Digital security in families: The sources of information relate to the active mediation of internet safety and parental internet skills

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Abstract

Home users of information and communication technologies are often the target of online attacks. At the same time they tend to lack the knowledge and skills to effectively protect themselves. Families with children are in a particularly difficult position since parents are responsible not only for their own digital safety, but of their children's too. This study focuses on the sources of digital security information used by parents. The aim of this study was to determine the factors that are associated with parents' preferences for digital security information. To achieve this aim, we conducted an online survey of 331 Czech parents and examined the patterns of sources used for digital security information using latent class analysis. This analysis identified four groups of parents: (1) those relying predominantly on the internet in general, (2) those using specialized sources (expert websites and professionals), (3) those utilizing a wide spectrum of sources, including internet, television, and friends and family, and (4) those who predominantly gain information from their partners, and partially from specialists. The study also shows that the preferences of specific sources are connected to parental mediation practices and both parents' internet skills.

1. Introduction

With the increasing presence of information and communication technologies (ICT) in family's everyday lives (Ofcom, 2017), digital security has become more important. To obtain relevant and helpful advice, parents have to navigate through various information sources, including traditional and new media. Different sources provide varying content (i.e., on what issues the sources focus) and they also vary in the quality of the information, from unreliable advice to highly specialized technical information (e.g., Furnell, Bryant, & Phippen, 2007; Rader & Wash, 2015; see below). Previous literature showed that preferring specific sources can be linked to several individual characteristics (e.g., education, digital skills; Redmiles, Kross, & Mazurek, 2016). Little is known, however, about links to other aspects of digital parenting. We enrich the literature by focusing on individual characteristics and take into consideration family structure and parental online mediation strategies (i.e., the parental efforts to maximize the benefits and minimize the risks of their children's internet usage (Livingstone et al., 2017). Furthermore, previous literature (e.g., Redmiles, Kross, et al., 2016) mostly analysed the links between the individual characteristics and each source separately — for instance, by focusing on the associations of using interpersonal sources, then by examining the associations of using expert sources. This approach enabled the disentanglement of the links to other characteristics for each individual source (or types of sources), yet it does not take into account the fact that one user can use multiple sources and that the specific pattern of the sources may also matter. In our study, we take a novel approach: instead of focusing on each source separately, we explore the patterns. This provides more complex insight into the parents' choices for the sources for digital security information. Such findings also have several implications for practice and policy making, which we describe in the Practical Implications section.

1.1 Navigating through Digital Security Information Sources in Families

Nowadays, ICT are commonly present in families. For instance, in the Czech Republic (where the current study was conducted), over 95% of households with children have internet access with two thirds of them owing 2 or more computers. On the other hand, only 67% of households without children have internet access, and 57% of these households own one computer (Czech statistical office, 2016). This suggests that parents, as opposed to households without children, are in a unique position with regard to the digital security of their homes: they have more devices to manage and they need to protect their children from online threats (Davis, 2012). Moreover, the children (especially older ones, like teenagers) engage in a broader variety of online activities than adults (Ofcom, 2017), including risky behavior, such as downloading files and installing questionable software (Furnell, Tsaganidi, & Phippen, 2008). To ensure the digital safety of the family, parents thus need to not only educate themselves about possible online threats and safe ICT usage, but they also need to teach their children to use ICT efficiently and above all, safely.

To keep the family digitally safe, parents can choose from a variety of information sources carried through a variety of media channels. Spanning from interpersonal sources, to more traditional media such as printed books, magazines, or television, to the internet, parents face a difficult challenge to identify the sources to trust and use. Moreover, not all sources are equal in terms of quality and content. For instance, Rader and Wash (2015) showed that interpersonal sources, such as friends or family members, focus largely on the topic of hackers, which is a topic almost missing in expert advice webpages. Similarly, phishing and viruses content, common to interpersonal exchanges and expert advice, is only rarely present in news articles. Rader and Wash further observed that while interpersonal sources often focus on the issue of *who* and *why* attacks online, the expert webpages focus on *how* the attacks are conducted, and news article on the *consequences* of the attack. Lastly, each of the examined sources in their study covered a different number of topics – with expert websites being the

narrowest in their scope and thus providing users only information about the limited amount of security threats. Similarly, Redmiles et al. (2016a) discovered that users use media primarily for information about passwords and two-factor authentication, friends and family for information about antivirus and software updates, and service providers for two-factor authentication. These studies show that there seems not to be any single source that would give a user complete and actionable information, and thus, when users rely on a single source, they might miss some important security concern or advice.

There are numerous studies on people's preferred information sources. Over the past few decades, the preferences have noticeably shifted from traditional media to preferring digital media (e.g., in health: Dutta-Bergman, 2004; education: Lenhart et al., 2001; or parenting: Daneback & Plantin, 2008). For digital security information or more general advice related to ICT, the internet as a searching tool also scores high, and is ahead of printed media, television, or radio (Davis, 2012; Furnell et al., 2007). It makes perfect sense: the internet is widely available, provides a huge amount of information, and the individual may feel less embarrassed or inhibited to ask for information in an anonymous environment (Joinson & Banyard, 2002).

