Psychological Need Fulfillment for Mobile Security and Privacy Actions: A Preliminary Investigation

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Abstract

In a preliminary online study we investigate the saliency of psychological needs as motivators for security and privacy actions on smartphones. We find distinct need profiles for a number of security and privacy actions, indicating that different psychological needs motivate those actions on smartphones. We discuss indications, limitations, and future work.

Introduction

"In daily life, people rarely do activities solely for the purpose of security. Instead most IT-security decisions are part of other activities with other purposes. When analyzing these use situations it is impossible to isolate IT-security tasks or decisions." – Bødker et al. [1]

The literature indicates that users perceive different threats on their smartphones such as physical theft or damage of their device, malicious apps, wireless network attacks, limited battery lifetime, and limited signal strength [2]. In some situations users take measures to mitigate these threats, but in other situations they do not, even if concern is reported.

We suspect that the theory of psychological needs can help to further explain user behavior related to threat mitigation by considering the underlying motives
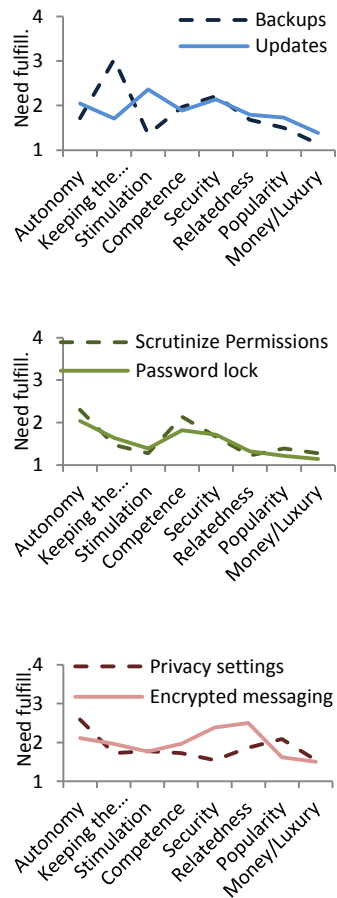
Figure 1 Mean need fulfillment ("need profiles") for backup and update users (top); password/ PIN lock users and user who scrutinize permissions (middle); users who use privacy settings in messaging apps and user of messaging apps with end-to-end encryption (bottom).

for pursuing an action. Also in the context of HCI, psychological needs have been suggested as high-level goals ("be-goals") which a user intends to fulfill [5]. A user for instance may activate the privacy setting in a messaging app so that the sender of the message cannot see when a message was read. This avoids the pressure to reply immediately to a message. In this case, the privacy setting would be used to fulfill the basic psychological need of *Autonomy*. Following the quote of Bødker et al. [1] at the beginning of this papers' introduction, we suspect that security and privacy actions are embedded into diverse goals (purposes) beyond security only. Gaining insights into these goals may serve as a basis to design security and privacy actions in such a way that they are harmonized with the psychological needs that drive them, resulting, in the best case, in increased adoption rates. Furthermore, psychological need fulfillment is related to a positive user experience [6] and can consequently serve as a design goal in order to achieve positive user experiences [6,4].

Methodology

70 smartphone users were recruited by word of mouth and email for an online survey. The survey first administered questions on demographics and smartphone usage. We further asked participants regarding their adoption of different security and privacy actions on their smartphones, including the use of backups, the installation of updates, the use of privacy settings in messaging apps (i.e. applying the "last seen" function), the use of messaging apps with end-to-end encryption, scrutinizing permissions, and using PIN/password locks. Note, that we have included end-to-end encrypted messaging as a separate action, as the study was conducted before the major

messaging app providers announced to implement end-to-end-encryption.

Participants who reported to do a certain action were then asked to indicate the level of need fulfillment they in general experience during this action (on a scale from 1 = not at all to 5 = very much). Thereby, we considered the following needs [7, 4]: *Autonomy* (i.e. the desire to do things one's own way), *Competence* (i.e. the desire to be able to master challenges), *Relatedness* (i.e. the desire to feel close to others), *Popularity* (i.e. the desire to influence others), *Security* (i.e. the desire to be safe from threats and to have a structured life), *Keeping the Meaningful* (i.e. the desire to keep meaningful things), *Money/luxury* (i.e. the desire to feel like a person that has enough money), and *Stimulation* (i.e. the desire to experience new things). These needs are based on well-known theories of psychological need fulfillment such as Deci and Ryan's self-determination theory and Epstein's cognitive-experiential self-theory [7]. To measure the needs, we employed the German translation [3] of the need questionnaire presented by Sheldon et al. [7]. Questions for *Keeping the meaningful* were taken from the UNeeQ questionnaire [8]. The high number of need questions (3 items x 8 needs = 24 items per action) would have likely resulted in fatigue effects. Thus, only a subset of action questions was shown to each participant and only two of the three items per need were used. This resulted in 16 need questions per action. We created different versions ("conditions") of the survey which contained different action questions. Participants were randomly assigned to a condition. The survey took approximately 20 minutes. Three Amazon vouchers à 50€ were shuffled among all participants.

