Log key functions                      |          | 4     | 0           | 4             |
|                                      | Preventing Access                      |          | 9     | 9           | 1             |
|                                      | Encrypt your device data               |          | 5     | 5           | 1             |
|                                      | Log out of accounts                    |          | 4     | 4           | 0             |
| Organizational Policies              | Incident & Recovery Plans              |          | 25    | 5           | 24            |
|                                      | Incident Response Plans                |          | 23    | 5           | 22            |
|                                      | Verify an incident response plan exists and is up to date |        | 11    | 3           | 10            |
|                                      | Access & Network Policies              |          | 16    | 0           | 16            |
|                                      | Apply least privilege access           |          | 8     | 0           | 8             |
|                                      | Track authorization and access, remove leavers |        | 7     | 0           | 7             |
| Learning & Teaching                  | Recommendations for Sharing Advice During Crises |          | 92    | 50          | 64            |
|                                      | Alert users about increased risks      |          | 18    | 11          | 13            |
|                                      | Share advice with friends and family   |          | 9     | 3           | 9             |
|                                      | Awareness & Resources                  |          | 58    | 31          | 40            |
|                                      | Support pointers                       |          | 43    | 25          | 27            |
|                                      | Guidelines                             |          | 5     | 1           | 5             |
|                                      | Learning                               |          | 9     | 5           | 6             |
|                                      | Seek professional help for cyber security issues |        | 5     | 2           | 4             |
|                                      | Always keep learning about security and privacy |        | 4     | 3           | 2             |
|                                      | Threat Modeling                        |          | 28    | 14          | 23            |
|                                      | Threat model                           |          | 10    | 7           | 6             |
|                                      | Advanced persistent threat groups      |          | 10    | 2           | 10            |

TABLE 4: Taxonomy.