Studies also show a high popularity for interpersonal sources (i.e., family, friends, co-workers, groupmates) that, in some studies, surpass the internet (Afifi & Weiner, 2004; Davis, 2012; Furnell et al., 2008; Nikken & de Haan, 2015; Redmiles, Kross, et al., 2016). Interpersonal sources can provide users with distinctive benefits: they are easily accessible, convenient, and are typically perceived as trustworthy (especially in the case of family and friends). Further, compared to other sources, they are interactive in nature (allowing synchronous conversation), typically cost-free, and the advice provider is usually already familiar with the context of the advice seeker (their devices, needs, and level of skills), and thus can provide targeted information (Poole, Chetty, Morgan, Grinter, & Edwards, 2009).

Other sources, that are also utilized for digital security information, albeit to a somewhat smaller extent (depending on the study), are presentations, IT professionals (including service providers), workplace information (newsletters, emails from IT department, training information and lectures), news (online, print or TV), and online forums and advertising (Davis, 2012; Redmiles, Malone, & Mazurek, 2016). Davis (2012), in her study on parents, notes that attending offline presentations is rather costly, i.e., parents have to devote the time to attend the event. However, she notes that such presentations may also provide the benefit of interactivity with professionals. Similarly, contacting IT professional requires effort, but it may be perceived as highly beneficial.

Thus, in addition to source content and quality, the convenience to access, the comfort of use, and interactivity are all important factors upon which people prefer one source over another. The source and its associated affordances and barriers are but one side of the coin – the content and quality of digital security advice provided by the source is another, and with regard to one's digital security, even more important side. Studies show, however, that people often do not evaluate information systematically and instead rely on simple heuristics such as the familiarity with the source/author, graphics or the recommendation by third parties (Metzger, 2007). Similarly, in case of digital security, Redmiles, Kross, and Mazurek (2016) found that users base their decision about trusting or disregarding security advice on the source evaluation (e.g., the trustworthy friend) rather than on a content evaluation. The authors noted that participants did not feel well-equipped to evaluate the content of digital security information and thus, relying on a trustful source was the only factor on which they could depend. This finding points to the individual characteristics that affect the evaluation and consequently the choice of preferred digital security source.

1.2 Digital Security Links to Individual Characteristics, Family Structure, and Parental Mediation

Studies show that people's activities on the internet depend on several individual characteristics. Being younger, male, more educated, and from households with higher socioeconomic status (SES) is positively associated to higher digital skills, digital efficacy and usage of the internet in terms of both frequency and variety of activities (Hargittai, 2002, 2010; Rothbaum, Martland, & Jannsen, 2008). Similar characteristics have been shown to affect the area of digital security. Based on an examination of a representative survey on US adults, Redmiles et al. (2016a) found support for what they label as the digital divide in digital-security advice seeking. The users with higher skills and higher SES utilize different sources than those with lesser skills and lower SES. Specifically, skilled users took advice from their workplace and learned from the negative experiences more, while less skilled users tended to find advice from family, friends or service providers. The authors conclude that already disadvantaged users (i.e., those with lower digital skills) may be at even greater risk due to the poor sources they use for digital security information.

The digital divide is also apparent in studies directly focused on families that reveal the common responsibility division among family members. Families, who have one digitally skilled member, often rely heavily on this person, called "guru" (Poole et al., 2009) or "security czar" (Rode, 2009), to set the network, keep the devices updated and secured, and help with any difficulties or online threats. Not every family, however, has such a skilful person. Apart from families with a security czar, Rode (2009) also distinguishes other family types: one where the family members are digitally self-sufficient (and thus, all members share the responsibilities), and one where family members search security-related advice outside the home, e.g., in the media, or via an outside support provider. The specific composition of skills among family members may thus influence the choice of the sources of an individual. Literature shows that as children grow older they gain digital skills and engage in more online activities, including the risky practices of downloading and installing questionable software, whereas

younger children's online activities are limited (Furnell et al., 2008; Ofcom, 2017). The parents of teenagers might be more motivated to search for digital security information, which can be reflected in the higher number of sources and the usage of specialized or professional sources.

Similar individual characteristics that relate to the preference of sources were also found to affect the ways that the parents teach their children about the safe use of ICT. In the media communication literature, the parental approaches to teaching their children about ICT is termed *online parental mediation* (e.g., Clark, 2011). It represents parental efforts to minimize online risks and to maximize the benefits of using ICT for their children (Livingstone et al., 2017; Talves & Kalmus, 2015). In our study we focus on five mediation strategies that are often used in this area (Livingstone, Haddon, Görzig, & Ólafsson, 2011): (1) *active mediation*, that includes parents talking to their children about the internet and online activities the children do, staying nearby or sharing the activities; (2) *active mediation of internet safety*, that is more directly focused on teaching the children how to stay safe online, for instance by explaining which websites are good and bad, or how to avoid problematic situations online; (3) *monitoring*, which includes parents checking the websites their children have visited or messages that they have sent; (4) *technical mediation* that includes using software applications to control or filter the online content for the children; and (5) *restrictive mediation*, which is based on limiting the children's ICT usage (e.g. limiting the time spent online or forbiding specific online activitites).