Friedman test results

Friedman test results

Backups:
$\chi^2 = 40.90$, $p<0.01$;

Updates:
$\chi^2 = 30.00$, $p <0.01$;

Password/PIN lock:
$\chi^2 = 30.00$, $p < 0.01$;

Scrutinizing permissions:
$\chi^2 = 58.89$, $p < 0.01$;

Privacy settings:
No sign. Effects;

Encrypted Messaging:
$\chi^2 = 18.78$; $p < 0.01$;

Need	Privacy settings (N = 11) M (SD)	Encrypted messaging (N = 13) M (SD)
AUT	2.59 (1.00)	2.12 (1.33)
COMP	1.73 (0.82)	1.96 (1.23)
STIM	1.77 (1.15)	1.77 (1.24)
MON	1.55 (1.29)	1.50 (1.19)
SEC	1.55 (0.82)	2.38 (1.45)
POP	2.09 (1.30)	1.62 (1.26)
KTM	1.73 (1.03)	1.96 (1.42)
REL	1.86 (1.10)	2.50 (1.34)

Table 1 Mean (M) and Standard Deviation (SD) of need fulfillment for users who use privacy settings and users of encrypted messaging apps.

Need questions

The following need questions were administered in the survey:

By doing [action] I have the feeling…

Autonomy [7][1]: … that my choices were based on my true interests and values./ … free to do things my own way. **Competence [7]:** … that I was successfully completing difficult tasks and projects./… very capable in what I did. **Relatedness [7]:** … a sense of contact with people who care for me, and whom I care for./ … close and connected with other people who are important to me. **Stimulation [7]:** … that I was experiencing new sensations and activities./ … intense physical[2] pleasure and enjoyment. **Money/ Luxury [7]:** … able to buy most of the things I want./ … that I got plenty of money. **Security [7]:** … glad that I have a comfortable set of routines and habits./ … safe from threats and uncertainties. **Popularity [7]:** … that I was a person whose advice others seek out and follow./ … that I had strong impact on what other people did. **Keeping the meaningful [8]:** … I was collecting meaningful things./ … I was keeping meaningful things.

Participants

The 70 participants (37.1% female) were between 18 and 61 years old (ø=28). Educational levels were diverse (Secondary school degree: 4.3%, Completed training: 12.9%, High school degree: 32.9 %, College/ university degree: 50%). Occupational groups were reported to be employees (38.6%) and students (44.3%), and other groups (e.g. job seekers, self-employed) (17.2%). The majority did not have

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[1] Note, that for questions taken from [7] a translated version was used [3].
[2] The word "physical" was excluded in the version we used

professional IT expertise (60%). The sample was diverse regarding age, smartphone usage, and occupational groups; however, there was a bias towards male participants, higher educational levels and undergraduate students.

Results

Figure 1 depicts the mean need fulfillment ("need profiles") for users of the security and privacy actions considered in the study. For some of the actions, the diagrams show clear peaks for single needs. We used non-parametric Friedman tests to investigate whether some of the needs are more influential than others (cf. sidebar). The Friedman tests were significant for all actions, except for the use of privacy settings in messaging apps.

For backups, post-hoc analysis (Dunn-Bonferroni) revealed that users ranked *Keeping the meaningful* significantly higher than *Popularity*, $Z = 3.16$, $p = 0.04$, $r = 0.60$, *Stimulation*, $Z = 3.74$, $p < 0.01$, r = 0.71, and *Money/Luxury*, $Z = 4.13$, $p < 0.01$, $r = 0.78$. Thus, the results suggest that *Keeping the meaningful* is a primary goal for doing backups, i.e. doing backups seems to be intrinsically motivated if files are deemed meaningful by the user.

