

The challenge of increasing safe response of antivirus software users

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Abstract. While antivirus software is an essential part of nearly every computer, users often ignore its warnings and they are often unable to make a safe response when interacting with antivirus software. The aim of our study was to find working connections to increase a number of mobile device users who select a premium license with more security features over a free license with a limited level of security. We cooperated with the antivirus company ESET and more than fourteen thousand users participated in first phase of our experiment. We tested two new types of a user dialog on the Android platform. The first user dialog was designed with a text change and the other with a new button “Ask later”. As a result, we found out that the text change increased the number of premium license purchases by 66% in the first phase of our experiment, the version with the “Ask later” button increased this number by 25% in the same period.

1 Introduction

User security often depends on user’s ability to comprehend information and warnings. Since a user is the weakest point of the security chain, it is crucial to empower him/her to make informed decisions when cooperating with security software.

Our study aimed to find working connections between user dialog design and user security behavior when using certain components of antivirus software. We have been undertaking experiment in cooperation with a company developing antivirus software, ESET. Cooperation with the company brings us a benefit of real life experiment participants. Unlike many other studies [1,2] whose results were based on participants recruited among students or Amazon Mechanical Turk users, our study is based on real product users.

Our team consists of experts from three faculties of Masaryk University. People from Faculty of Informatics, Faculty of Social Studies and Faculty of Law have been involved. This innovative connection brings a multidisciplinary view into the experiment.

Our challenge is to increase overall user security by empowering the user to make a qualified decision on the use of antivirus software on the Android

platform. Thus, we designed an experiment where we made changes in the user dialog offering the upgrade to the one-year premium license after a trial version has expired. The effect is measured by monitoring a conversion rate of the product. The conversion rate is defined as a percentage of customers who opted for the one-year premium license out of all users. Despite all effort provided by the company so far, the conversion rate on the Android platform is still low. Our challenge is to increase this number by changes in the user dialog offering the upgrade to the one-year premium license after a trial version has expired. The second chapter is focused on related work in visual warning design and persuasive approach. The third chapter describes our experiment design. The fourth chapter concludes with experiment results and observations.

2 Related work

User dialogs and warnings design has its place in the field of security. Despite an increasing trend of automatic decisions, there are still many problems that must be decided by a user himself. Since the user sees dozens of warnings and user dialogs every day, a general blindness to them is widely observed simply due to a process of habituation [3].

There is a common term “safe response” used for a choice that brings security benefits to the user [4]. A user dialog is considered to be successful when the safe response was selected by the user. There is a question that has been asked for many times. How to empower the user to select the safe response?

2.1 Best practises in visual warning design

An effective warning structure consists of a signal word to attract attention, identification of the hazard, explanation of consequences and directives for avoiding the hazard [5]. The other approach prefers a different structure. A good warning should contain a signal word panel with signal words, color coding and an alert symbol [6]. Since the structure is not enough to increase the power of warning, use of attractors is recommended.

Attractors are parts of warnings or user dialogs serving to attract user attention [7]. Wogalter [8] recommended to add a bold type in contrast with a standard type or to add a color in contrast with a background. Especially red and yellow are very good in increasing readability [9]. Pictorial symbols in contrast with rest of background, special effects, frames, personalization and dynamic elements also work as good attractors.

Some user dialog designs become successful, but with a great loss of usability. For example, authors in the study [7] proved that the user dialog with the greatest influence requires rewriting the most important word of the whole user dialog by a user himself. Since text rewriting makes the whole process very slow, this approach is not recommended to be widely used. Other good user dialog designs highlight important text of the warning and make the user to swipe it

with his mouse or simply add 10 second delay before a decision can be made. All these features inhibit the user and empower him to comprehend the text better.

Providing an explanation is a tricky question. The study [7] proved that a detailed explanation serves as a bad attractor, but other authors [10] pointed out that a warning with a “purpose string” has a higher impact on a user over the warning without any purpose. Surprisingly, an effect of different content in a purpose string is statistically insignificant. When a hazard is communicated in an explanation, the description should be specific, complete and the most important risks should come first [8].

Text structure also influences warning effectiveness. Many studies have shown that warnings in bullets or in an outline form are considered more readable than a continuous text [11]. A common fact is that people are not reading the texts, they are scanning them. Rules following from this observation are: putting most important content first, avoid being vague, get to the point quickly and structure the text [12]. Eye tracking studies proved that the area where users really read has the F-shaped pattern [13]. They read first one or two paragraphs at the top of the text and then briefly scan down in the nearly similar shape that the letter F has.

2.2 Persuasive approach

Apart from visual principles, a persuasive approach is also involved in our study. Persuasion can be defined as a set of influence strategies based on inner human reactions and needs. Cialdini [14] introduces six basic principles of persuasion. These principles are: Reciprocity, Commitment, Social Proof, Liking, Scarcity and Authority.