Research on the mediation strategies focused on (among other things) the same characteristics that were connected to the preference of digital security sources: age, gender, socioeconomic status (i.e., education, income), and digital skills. It shows that younger parents, mothers, more educated, and more digitally skilled parents utilize more mediation strategies in general, with active mediation being especially popular (e.g., Livingstone et al., 2017; Nikken and Jansz, 2014; Talves and Kalmus, 2015). However, it is important to note that these effects are not consistent across all studies on mediation strategies and that there are studies showing

non-significant or opposite effects (see, e.g. Nikken and Schols, 2015). Considering the above-described characteristics connected to security information sources, which have also been associated with the employment of mediation strategies (especially the effect of digital skills or digital efficacy), we presume that the preference of information sources should be reflected in parental mediation too. Parental mediation represents one of the aspects of how parents approach ICT in their lives, and this can be affected by the information they learn from different information sources. Similarly, engaging in certain types of mediation strategies may prompt parents to search for specific information, hence the link between the preferred sources and the mediation can be bidirectional. Given that we focus directly on the sources of digital security information, we presume that the relation among the preferred sources should be strongest for the active mediation of internet safety and technical mediation, and weaker for other strategies.

1.3 The Study's Context: ICT Usage and Digital Security in the Czech Republic

To offer a context for the study, we present a brief overview of a digital landscape in the Czech Republic in the time the data was collected (i.e., in 2016). This section provides information about the ICT usage and digital security in the country. At the end of the section, we consider whether and how the Czech specifics could affect the relations examined in this study.

Internet usage in 2016 was common in the Czech Republic: 82% of Czechs aged 16-74 used the internet at least once in last three months, which was the same as the European average. Internet access was more prevalent for households with children than for those without: 95.3% of households with children had internet access at home, which was also close to European average (96%) (Czech statistical office, 2017a). The Czech Republic was close to the European average in many online activities in which the users engage (e.g., reading news, using email, shopping) as well as online security threats they experienced (e.g., identity theft, online fraud, hacked email, social networking site account; (Czech statistical office, 2017a; European

Commission, 2017). Despite the similarities in the usage patterns and the experiences with cybercrime, Czechs perceived themselves to be somewhat less capable of protecting themselves against cybercrime (16% of Czech strongly agreed they were capable, whereas European average was 27%) (European Commission, 2017).

A different perspective on the country specifics is provided by EU Kids Online II project, which is a study of internet use by children and their parents in 25 European countries. Based on usage patterns, experienced risks, and parental regulation of internet use, Helsper, Kalmus, Hasebrink, Sagvari, and de Haan (2013) differentiated four country clusters in Europe: unprotected networks; protected by restrictions; semi-supported risky gamers; and supported risky explorers. The Czech Republic belonged to a "semi-supported gamers" cluster (together with Bulgaria, Cyprus, Estonia, Poland, and Romania), in which children encountered moderate online opportunities and a higher level of risks. Parental mediation in these countries covered a wide range of strategies, but they tended to be less effective than in other countries. The authors argue that lower effectiveness may be the result of relatively late (yet quick) ICT adoption, and that the countries are yet to establish supportive structures and to establish good practice.

This conclusion can be corroborated with worldwide indices that focus on general ICT development and digital security, which show that the ICT infrastructure and ICT usage in the Czech Republic is ahead of the country's focus on digital security. We considered two indices: the Networked Readiness Index (NRI) and the Global Cybersecurity Index (GCI). The NRI is computed by the World Economic Forum and it compiles the number of indicators (e.g., affordability, individual usage, social impacts) and reflects countries' preparedness to reap the benefits of digital technologies (Baller, Dutta, & Lanvin, 2016). With a score of 4.7 (7 was the maximum; the highest actual value was 6 in Finland and Singapore), the Czech Republic was 36th worldwide (out of 139 countries) and 21st in Europe[1]. The CGI, composed by the

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[1] For comparison, USA's NRI was 5.8 (5th place) and UK 5.7 (8th place)

International Telecommunication Union, represents the countries' commitment to cybersecurity in order to raise cybersecurity awareness (International Telecommunication Union, 2019). Here, the Czech Republic is in 71st place worldwide (out of 175 countries) and in 37th place in Europe with GCI of 0.569 (range 0-1)[2]. The Czech Republic's ICT infrastructure has developed quickly over the past years, but these figures suggest that cybersecurity has yet to catch up to this development. While GCI takes into consideration several cybersecurity indicators, it mainly focuses of professionals and governmental/legal actors rather than on individuals. Still, these country-level specifics may be one of the distant reasons for the lower confidence of Czech users in dealing with cybercrimes, and, as suggested by Helsper et al. (2013), the lack of supportive structures could also be a reason for less effective parental mediation efforts.

For the current study, the Czech specifics might mean that parents could face more challenges in finding the appropriate sources for digital security information than they would in other countries. This could mean that, in order to find relevant information, Czechs might need to use more sources and that they could prefer interpersonal sources more than parents elsewhere. However, despite the relatively low stress on cybercrime in Czech society, the overall ICT usage patterns are remarkably similar to other European countries. Furthermore, Helsper et al. (2013) stress in their detailed analyses of ICT usage, risks, and parental mediation in 25 European countries that the differences among individuals within countries were substantially larger than the differences between countries. This means that, overall, the sampled countries were quite similar to each other and the country level differences should not be overrated.

1.4 The Present Study

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[2] For comparison, USA's GCI was 0.926 (2nd place) and UK 0.931 (1st place)

The first aim of the present study is to examine the sources for the digital security information used in families with children in the Czech Republic. Previous studies examine the sources separately or used a sum of used sources to examine its relation to other variables (e.g., Davis, 2012; Redmiles, Kross, & Mazurek, 2016). But, different parents can utilize a different mix of sources, thus we newly examine the patterns of sources rather than individual sources.

