Feeling Secure vs. Being Secure
the Mobile Phone User Case

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Abstract. In this work, we are comparing the subjective security feeling of mobile phone users to the (objectively agreed) best security practices. This was possible by statistically processing a large pool of 7172 students in 17 Universities of 10 European countries. We introduced a "mean actual security value", comparing their security practices to best practices. There was a clear negative connection between feeling secure and actually being secure. Users that feel that mobile phone communication is secure, tend to be less cautious in their security practices. Moreover, we extracted profiles of students according to their mobile phone communication security feeling. These profiles belong to well defined categories. Users, exhibit different values of a metric that we named "mean security feeling value" according to their age, field of study, brand and operating system of phone, connection type, monthly bill and backup frequency. These results can help both academia and industry focus their security awareness campaigns and efforts to specific subsets of users that mostly need them. Finally, as there are not available any already validated questionnaires in regards to this specific research topic, our research, apart from revealing the situation, aims at providing a basis for the formulation of similar questionnaires for future use.

Keywords: mobile phone security, user profiling, security practices, survey, mean security feeling value, mean actual security value.

1 Introduction

Mobile phones have become a vital part of daily life for billions of people around the world. Their presence is ubiquitous and most users report that their cell phone makes them feel safer, even sleeping with their phone on or right next to their bed [1]. Physical safety however is completely different than communication security. As such, in this paper, we are comparing the subjective security feeling of mobile phone users to the (objectively agreed) best security practices.

Since mobile phones are used from both experienced, security savvy users and from people that do not pay that much attention to security issues, there is a relevant

distinction in the results of the survey. Users indeed, exhibit different levels of security feeling in regards to mobile phone communications. As a matter of fact, there are categories of users that face increased security risks due to their self-reassuring feeling that mobile phones are per se secure.

These categories need proper training and education, otherwise, a security incident will soon follow, harming in the long term the operators too. They must be protected from unauthorized third party access to their data and from economic frauds. Thanks to the statistical process concluded in this work, these specific user categories can easily be pinpointed by operators and handset manufacturers. This way they can offer better security training and intrinsically more secure products and services. It must also be noted that there are not available any already validated questionnaires for the specific research topic we examined. As such, our research aims at providing a basis for the formulation of such questionnaires for future use.

In the rest of the paper, in Section 2, related literature is examined. The methodology used for the survey is described in Section 3. Results are presented in Section 4, closing with conclusion and future work in Section 5.

2   Related Work

Although there have been quite many theoretical studies concerning mobile services and mobile phones, a significant means for investigating and understanding users' preferences is asking their opinion via specific questioning techniques. The vast majority of these surveys indicate the growing importance of mobile phones in everyday life and the increased popularity of new features [1][2].

In any case, the security of mobile phones is proven not to be adequate in many research papers. Modern smart phones, specifically, are vulnerable to more security risks [3]. There also exist several survey studies in this direction. Some of these surveys studies focus on mobile phone's security issues [4][5] while others on mobile phone services, touching also security issues [6].

More surveys [7][8] focused on mobile phones security issues and in which degree these issues concern the users. The conclusion was that a major part of the participants are extremely concerned about security and don't want any of their private data to be available to 3rd party unauthorized users. Furthermore, users are interested in mobile services adoption only if the prices are low and the security framework tight enough [9].

Despite the importance of security in the given field, cyber security and safety education is left out from the educational system [10]. Users, in turn, do not know if their phones are secure or not [11].

3   Methodology

A very useful evaluation method for surveying user's practices is the use of multiple-choice questionnaires (i.e. in person delivery or e-mail questionnaires) [12][13]. Our survey was conducted using in-person (face to face) delivery technique, with a total of

7172 respondents participating in this survey. This method was selected from other alternatives because is more accurate and has a bigger degree of participation from the respondents (e-mail questionnaires usually are treated as spam mail from the respondents plus there is the risk of misunderstand some questions). Indeed, the approximate ratio of participation was 80% since the researchers were able to answer the questions of participants regarding the scope and the purpose of the survey. There was also a pilot study, conducted in the University of Ioannina, Greece, before the questionnaire was administered to the sample, to ensure the reliability and validity of the questionnaire. As stated, there are not available already validated questionnaires for the subject. Data entry, finally, took place using custom software [14] while processing was done with SPSS.