- **Reciprocity** says that people tend to reciprocate behavior towards them.
- **Commitment** speaks about fact that people like being consistent in their opinions and decisions. People who did a favor for something in past, tend to do same favor in future because they feel obliged to do so.
- **Social proof** principle is simply declaring “safety is in numbers”. People in an ambiguous situation tend to behave similarly as the majority.
- **Liking** says that we are more influenced by people who are similar to us. For example, they like same things as we do.
- **Scarcity** says that rare objects are more desired by people than the widely available ones.
- **Authority** emphasizes that we are easily persuaded by people who speak to us from the position of authority.

The decoy effect is also involved in persuasive approach. It describes a change in user preferences after an introduction of a decoy option. When a user decides between two equally selected options (if presented on their own) and the decoy option is introduced, consequently one option looks more favorable and the user tends to prefer it over the other. Dan Ariely in his book [15] describes an experiment to illustrate the decoy effect. The study was conducted on MIT

students. They should have selected the most favorable offer of a newspaper subscription. The first offer was to buy the online newspaper subscription for \$59. The second offer was to buy the newspaper subscription in a paper version for \$125. The third offer was to buy both paper and online newspaper subscription for \$125. The middle offer (\$125 for the paper version) then seems without sense, because it is very unfavorable for a customer, but it has large impact on a user decision strategy. It serves as a decoy offer.

When respondents were selecting from the first and third offer only, they preferred the first offer (68 picked the first offer and only 32 the third offer) mostly. When the experiment settings changed, the decoy offer was introduced, and respondents were selecting from first, second and third offer, they preferred mostly the third one (more than 80 out of 100 picked that offer). We can observe that adding the decoy option changed the user's decision and influence him to pick a different offer.

The book [15] also mentions the power of the word "free". When something can be obtained without money, it is far more attractive than when it costs \$1 or any similar small price. Word "free" works as a very powerful attractor.

People do not like making decisions and also prefer to make changeable decisions over the unchangeable ones. They do not want to lose any possibility [16].

3 Experiment design decisions

Our experiment was divided into two phases. First, initial phase started in December 2014, and was stopped on the first of April, and the inflow of results slowly came to an end by early May. A zero variant together with first and second variants were tested. The follow-up phase started in May 2015. Based on results from the first phase, where the most successful variant was that with a text change, we applied this text change to all variants tested in the follow-up phase. Moreover, a questionnaire about a smart phone use was included. Initial phase participants were English-speaking antivirus users mostly from USA and UK. The follow-up phase was designed in four language versions – English, German, Czech and Slovak. Results of the follow-up phase will be available at the end of 2015. We focused on the product's user dialog that appears after a trial license expired. Unfortunately, we can not influence several other factors, for example marketing campaigns running in different countries differently or users' satisfaction with the product. Similarly, we can not influence the overall product workflow – there are several ways to buy the premium license and several ways to reach this user dialog.

Experiment limitations

Unfortunately, we could not follow several good principles that have been already introduced due to several limitations that follow from cooperation with the company.

Limitations reflecting company specific requirements must be taken into account. Only minor changes could be done in a GUI because a complete redesign was ruled out by the company. We also can not influence the whole workflow or anything out of the scope of the user dialog. Several variants can not be tested due to system limitation because implementation in the system would be costly or impossible. Some variants were canceled due to unexpected turn of events. For example, to increase attractiveness of buying the premium license, we used the principle of Reciprocity and designed a user dialog offering “something more” in addition to the user who bought the premium license, in our case it was a charity donation. Due to excessive bureaucracy connected with the donation, company ruled out this variant.

Principles used in design

We also made a descriptive text redesign to increase its readability and comprehension. We have used several mentioned visual design principles. As attractors we used only those that do not influence overall usability of the system. Large attractors were ruled out by the company because flashing, framing or aggressive colors do not fit the company visual style. So as an attractor we used the bold type that stresses important information which should not be overlooked by user.

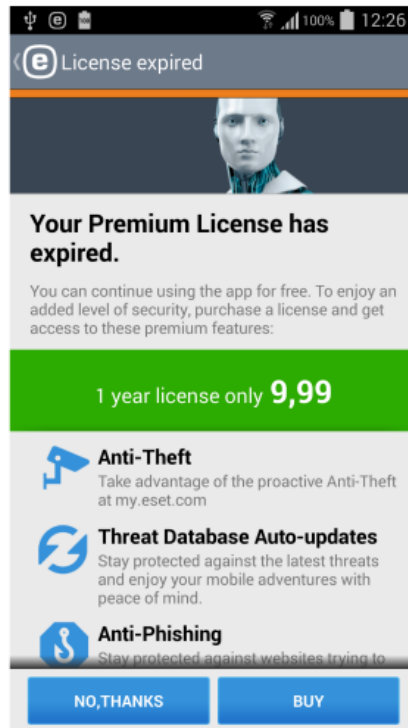
As for the persuasion principle use, we added a decoy option that should give special preference to buying the premium license over using free version. The decoy option pricing was set after a negotiation with the company. We also have used principle of postponing the decision by implementing the button “Ask later”. Principle of reciprocity to invoke a feeling of an obligation was used in a last variant.