Secondly, we aim to link the identified patterns to other characteristics. Previous research provides insights into the links of individual characteristics to information sources (such as demographics, socioeconomic status, and digital skills; e.g., Davis 2012; Redmiles, Kross, & Mazurek 2016). In addition to these individual characteristics, we aim to provide novel findings by examining the links to online parental mediation (i.e., active mediation, active mediation of internet safety, monitoring, technical mediation) and family structure (i.e., the number of children, the age of children, the partner's internet skills).

2. Method

2. 1 Sample *and Procedure*

The data for this study comes from an online survey of Czech parents that was conducted in August 2016. No major digital security incident that would have been covered in national media happened during the time of data collection and the authors are not aware of any other event or issue that would have led to a systematic bias as a result of the timing of the data collection. The survey was part of a project between the second author and KasperskyLab. The company's aim was to gain insight into how parents secure their children's safety, with specific focus on differentiating between offline safety (i.e., physical) and online safety. The company contacted the second author to design a survey and analyse the answers in order to create a marketing campaign to stress the role of the father in the online security of children. The items used for the current study were designed by the authors of this article. KasperskyLab did not influence

the current study's results in any way; the choices of questionnaire items, the analyses, and the interpretation of the results were the sole responsibility of the authors. The participants were recruited through a survey management company, Toluna, which contacted members of their existing pool of panelists in the Czech Republic. A sample representative of a Czech parent was required. The questionnaire was hosted on the Toluna website (i.e., participants were not invited through KasperskyLab). Since KasperskyLab was not mentioned in the questionnaire and the questions did not ask about any of its products, the participants were not aware of the KasperskyLab involvement. Thus, their answers should not have been biased.

Online panels are a common research tool in social science (Callegaro et al., 2014). Online panelists are subscribed to the agency's database and they are regularly invited to participate in various surveys according to the survey requirements (i.e., eligibility criteria) of the survey contractor. Using the existing pool of online panelists of a professional agency has several benefits (Baker et al., 2010): the company has extensive experience with conducting surveys and it has the necessary infrastructure to ensure the smooth and efficient collection of data. Regarding the specific panelists, professional agencies carefully construct their panels to cover all population segments in order to produce representativity. This is a particularly important advantage because it limits the biases caused by the systematic omission of certain population segments that occurs in convenience samples. Similarly, using an online panel with a representativity requirement limits the possible biases that could result from the time period of the data collection (summer in our case), which might otherwise lead to the under-representation of respondents with high socioeconomic status who might be on vacation. Further, the agency employs a variety of quality checks (e.g., verifying the consistency of a panelist's answers across surveys, continuously checking the quality of the panelist's answers, removing panelists who provide untrustworthy answers). This leads to the high quality of the collected data. On the other hand, online panelists can differ from the general population. Most

notably (and specifically relevant to our study) their ICT usage is likely to be higher or more frequent than that of the general population. This poses a specific limit to our findings, which is discussed below (see Section 5.2).

Eligibility criteria for participants in our study included: being an adult over 18 years old and living with at least one child within the age range of 5 through 17 in a household. Eligible respondents filled an online informed consent form. In total, 450 questionnaires were obtained, 46.4% filled by mothers or stepmothers, 39.6% by fathers or stepfathers, 5.6% by grandparents and 8.4% by other relatives.

For the current analysis, we used a subsample of 331 parents from households in which two parental figures were present, i.e. we excluded questionnaires from single parents and other relatives. Final sample comprises 52.4% of mothers/stepmothers ($n = 174$, $M_{age} = 38.69$, $SD = 9.41$) and 47.6% of fathers/stepfathers ($n = 157$; $M_{age} = 42.95$, $SD = 9.04$).

To investigate the differences in our sample of parents in two-parent families, we compared our data to data from the Czech statistical office (Czech statistical office, 2017b). There were small differences for the age and education of fathers, with the fathers in our sample being somewhat older and achieving higher education (the largest difference in age categories was 8.6 percent points - in our sample, there were 8.3% of fathers between 25-34, whereas in Czech population, there is 16.9% of them; the largest difference in education was 17.4 pp - 39.7% fathers in our sample had tertiary education, and 22.3% have the same education level among Czech fathers). The mothers' ages and education in our sample reflected Czech mothers quite well (largest difference 3.5pp in age categories, and 2.1pp in education). Given that we invited only parents who are internet users to our study, the differences are understandable and in expected direction. We conclude that our study represents Czech (online) parents well.

2.2 Measures

2.2.1 Sources of ICT security information

Respondents were asked to identify the sources that they use to find information regarding the security of digital devices. They were offered 11 multiple-choice items including "*from elsewhere*". The low popularity of the last, *elsewhere* option (5.4%), suggests that the other ten specified options sufficiently covered most sources respondents use for this purpose. Due to the ambiguity of "*elsewhere*" and the low prevalence this option was omitted from the analysis. The overall distribution of the sources is presented in Table 1.

[Table 1 near here]

2.2.2 Education

Respondents indicated their highest achieved education level from a selection of three options. A small percentage reported having a primary education (4.8%), the majority had a secondary education (62.7%), and about a third reported tertiary education (32.4%). Due to low representation of the primary level education, we collapsed the first two categories into one and used dichotomized variable (not having vs. having a tertiary level education) in the analysis.

