Understanding User Preferences towards Rule-based Notification Deferral

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Abstract
Mobile devices generate a tremendous number of notifications every day. While some of them are important, a huge number of them are not of particular interest for the user. In this work, we investigate how users manually defer notifications using a rule-based approach. We provide three different types of rules, namely, suppressing, summarizing once a day, and snoozing to a specific point in time. In a user study with 16 participants, we explore how users apply these rules. We report on the usage behavior as well as feedback received during an interview. Last, we derive guidelines that inform future notification deferral systems.

Author Keywords
Mobile Notifications; Rule Based Deferral.

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous

Introduction
Notifications are a popular tool to inform the user about new information or scheduled events on the mobile phone. Myriads of mobile applications make use of notifications to attract the user's attention [6] to incoming messages (e.g., email, instant messaging), events on social networks, calendar entries, or running processes as well as software

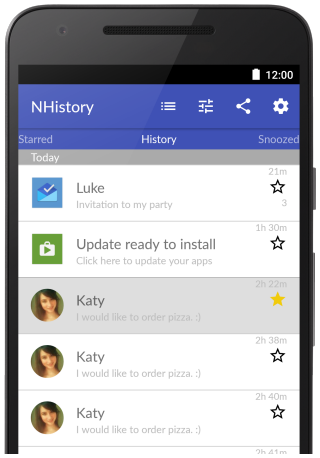

Figure 1: List of notifications a user has received.

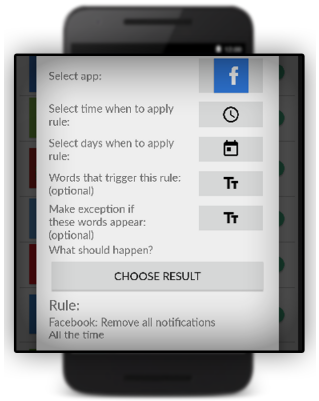

Figure 2: Rule that suppresses notifications from Facebook with no exception.

updates and reminders [8]. The concept of notifications is derived from classical desktop environments in which, for example, users get notified about incoming emails. In the desktop setting, users are mainly actively interacting with the computer when receiving notifications [9]. In contrast, the user is notified on mobile devices all day long even when the user is not actively interacting with the mobile device [10]. Thus, managing notifications to not continuously disturb the user is a crucial task. Simply disabling notifications entirely is no suitable solution [7]. Various approaches exist that aim to find out opportune moments to present these notifications [1, 3, 4, 5]. In contrast to them, we revisit notification rules known from traditional email tools. Rules are user-defined ways of automatically handling incoming notifications. For emails, they are mainly used to automatically move certain emails into specific folders. In the mobile domain, however, the understanding of how users want to handle such kind of rules still needs to be explored. Approaches such as *PrefMiner* exist that automatically try to generate rules for mobile notifications based on the former user behavior [2]. In contrast, we focus on the user's intention and explore the actual reason for defining specific rules to gain a better understanding of the user's preferences with regards to notification deferral rules.

In this work, we explore how users create notification deferral rules on mobile phones. We developed a mobile application allowing to create three different types of rules. These rules allow to suppress incoming notifications, show them in a daily summary, or postpone them to a certain point in time. In a user study with 16 participants, we investigate how users create rules on mobile devices and what their intention is. We show that most rules are created for instant messages, system notifications, and email. From the conducted interviews, we derive guidelines for future notification deferral systems.

Notification Rules

We created an Android app that records and lists all notifications that are received on the user's smartphone (cf., Figure 1). In this app, the user can create *Notification Rules* that will automatically apply to new incoming notifications. The app supports three types of actions for *notification rules*: One type of *notification rule* can suppress incoming notifications automatically, delay incoming notifications to a specific point in time, or add the notifications to a daily summary that is displayed to the user once a day.

The user can access the summary either through the app or by clicking on a summary notification issued at a specified time. The default time when the summary reminder is triggered is at 8 pm. However, the user can adjust this time to his or her liking. In this summary, all apps that issued a notification are shown (cf., Figure 5). The user can access all notifications of a particular app through this overview by clicking on one of the app listings (cf., Figure 6).

Rule Anatomy

A *notification rule* consists of two mandatory elements and additional options that the user can specify according to his or her needs. First, a *notification rule* must be applied to a specific application that is installed on the user's smartphone. Second, the user must choose the type of the *notification rule* as suppressing the notification, delaying the notification to a specific point in time, or adding the notification to the daily summary.

The user can choose additional options to define a *notification rule*. First, the user can define time slots when the *notification rule* is active. The user could, for example, choose a time range from 9 am to 5 pm from Monday to Friday since the user is at work during these time slots. If no time slots or day(s) are specified, the rule is always applied. Second, the user can also define words that are included

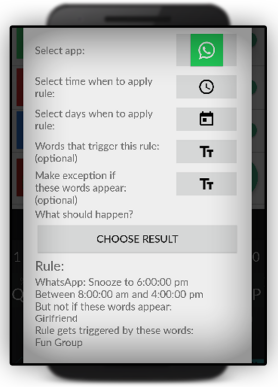

Figure 3: Rule that snoozes notifications from WhatsApp under particular conditions.