Variants in consideration

The initial screen (Figure 1) contains a descriptive text, an offer to buy an one-year license, description of the one-year license features and action buttons. The descriptive text was: “*You can continue using the app for free. To enjoy an added level of security, purchase a license and get access to these premium features:*” The redesigned text is: “*To continue with highest level of security, purchase your license and get access to these premium features:*” We redesigned the text to make it shorter and better understandable for a user. The word “free” was removed because it stresses an undesired option of not buying the premium license.

The features description was also redesigned to be more concrete, because users with lack of technical skills may have difficulties to understand what general features description represents. Thus we pinpoint illustrative subset of functionality for each feature. For example, instead of *Take advantage of the proactive Anti-Theft at my eset.com* we recommended *Locate your missing device at my eset.com*.

Fig. 1. The initial user dialog encouraging a user to buy the one-year license.



Initial experiment variants

- **Var. 0** is an initial variant with no change.
- **Var. 1** uses the new redesigned text instead of the old one.
- **Var. 2** implements a button “Ask later” due to an assumption that some people do not like quick decisions and may want to make an installation later. The text remained the same. There are three buttons on the screen – “Buy”, “No, thanks” and “Ask later”. When a user presses “Ask later”, the screen appears again after a couple of days. Button “Ask later” can be pressed 3 times at most. After the third “Ask later” pressing, the screen never appears again.

Following variants are currently involved in the follow-up phase. All variants contain also the text change taken from the first variant.

- **Var. 3** uses a principle of adding the decoy option next to the standard one. In this option a basic version is for free, a three-month license for \$4.99 (the decoy option) and a one-year license for \$9.99.
- **Var. 4** uses the same principle as in the first variant. In this option a basic version is for free, a one-year license for \$9.99 (the decoy option) and a two-year license for \$14.99.

- **Var. 5** introduces a principle of reciprocity and experiments with a business model “Pay what you can” where the user can select among three prices for the same antivirus product. Users have used an antivirus trial version for free and we assume that they may feel “obliged” to the company and buy a license. The user is asked to value his/her security and user can select a price he/she wants to pay for the product out of the three offers (\$6.99, \$9.99, \$12.99).

Technical solution of initial experiment: Only English speaking customers were involved in the study, an estimated number of respondents was 500 users per the variant. Finally, we got 14,142 participants in total after three months. Following attributes were logged in company’s systems. Unfortunately, we had no other information source (for example user questionnaire) to gain more information about product users in this phase.

- Variant of the screen displayed.
- User’s country.
- Summed time spent on “Premium expired screen”.
- User tapped “Buy” button (yes/no).
- User actually bought the license (yes/no).
- Final decision (yes/no).
- Number of “Ask later” decisions (if applicable).
- Date – screen displayed for the first time.
- Date – user bought the license.
- Date – user tapped “No, thanks”.
- Device manufacturer.
- Device resolution.
- Device model.
- Android version.

4 Results and observations

The initial experiment ran from December 2014 to early May 2015. However, there was a marketing campaign in early March 2015. Our analyses of the data showed that this campaign had a significant impact, the trends observed from the data from first three months of experiment (December 2014 to early March 2015) are completely different from trends observed afterwards. We are currently (September 2015) investigating details of this marketing campaign, but we did not come to a rational explanation and conclusion of the causes and consequences in detail. The zero variant together with the first and the second variant were tested in the first phase. Results are described in Table 2. Participants were English speaking users of trial antivirus software running on the Android platform. All variants were randomly distributed among countries, manufacturers and device users to gain an equal representation. There were 14,142 participants in total. Half of them came from USA (49.1%). Others came mostly from UK (33.1%) or India (5.9%). Nearly 90% of them use antivirus in their mobile

phones, only 10% in tablets. As for device manufacturers, nearly half of them use Samsung (48.8%). The other half is split among many producers, for example Sony (7.4%) or HTC (5.3%).

Table 1. Crosstable of results at the end of December 2014.