2.2.3 Internet skills

Respondents were asked to evaluate how skilled they and their partners are with regard to the internet use on a scale from 1 = *beginner* to 6 = *expert* ($M_{respondent} = 4.53$, $SD = 1.12$, $M_{partner} = 3.8$, $SD = 1.41$).

2.2.4 Children

Respondents reported how many children aged 0-17 currently lived in their household. Almost half respondents lived with one child (47.4%), followed by two children (37.5%), three (11.8%) and more (3.3%). For analysis, we dichotomized the variable *Number of children* in two categories: *one child* and *two and more children*. Based on children's ages, we created a variable *Teenager* to differentiate families with at least one child 13+ (44.1% families) from families with younger children (55.9% families).

2.2.6 Mediation strategies

Respondents were asked who is the dominant person (if anyone) to do each of the four specified mediation practices from EU Kids Online II project (Livingstone et al., 2011) with the answer options of me, my partner, no one, someone else, or do not know. The respondents' level for each mediation strategy was created by summing the occurrences of "me" answers. *Active mediation* was assessed by 3 items (e.g., "Talk to the child about what the child does on the internet," "Do shared activities together with your child on the internet") (M = 1.84, SD = 1.03, α = .54). *Active mediation of internet safety* included 4 items (e.g. "Explained why some websites are good or bad," "Suggested ways to use the internet safely") (M = 2.51, SD = 1.54, α = .82). *Monitoring* included 4 items (e.g., "Check which websites the child visited," "Check the child's profile on a social network or online community") with final scores from 0–4 (M = 1.73, SD = 1.65, α = .85). *Technical mediation* was measured on a family level, i.e., the respondent was asked whether he/she or other carer in the family uses software features allowing to control and restrict children's online activities. It was assessed by 4 items inspired by Livingstone et al. (2011) (e.g., "Parental controls or other means of blocking or filtering some types of the website," "Specialized software for complex control of this child's online activities") (M = 1.08, SD =1.65, α = .81). *Restrictive mediation* was measured by two items asking about rules limiting the content (what can children do online) and time (how long can children be online; M = 1.47, SD = 0.74, α = .62).

2.2.7 Responsibility for securing children's devices

Respondents reported who is responsible for securing (e.g., installing and updating the online security software) the devices that children use. They could choose multiple options: "me" (76.3%), "my partner" (45.2%), "a professional" (4.4%), "child on his/her own" (16.2%), "someone else" (10.1%), or "no one" (3.7%). Since respondent reported his/her own usage of

sources for security information, we included only dichotomized variable reflecting whether the respondent has the responsibility of securing the devices or is not responsible for it at all. The questions were framed to ask about the general patterns of the long-term behaviors of the respondent and, therefore, the time frame of the survey should not systematically bias individuals' answers.

3. Results

To fulfil the first aim of this study — to differentiate the distinct groups of parents according to their sources — we conducted a latent class analysis in MPlus7 on the sources of the ICT security information that respondents reported. We ran analyses for two-, three-, and four-group solutions. Based on the Vuong-Lo-Mendell-Rubin likelihood ratio test bootstrapped parametric likelihood ratio test, and observation of the sources distribution in the resulting groups, we evaluated the 4-group solution as the most adequate for our data. We then transported the group membership into SPSS file and ran frequencies of each source across the groups to give an overview of the sources used by each group of parents (see Table 2). Based on identified patterns, the groups were labeled as: 1) internet-based, 2) specialized, 3) multiple-sources, and 4) partner-oriented.

[Table 2 near here]

To fulfil the second aim, we examined the differences among the groups of parents using chi-square analyses (and Fisher's exact tests when expected counts were less than 5) for categorical data. When omnibus tests did not show significant overall differences, we ran pairwise comparisons to examine the differences between the two respective groups. Due to disproportionally distributed respondents in the groups, we used the non-parametric Kruskal-Wallis test with subsequent Mann-Whitney U tests for scale data. Tables 3 and 4 provide an overview of these comparisons. For clarity, all categorical variables are presented in Table 3

and all interval variables are presented in Table 4. We describe the specifics and differences of each group in the following sections.

[Tables 3-4 near here]

3.1 Group 1: Internet-based

The first group includes 58.3%% of the full sample, and it is the largest group of respondents. This group of parents is unique because of their dominant reliance on the internet and comparatively much lower utilization of other sources — 89% of parents in this group generally turn to the internet to seek the digital security information, and the second most utilized source (specialized websites) are used to a much lesser extent (by 25% of parents). For parents in this group, traditional printed or offline sources including interpersonal ones seem to be rather irrelevant for security information.

3.2 Group 2: Specialized

The second group includes 19.9%% of the sample. The parents in this group are defined by their high use of specialized sources in both interpersonal sources (i.e., other people specializing in the ICT security is true for 88% of the parents in this group) and in the media (i.e., specialized websites on the internet are used by 62% of these parents). No other group of parents uses specialized sources to this extent. Interestingly, learning security information from their partners or their children is minimal, even though 11% of them state that they do learn from someone else in the family.

3.3 Group 3: Multiple-sources

The third group includes 16.9% of the sample. The parents in this group use the widest range of sources to a high extent. Further, they are substantially different from other groups by their use of television (98% of parents in this group), which is used only a little in other groups, as

well as by frequent gaining information from their friends and all family members, including children – which, again, is almost lacking in other groups.