The target group of the survey was university students from ages mostly 18-26, incorporating both younger and older youth segments because these ages are more receptive to new technologies. Given the fact that nowadays a very high percentage of young people is studying, the sample is not deemed limited and can be considered as representative of a large percentage of general youth population. Furthermore, since they are still studying, it would be easier to participate in security education programs, possibly implemented in Universities.

We correlated the answers using the last question: "Are you informed about how the options and technical characteristics of your mobile phone affect its security?" which had the following possible answers: "A Very Much, B Much, C Moderately, D Not too much, E Not at all". Apart from the statistical interpretations, a simple mathematical formula was developed in the analysis of the security knowledge to produce numerical values from the multiple choice questionnaires. We weighted the responses with the following weights: Very Much: 4, Much: 3, Moderately: 2, Not much: 1, Not at all: 0 and then divided by the number of occurrences, in order to get a mean value that we called "Mean Security Feeling Value (MSFV)".

In addition to MSFV which was based on subjective answers, another, objective, metric was introduced, the "Mean Actual Security Value (MASV)". MASV was calculated as following: we added one point for each of the following practices, which are objectively correct: Having IMEI noted down, knowledge of lack of encryption icon, having SIM PIN enabled, using a screensaver password, having Bluetooth disabled, not lending the phone, not downloading software to the phone, using antivirus, not saving passwords in the phone and not saving personal data in the phone. The maximum score would hence be 10, since there were 10 specific questions.

4   Results

The questionnaire was divided in two parts. In the first part participants were asked demographic questions including gender, age and field of studies as well as some economic data including mobile phone usage, connection type and budget spent monthly on phone service. In the second part we introduced security knowledge and practice questions. In the following sections we present the results of categorizing users in regards to their security knowledge using the correlation and the simple

formula described earlier. All of the findings presented are statistically significant at the Pearson's Chi-Square test p<0.05 level.

4.1   Demographics

53% of the participants were females and 47% were males. The Mean Security Feeling Value MSFV was 2.26 in the scale 0 to 4 (0 not at all, 4 very much), with minimal differences among genders. Correspondingly, the Mean Actual Security value MASV was calculated to be just 3.55 out of maximum value 10.

Most of the respondents, in turn, were aged 18-26 (75%). The MSFV was found to be somewhat higher in younger ages. Examining the field of study we discovered that soon to be medical doctors are feeling the most secure. the most informed (MSFV 2.69). Mathematics and Natural Science students with MSFV 1.89 were in the other end of spectrum the most worried ones. Engineers were in the middle of the range, with MSFV 2.24.

4.2   Economics

Proceeding to economics, participants were asked whether they are using a pre-paid or post-paid (contract) mobile phone connection. 42.4% of students are using a contract based subscription, a rather high percentage, while 13.6% have both prepaid and post-paid SIMs (Subscriber Identity Module). Users having both types of connection seem to be more worried about security issues.

Answering how much money they spent monthly, student mobile phone users had a wide range of financial capabilities. The leading 36.7% spends 11-20 Euros (currency converted) monthly while 30.5% spend less than 10 Euros. Only 9% spend 31-40 Euros and some 6.3% spend more than 40 Euros per month. The MSFV shows an interesting trend. It progressively gets lower as the bills get higher, from 2.33 (<=10 Euros bill) to 2.05 (31-40 Euros bill). Then, for users that spend more than 40 Euros it grows a little to 2.12. This is quite logical, since the more users spend, the more are concerned about the security of communication and possible fraud.

4.3   Security Specific Questions

Our fundamental research question was how "secure" users feel that mobile phone communication is. The majority (36.9%) replied "moderately" followed by 28.6% "much" (Figure 1). On the other hand, some 21.36% felt not too much or not at all sure they are secure. Using the simple formula described in Section 3 (Methodology), the mean security feeling value (MSFV) was 2.26, in the 0-4 scale (0 not at all, 4 very much).