	Purchased	Not purchased	Total
Var. 0	34	1,099	1,133
Var. 1	52	1,114	1,166
Var. 2	36	960	996
Total	122	3,173	3,295

	Purchased	Not purchased
Var. 0	1.96%	98.04%
Var. 1	3.18%	96.82%
Var. 2	2.65%	97.35%

Table 2. Crosstable of results in early March 2015.

	Purchased	Not purchased	Total
Var. 0	77	4,780	4,857
Var. 1	125	4,731	4,856
Var. 2	87	4,342	4,429
Total	289	13,853	14,142

	Purchased	Not purchased
Var. 0	1.59%	98.41%
Var. 1	2.64%	97.36%
Var. 2	2%	98%

We set up a null hypothesis claiming that there is no difference in a number of purchases among variants. An alternative hypothesis was claiming that the difference exists.

We have conducted a Pearson Chi-Square test ($\chi^2=12.062$, $p < .05$, $df=2$). [17] Since the p-value is less than the significance level .05, we rejected the null hypothesis in favor of the alternative hypothesis and proved a difference in the number of purchases among variants.

We made a post-hoc analysis among variants based on arcsine transformation of each variant. At the significance level $\alpha=.05$ we have proved difference between the zero variant and the first variant. The difference between the zero variant and the second variant was not statistically significant.

We proved that a simple text change can provide a clearer presentation of security benefits to the user and lead to an increased uptake of a more advanced security solution.

Other observations

Observing the data, we can see interesting trends in increase and decrease of obtaining the license. Comparing the first variant with the zero variant, the first variant has 62% increase in getting the license over the zero variant in December (Table 1) this trend continued to early March when the increase was also about 66%. Comparing the zero variant with the second variant, the second variant has 35% increase in December but only 25% increase in early March 2015. December increase in obtaining the premium license was quite likely influenced by overall Christmas shopping spree.

Average time spend on the screen is same for all variants. It is good news for the company that new variants do not imply any delay for users. We can observe that customers who bought the license spend more time on the screen than customers who did not.

We have observed that people who bought the license via the second variant did not use the button “Ask later” mostly. 96.2% out of all customers who obtained the license after being exposed to the second variant did not use the button “Ask later”. 3.5% used the “Ask later” button once. Only one user obtained a license after pressing “Ask later” twice. The current results indicate (while still not being statistically significant) that postponing the decision does not lead to purchase in a future.

We made also several observations based on the other attributes of collected data. All are at the significance level $\alpha = 0.05$.

- There is a statistically significant difference in a number of purchases in India and USA ($\chi^2=15.86$, $p < .001$, $df=1$), and India and UK ($\chi^2=11.813$, $p < .001$, $df=1$). Users from USA and UK purchase statistically more than users from India.
- There is a statistically significant difference between zero and first variant among USA users ($\chi^2=13.98$, $p < .001$, $df=1$), whereas UK users do not prefer any of variants significantly.
- Tablet users buy a license more often (statistically significant) than non-tablet users ($\chi^2=42.586$, $p < .001$, $df=1$). Average conversion rate for tablet users is 4.4%, whereas for non-tablet users is 1.78%. There are no statistically significant preferences in variants among tablet users, but non-tablet users prefer the first variant significantly more.
- Comparing manufacturers who are represented by at least 500 participants, the highest conversion rate was observed for users of LG (3.27%), Samsung (3.06%) and Motorola (2.92%), whereas the lowest rate was observed for Huawei customers (around 0.2%). There is also a statistically significant difference in purchases among Huawei and any of the following manufacturers: Sony, Samsung, Motorola, LG. We also have observed statistically significant

preferences among zero and first variant in HTC ($\chi^2=7.631$, $p < .005$, $df=1$) and Samsung ($\chi^2=4.264$, $p < .05$, $df=1$).

Conclusion

Our task was to increase user security by empowering him/her to select the safe choice and obtain the premium license that offers more security features than the free license. We have cooperated with the antivirus company ESET and 14,142 real users of their product participated in our experiment. We have rejected the null hypothesis claiming that there is no difference in a number of purchases among variants ($p < .05$). When comparing the number of purchases of the same version of software with better security features description, a slight difference in presenting the features implies a 62% (December) and 66% (March) increase in purchases as a result of using the first variant. The difference between the zero variant and the first variant with the text change was statistically significant at the significance level $\alpha=.05$. Increase in the number of purchases by implementing the button “Ask later” was about 35% in December and 25% in March, but not enough to be statistically significant. Based on results and observations, we decided to use a text change for all variants in the follow-up experiment.

Considering limitations of our experiment, we focused strongly on user dialogs in our study and we did not take into consideration a lot of other related issues. For example, the conversion rate on the Android platform is quite likely influenced not only by the user dialog, but also with overall satisfaction with the product and with the complex product workflow which offers many ways to buy a product.

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