3.4 Group 4: Partner-oriented

The last group includes only 4.8% of the sample – it is the smallest group, which, however, differs substantially from all others: parents in this group are the only ones who do not use the internet in general, and in fact, only three sources are used by more than 10% of the respondents in this group. They rely heavily on their partners to share digital security information (88% of parents in this group), and to a smaller extent, they also utilized expert's knowledge, either from specialized websites or lectures or workshops.

3.5 The Differences Among Groups in Other Aspects

Overall, we found a number of differences among the groups of parents. Regarding demographics, two groups in particular were clearly distinguishable by the gender distribution — fathers formed the majority of parents in the *Specialized* group (74.2%) and mothers were the vast majority of the *Partner-oriented* group (81.3%). The predominance of fathers among *Specialized* parents is probably the reason behind the higher average age in this group. The *Specialized* parents were also most different in their education (i.e., more parents have tertiary education) and internet skills are also higher. Interestingly, there is a noticeable pattern of skills in a family: *Specialized* parents report themselves to be the most skilled and perceive their partners to be comparatively less skilled. The opposite trend can be seen among *Partner-oriented* parents, who perceive themselves as much less skilled than their partner. In the other groups of parents the differences in parental skills are less apparent.

Regarding family structure, *Internet-based* parents and *Partner-oriented* parents more often had more than one child than those in the other two groups, but the age of the children (i.e., a teenager) was not different among the groups of parents.

When we look at family practices connected to the safe usage of the internet by children, we can see that the groups of parents were different in the practices that were closely connected to digital security: the *Specialized* parents were those who were responsible for securing their children's devices and they were also most often engaged in the active mediation of internet safety. Similar to the demographics and internet skills, this particular group is in sharp contrast to *Partner-oriented* parents, who score low on both of these practices. The other four parental mediation strategies (i.e., active mediation, monitoring, technical mediation, restrictive mediation) were not substantially different among the groups of parents.

5. Discussion

The present study focused on examining the digital security information sources among parents. Regarding the overall usage, parents in our study utilized the internet most — both as a general medium for information as well as for specialized websites. This is not surprising given the wide availability and convenience of the internet for parents. Friends and other family members in our study were preferred much less than internet sources. This was also reflected in the identified groups of parents based on the specific pattern of the sources they used — the *Multiple-sources* group and the *Partner-oriented* group are where most parents used interpersonal sources and both were the smallest groups in our sample. This is surprising given the high popularity of interpersonal sources in other studies (e.g., Davis, 2012; Furnell et al., 2008). Considering that Czech cybersecurity awareness is lacking in ICT development as a country (see the Introduction), we assumed that the interpersonal sources would be especially popular among Czech parents. It is, however, possible that the country specifics in this area mean that many Czech parents in our sample lacked the go-to person ("guru" or "czar") in their social circle and, hence, had to depend on external sources to a greater extent. On the other hand, such a reliance on an external source does avoid the problem with interpersonal sources

often mention in the literature, i.e., that perceiving oneself (or others) as advanced users and being confident in one's own/others abilities does not ultimately mean that one is truly advanced and provides appropriate advice (Furnell et al., 2007, 2008; Redmiles, Malone, et al., 2016). In this aspect, seeking digital security information on the internet rather than within the family and friends circle might be considered as appropriate and advisable approach.

Examining the patterns of sources allowed us to distinguish among the distinct groups of parents. This quantitative approach complements the classification of families based on qualitative research (e.g. (Poole, 2014; Poole et al., 2009). In our study, the most distinct group seems to be *Specialized* parents, who largely prefer expertized sources of digital security information and seldom use family as a source. Among these parents, there is a majority of fathers with higher average age, there is the highest proportion of tertiary-educated parents, their self-reported level of internet skills is the highest among other groups and most of them are also responsible for securing their children's devices. This finding is consistent with other studies that discovered that socioeconomic status (which includes education), gender and skills are associated with preference expertized sources of digital security information (Davis, 2012; Redmiles, Kross, et al., 2016). This group also shows the highest engagement in the active mediation of internet safety, although the difference is significant only when compared to the *Partner-oriented* parents. The *Specialized* parents could thus play a role of a "guru" or "security czar" in their families (Poole et al., 2009; Rode, 2009), who secure other family members devices and provides security and safety information.

The *Partner-oriented* group is in a sense complementary to the *Specialized*. This was the smallest but nevertheless interesting group. *Partner-oriented* parents are mostly mothers, they perceive their partners as more digitally skilled than themselves, most of them are not responsible for children's digital security, and they often use their partners as a source for digital security information. This is in line with previous studies that showed that less skilled users

tended to learn digital security from the family and friends (Redmiles, Kross, et al., 2016). In a way, parents in the *Specialized* and *Partner-oriented* groups could fit well together and complement each other if they would be part of one family. As noted, such constellation might represent a family with a dominant digitally skilled person – a 'guru' or 'security czar', who takes care of the digital security of all family members, so the other parent does not have to. Further, such a person might serve as a family's connection to external sources-he/she brings the knowledge from the outside to the inside of the family, where it can be distributed via interpersonal sources. Redmiles et al. (2016a) suggest that users with low skills and preferences for interpersonal sources (that correspond to *Partner-oriented* group) are those at most risk. Our study shows that for a family, this might not be a case if the other partner really serves as a "guru" and protect the other family members. On the other hand, (Poole, 2014) points out that one skilled person in the family who takes care of other members' devices might also pose as a barrier because other member do not need to learn about security. In our study, though, the *Specialized* parents were also highly engaged in the mediation of internet safety, suggesting that they actively strived to educate other family members, and to increase their own skills to protect themselves online.