In addition, students answered whether they are informed about how the options and the technical characteristics of their mobile phones affect the security of the latter and whether they are taking the necessary measures to mitigate the risks. The majority (30.8%) states that they are "moderately" informed while a large 15.8% believes that they are "not at all" informed (Figure 2).
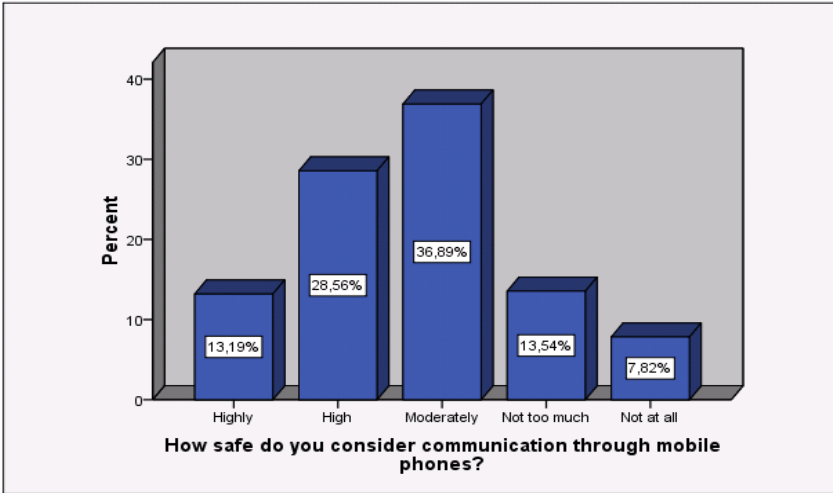
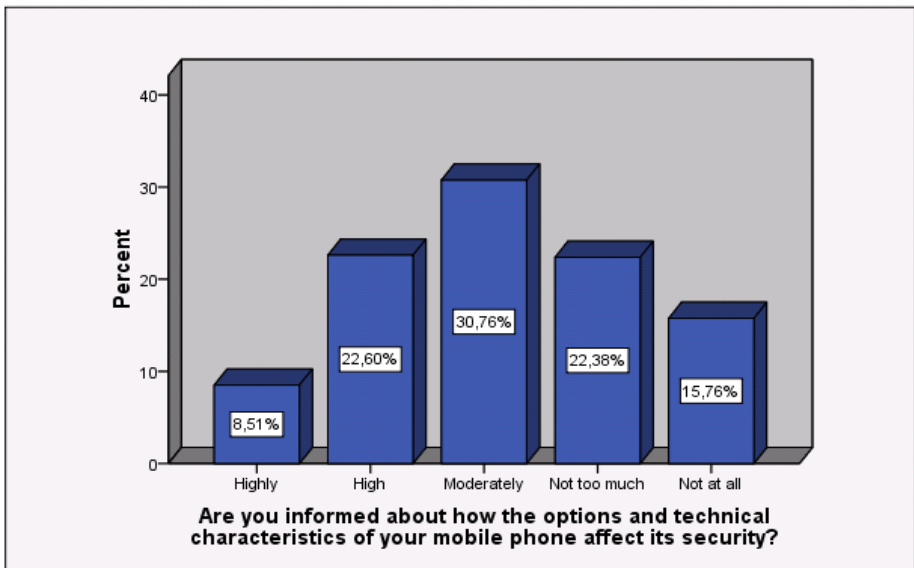**Fig. 1.** How secure do you consider communication through mobile phones?

Fig. 2. Knowledge of mobile phone security aspects

Correlating MSFV value to awareness feeling (Figure 3), we see that there is an almost linear relationship between them. Users that feel very much informed believe that communication is very much secure. On the other end, users that do not feel informed are afraid that communication is not at all secure. At this point one can argue that excessive confidence can lead to "relaxation" of security practices. In

addition, a campaign to enhance the security knowledge of users would lower their fear of communication insecurity, probably leading to greater phone usage and profits for the operators.
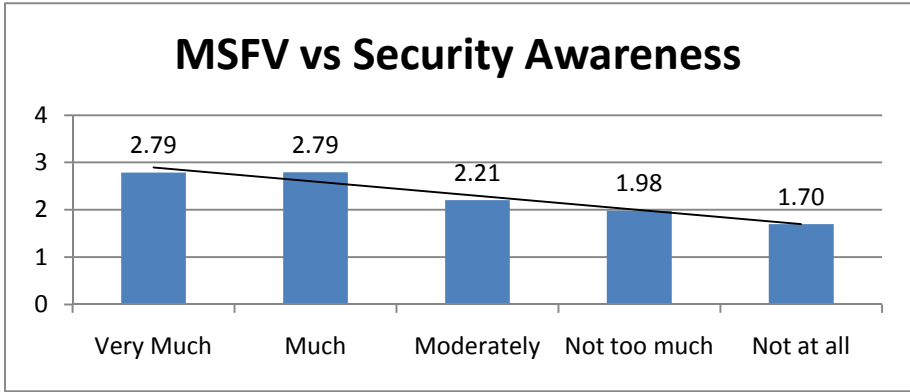