For updates, post-hoc analysis revealed that *Stimulation* was ranked significantly higher than *Money/ Luxury, $Z = 3.85$, $p < 0.01$, $r = 0.58$*. This indicates that *Stimulation* is a primary goal for installing updates; i.e. installing updates seems to be driven by the desire to experience new things (this could be, for example, new features).

For scrutinizing permissions, post-hoc analysis revealed that users rated *Autonomy* significantly higher than *Relatedness, Z = 3.61, p < 0.01, r = 0.60*, *Money/ luxury*, $Z = 3.91$, $p < 0.01$, *r = 0.65*,

Need	Backups (N = 14) M (SD)	Scrutinize Permissions (N = 18) M (SD)
AUT	1.71 (0.89)	2.31 (1.10)
COMP	1.96 (0.84)	2.14 (0.78)
STIM	1.36 (0.60)	1.28 (0.55)
MON	1.14 (0.36)	1.28 (0.60)
SEC	2.21 (1.19)	1.67 (1.03)
POP	1.50 (0.76)	1.39 (0.78)
KTM	3.04 (1.34)	1.47 (0.74)
REL	1.68 (1.08)	1.22 (0.57)

Table 2 Mean (M) and Standard Deviation (SD) of need fulfillment for backup-users and users who scrutinize permissions.

Need	Password/ PIN lock (N = 14) M (SD)	Updates (N = 22) M (SD)
AUT	2.04 (1.06)	2.05 (1.25)
COMP	1.82 (1.12)	1.89 (1.09)
STIM	1.39 (0.74)	2.36 (1.33)
MON	1.15 (0.53)	1.39 (0.83)
SEC	1.71 (0.91)	2.14 (1.28)
POP	1.21 (0.58)	1.73 (0.98)
KTM	1.64 (0.84)	1.70 (0.85)
REL	1.32 (0.72)	1.80 (1.20)

Table 3 Mean (M), and Standard Deviation (SD) of need fulfillment for password lock and update users.

Stimulation, $Z = 3.71$, $p < 0.01$, $r = 0.62$, and Popularity, $Z = 3.20$, $p = 0.039$, $r = 0.53$. Also, users ranked Competence significantly higher than Relatedness, $Z = 3.50$, $p = 0.013$, $r = 0.58$, Money/Luxury; $Z = 3.81$, $p < 0.01$, $r = 0.64$, and Stimulation, $Z = 3.61$, $p < 0.01$, $r = 0.60$. Thus, the results suggest that Autonomy and Competence are two goals of scrutinizing permissions. This further suggests that users who scrutinize permissions experience a feeling of being autonomous and competent. This is a promising result as it indicates that users may appreciate being asked for permission. However, it does not indicate whether users take "good" privacy decisions.

For the remaining actions, namely the usage of password locks, privacy settings, and messaging apps with end-to-end encryption, post-hoc analysis did not yield significant results; the results for these actions are inconclusive.

Discussion, Limitations and Future Work

The need profiles (cf. Figure 1) suggest that a variety of psychological needs are influential for different security and privacy actions. We plan to conduct further studies to gain further insights into users' goals. Those insights can then be used to describe user behavior and to design security and privacy actions in such a way that psychological need fulfillment is maximized. How security and privacy actions need to be designed in order to achieve this is an interesting research question for future studies.

Interestingly, in the post-hoc analyses, the need for Security did not show to be of special influence for any of the investigated actions. A possible explanation is that in the questionnaire which was used in the study, the Security definition is broader and encompasses, besides the aspect of protection, also the aspect of routine and structure as a source for feeling secure. While users might associate the first aspect - being safe from threats - with smartphone related security actions, this might not be the case for the second aspect - the daily routines.

Need fulfillment for all actions was rather low with most of the mean values being below 3.0 (cf. Table 1-3). This suggests that security and privacy actions on smartphones may profit from new design methods which target higher need fulfillment.

For some of the actions the results were inconclusive, i.e. it was not possible to identify which needs mainly influence those actions. A possible explanation is that we asked participants about general need fulfillment for an action which might have been difficult to recall. In future studies, we will ask for concrete situations and contexts (e.g. location, alone vs. social, etc.). Thereby, future studies might also benefit from other study methods such as the experience sampling method (ESM) or diary studies as they may provide better insights into participants' everyday practice compared to an online study.

As the sample size of the study was rather small and slightly biased towards male participants and students, generalizations of the results should be made with caution. We plan to conduct further studies with a more diverse and larger sample. As our set of security and privacy actions was limited, we further plan in future studies to consider more actions.

Acknowledgements

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