The other two groups of parents, *Internet-based* and *Multiple-sources* are similar to each other in several aspects. They have a similar proportion of mothers and fathers, similar average age, internet skills (respondents' own as well as their partners), and are similarly responsible for securing their children's devices. Three-quarters of *Internet-based* parents did not have a tertiary education, which is the highest proportion from all groups, and compared to *Multiple-sources* parents, most of them have more than one child. Regarding the sources' patterns, *Internet-based* mostly use the internet in general, while other sources (including specialized websites) are utilized to a much lesser extent – this might be a potentially troubling finding given that such strong preference for a single source might result in incomplete digital security

information (Rader & Wash, 2015). From this perspective, the *Multiple-sources* parents seem to be those who can reap the most benefits from the variety of sources they use.

In regards to parental mediation and the introduced groups, we found significant differences among groups only for the active mediation of the internet safety and not for the active mediation, the monitoring, the technical restrictions, or the restrictive mediation. Helsper et al. (2013), in their classification of European countries, describe the Czech Republic as one of the countries with a high number of "all-rounder" parents (i.e., parents who engage to a high extent in all of the parental mediation strategies). If all Czech parents engage in all of the strategies similarly, this might explain the lack of differences. Nevertheless, the authors stress that cross-country differences were smaller than within-country differences. We also observed variability in the reported engagements in most strategies, so we do not consider these particular findings to be affected by country specifics. Rather, we presume this points to the different nature of the strategies that require different sets of skills. While active mediation of internet safety requires some level of knowledge about digital safety, the other strategies can be applied without it. Moreover, we specifically asked about the sources for digital security information. The insignificant links with other mediation strategies might also mean that the sources used for digital security information do not include information about the "wider" aspects of digital security and digital parenting — for which parents can utilize different sets of sources. The limited extent of the information that can be found in different sources, which are often very narrow in scope, was shown in (Rader & Wash, 2015). We encourage future researchers to examine the patterns of sources for different aspects of digital security.

It is however surprising that the patterns in information sources were not reflected in using technical mediation strategies, i.e., using the software applications to filter or limit children's internet use. We presumed that this strategy, similarly to active mediation of internet safety, requires specialized knowledge about the existing software solutions and skills to installs

and set up the software. However, there are at least two possible explanations for the lack of a presumed link. On one hand, installing and managing software might no longer require extensive skills because software producers strive to make their product as user-friendly as possible. Thus, our presumption might not apply. On the other hand, specialized websites and experts might also provide information about problems with parental control software that can be easily bypassed by children (Zaman & Nouwen, 2016), lowering the willingness of parents to use them. It is also important to note that using the technical mediation was overall rather low in our sample.

5.1 Practical Implications

Our study shows that there are distinct patterns in the sources used for digital security information, with some parents utilizing a wide scope and others limiting themselves to only a few. Taking into consideration the findings and conclusions from (Rader & Wash, 2015; Redmiles, Kross, et al., 2016) that different sources provide different information, this finding points to parents being equipped with different information about how to take care of digital security in their homes. This is then linked to different behaviour in their families: parents who used expertise sources have higher digital skills, are responsible for securing devices in the household, and engage in teaching children about safety, especially when compared to parents who seek advice from interpersonal sources and who have lower skills. The sources parents use may contribute to a digital divide and make disadvantaged parents even more vulnerable. Based on the Global Security Index (International Telecommunication Union, 2019), the Czech Republic should pay more attention to digital security in general. As part of this effort we would recommend providing quality information to parents that would advise them about how to ensure digital safety in their families and promote digital skills among family members, which

would lead to lower experiences of the risks (Helsper et al., 2013). The results of our research indicate that providing the advice on the internet may be particularly beneficial given that the majority of parents use the internet as their main source of information. It might be helpful to provide a special website that is focused on providing such information to parents. The policy makers could support the development of such an online platform.

Similar to other studies, we found that the preferences of sources are connected to individual skills; moreover, we showed that parental partners' skills matter as well. This points to the labour division in the families — and our study showed that the skill division is quite disproportional in some families. Given the ever increasing usage of ICTs in many areas of our lives (i.e., personal, professional, civic), it would be desirable that both parents have a certain level of digital skill so that the family would not need to rely heavily only on one parent. Thus, we should encourage those with less skills to learn more about digital security. Unfortunately, these parents might be hard to reach and it may be a challenging task if they were to face it alone. Hence, we would recommend encouraging those family members with high skills (be it a parent or a child) to share their knowledge. Since these are also the people who utilize expert sources, expertized digital security information could include a prompt to share the information with family and friends to increase its impact.

Our results indicate that security experts in the family are most often fathers, and that mothers more often rely on another security expert in the family. We recommend that policy makers support the digital literacy and security-related literacy of mothers, especially because mothers are often highly engaged in parental mediation (e.g., Livingstone et al., 2017). Both parents should receive security-related education to be able to mediate the digital security of their children.