Fig. 3. Mean security feeling value vs. security feeling

There was an even better (negative) linear association between the subjective security feeling and the objective mean actual security value (Figure 4). Users that believe that mobile phone communication is very much secure have the lowest Mean Actual Security Value MASV (3.44). That is, there is a clear discrepancy between user opinions on security and actual security practices. The association grows linearly to the highest MASV of 3.84 for those that believe that communication is not secure at all. This group employs the most best practices, bit still fails in more than half (c.f. Methodology, where the maximum value of MASV is theoretically 10).
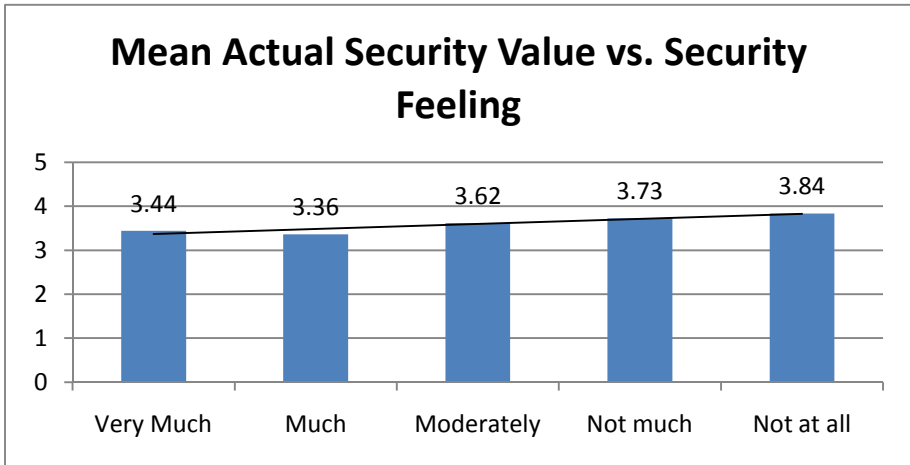

Fig. 4. Mean actual security value vs security feeling

Further correlating the responses to the type of operating system–O/S (advanced or not) proved that students owning phones with an advanced operating system believe they are more secure than those who actually own a phone without advanced O/S. There was a also a clear connection between increased backup frequency and security feeling.

At the same time, knowledge of the existence of the special icon that informs the user that his/her phone encryption has been disabled increased the safety feeling of users. In short, when A5 encryption is switched off or not supported, there is provision for handsets to display a special icon informing the user about the situation. Such an occurance can be attributed either to network's lack of encryption capability or to temporary failure/overloading. The same can happen when a malicious attacker is launching a man in the middle attack, impersonating network's base stations to deceit the handset into connecting with the fake base station instead of the legitimate one. The fraudster can then channel the communication through his own equipment, effectively intercepting it [15]. This finding is a clear explenation of how better User Interfaces can help enhance the subjective security feeling via an objective method.

5   Conclusion

As the findings of this survey support (using Pearson's Chi Square), users can be grouped in well defined categories according to the subjective statement of how secure they feel mobile phone communication is. These categories exhibit different values of a metric that we named "mean security feeling value". Further introducing a "mean actual security value", we counted how many "good" security practices they follow.

Comparing this (objective) value to their subjective security feeling we got very interesting results. There was a clear negative connection between feeling secure and actually being secure. Users that feel that mobile phone communication is secure, tend to be less cautious in their security practices, being actually less secure than they feel. This discrepancy between user opinions on security and actual security practices is a fact that should be addressed in order to minimize vulnerabilities and user exposure.

In regards to awareness, users that feel they are very much informed believe that communication is very much secure. On the other end, users that do not feel informed are afraid that communication is not at all secure. Excessive confidence could lead to "relaxation" of security practices while excessive fear certainly hinders technology adoption and especially mobile downloading.

As such, academia and industry should focus their security awareness campaigns and efforts in order to combat the false sense of security that users have. Moreover, given the growing usage of mobile phones to access the internet, it is of paramount importance to enhance the overall users' security levels that were found to be alarmingly low.

Closing, as there are not available any already validated questionnaires in regards to this specific research topic, our research, apart from revealing the situation, aims at providing a basis for the formulation of similar questionnaires for future use.

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