5.2 Limitations and Future Research

The study has several limitations. First, we asked only one of the parents, and asked them to report about their partners. Input from both parents would be desirable to gain a more complex picture and to confirm our assumption that *Specialized* parents and *Partner-oriented* parents would form a household with strong responsibilities and labour division.

Second, since our respondents were members of an online panel, they were probably more vivid internet users than average parents, which most likely also means that they had more digital skills and consequently they might also be more engaged in parental mediation. These sample specifics could especially be reflected in the proportion of the identified groups — which may underestimate the prevalence of the least skilled *Partner-oriented* parents and overestimate the *Internet-based* and *Specialized* parents. The low number of *Partner-oriented* parents also means that our analyses may not have captured smaller effects that might still exist.

Third, our research used only two categories for online sources: "internet in general" and "specialized websites." We revealed that most of the parents rely on sources from the internet in general, looking for information through search engines or social media sites. We did this because we were more interested in sources across media (i.e., printed, television, interpersonal) rather than within media. However, as a result, we do not know what exactly the online sources represent or their quality. Further research should investigate in details, what kind of online sources parents read, and how they select and evaluate these sources. We recommend utilizing a mixed-method design, combining qualitative and quantitative methods that would allow for testing the associations and the in-depths explanations of what lies behind them.

7. Disclosure of interest

The authors report no conflict of interest

8. References

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Table 1. *The Percentage of Respondents Using Explored Sources of Digital Security Information.*

	Total (*N* = 331)
From the internet in general	85.8%
From specialized websites	36.0%
From television	32.9%
From friends	26.6%
From my partner	23.0%
From other specialists	22.1%
From magazines	17.8%
From someone else in the family	15.4%
From the children	12.7%
From lectures or workshops	10.0%

Table 2. *Sources of Digital Security Information in Each Group.*

	1 "Internet-based"	2 "Specialized"	3 "Multiple-sources"	4 "Partner-oriented"
N	*193*	*66*	*56*	*16*
From the internet in general	**89%**	**83%**	**100%**	
From specialized websites	25%	**62%**	**45%**	31%
From television	22%	18%	**98%**	
From magazines		23%	**54%**	
From my partner	15%		**55%**	**88%**
From someone else in the family	10%	11%	**45%**	
From the children	10%		39%	
From friends	18%	38%	**52%**	
From other specialists		**88%**	27%	
From lectures or workshops		30%	14%	31%

Note: Displayed percentages show how many respondents (in relative frequencies) in each group utilized the sources listed in the first column. The most represented sources (above 40%) in each group are highlighted. The frequencies under 10% are not displayed to improve the clarity of the table.

Table 3. *The Differences Among Groups in Gender, Education, Children in the Household, Responsibility to Secure Children's Devices, and Children's Experiences with Online Threats (Chi-square tests and Fisher's exact tests).*

	1	**2**	**3**	**4**
	Internet-based	*Specialized*	*Multiple-sources*	*Partner-oriented*
Gender	57.5%	25.8%	58.9%	81.3%
(*male* x *female*)	$X^2(3) = 27.107$, p<.001, Cramer's V = .286			
Education	25.4%	47.0%	38.2%	37.5%
(*below tertiary* x *tertiary*)	$X^2(3) = 11.753$, p=.008, Cramer's V = .189			
Number of children	60.1%	45.5%	32.1%	62.5%
(*one* x *more than one*)	$X^2(3) = 15.738$, p=.001, Cramer's V = .218			
Teenager in family	43.0%	43.9%	48.2%	43.8%
(*no x yes*)	$X^2(3) = 0.480$, p=.923, Cramer's V = .038			
Responsibility to secure children's devices	76.9%	86.3%	75.6%	35.7%
(*no* x *yes*)	FET = .003, Cramer's V = .240			

Note: the categories whose percentages are presented in the table are underlined. FET = Fisher's exact test.

Table 4. *The Differences Among Groups in Respondents' Age, Respondents' and Partners' Internet Skills, and Parental Mediation Strategies (Kruskal-Wallis test with subsequent Mann-Whitney U tests).*

		1 Internet-based	**2** Specialized	**3** Multiple-sources	**4** Partner-oriented	*H*	*p*	
Respondent's age	*M*	40.036[a]	43.788[a]	39.804	39.313	9.544	.023	
	SD	9.123	8.273	11.313	9.336			
Respondents' internet skills	*M*	4.460[a]	5.000[abc]	4.319[b]	4.067[c]	16.287	<.001	
	SD	1.121	1.017	1.065	1.100			
Partner's internet skills	*M*	3.718[a]	3.672[b]	3.809[c]	5.200[abc]	16.996	<.001	
	SD	1.390	1.338	1.454	1.082			
Active mediation	*M*	1.783	1.885	2.089	1.571	3.908	.272	
	SD	1.059	1.022	0.925	1.089			
Active mediation of internet safety	*M*	2.556[a]	2.885[b]	2.422[c]	1.214[abc]	12.168	.007	
	SD	1.545	1.381	1.459	1.578			
Monitoring	*M*	1.665	1.720	2.046	1.214	3.619	.306	
	SD	1.673	1.761	1.493	1.369			
Technical mediation	*M*	1.012	0.944	1.388	1.451	3.004	.391	
	SD	1.332	1.235	1.552	1.391			
Restrictive mediation	*M*	1.438	1.617	1.365	1.714	4.450	.217	
	SD	0.783	0.592	0.767	0.611			