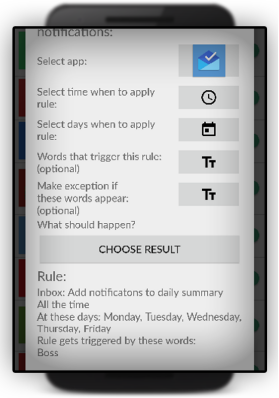

Figure 4: Rule that adds email notifications to the notification summary if they contain specific words.

in the content of a specific notification (e.g., “Candy” or “Crush”). In this process, the user can distinguish between *trigger words* and *exempt words*. A *notification rule* is applied to a notification if the notification contains at least one of the words specified as *trigger word*. However, if the notification also contains a word that was defined as *exempt*, the rule will be not applied, and the notification is shown to the user as usual.

During the creation process of a *notification rule*, we display a textual description of all details of the created rule. Figure 2 displays a defined *notification rule* that suppresses incoming notifications from *Facebook* automatically at any time. In addition, Figure 4 shows a specified *notification rule* that automatically adds a notification to the daily summary if the notification is received at a working day and the content of the notification contains the word “Boss". Finally, Figure 3 displays a *notification rule* that delays an incoming notification from WhatsApp. An incoming WhatsApp notification is delayed to 6 pm of the current day if the notification contains the word “FunGroup” and the notification is received between 8 am and 4 pm. However, if the notification also contains the word “Girlfriend” the rule will be not applied. A snoozed and then redelivered notification uses the same cues as the original notification (e.g., same audio and vibration pattern). The notification content is the same as in the original notification as well. The app supports that users create more than one rule for one particular app. Our app combines the rules when it checks them against an incoming notification. If two different *notification rules* to delay a notification apply to the same notification, it is delayed to the earliest point in time specified by the rules. Further, rules that delay notifications or add them to the notification summary do not suppress the appearance of them in the status bar of the user’s device. If the user desires to suppress notifications that are delayed or added to the summary by corresponding rules, he or she has to create an extra suppress rule for that with a similar configuration. Note that the user is always able to access all notifications through the app. This is to achieve a more flexible rule concept.

Study

In this study, we investigated how users create rules that automatically handle their incoming notifications and how they apply rules to incoming notifications.

Participants and Procedure

We invited 18 participants through University mailing lists and personal contacts. Due to technical issues, we excluded two of them and did not take them into account for the evaluation. The remaining 16 participants (14 male, 2 female) were between 17 and 60 years old ($M = 29.8, SD = 11.3$ years). Our participants had technical backgrounds such as computer science, engineering, or chemistry.

We invited the participants to our lab and asked them to fill in an informed consent form. Afterwards, we installed the application on their mobile phones. We first instructed each participant on how the application works. This includes how rules can be generated and how each *notification rule* concept exactly works. Instructing the participants took about 30 minutes on average. We asked them to use the app for one week in their daily life. After the participants used the app for a week, we conducted semi-structured interviews to collect feedback on their rule creation behavior. We particularly focused on finding reasons why rules were created, how they were configured, and how the participants perceived their notifications after the rules were activated.

Results

All 16 remaining participants created in total 103 *notification rules* ($M = 6.44, SD = 3.79$ per participant) for 43

	App Cat. (#Rules)	#TW	#EW	Active Hours	Days
Suppressing	SMS/IM (11)	3.36 (9.39)	1.09 (2.35)	2.27(3.77)-22.35(2.67)h	0, 4, 0, 7
	System (10)	1.30 (2.15)	0	0-24h	0, 0, 0, 10
	Tool (9)	0.89 (1.52)	0	0-24h	0, 0, 0, 9
	Email (5)	1.00 (0.63)	0.40 (0.80)	0-24h	0, 0, 1, 4
	Social (4)	0	0.25 (0.43)	0-24h	0, 0, 0, 4
	News (3)	3.00 (4.24)	0	0-23.66(0.46)h	0, 0, 0, 3
	Media (2)	0	0	0-24h	0, 0, 0, 2
	Game (2)	0	0	0-24h	0, 0, 0, 2
	Calendar (1)	0	0	0-16h	0, 1, 0, 0
	Shopping (1)	0	0	0-24h	0, 0, 0, 1
Summary	SMS/IM (11)	0.55 (0.78)	0	0-24h	0, 2, 0, 9
	Email (4)	2.75 (2.95)	0.50 (0.87)	2.00(3.46)-22.49 (2.59)h	0, 1, 0, 3
	Calendar (3)	0	0	0-24h	0, 0, 0, 3
	News (2)	3.00 (3.00)	0	4.00(4.00)-20.99 (2.99)h	0, 0, 0, 2
	Social (2)	0	0	0-24h	0, 0, 0, 2
	System (2)	0	0	0-24h	0, 0, 0, 2
	Tool (2)	0	0	0-24h	0, 0, 0, 2
Snooze	SMS/IM (13)	0.23 (0.58)	1.77 (2.36)	4.66(4.71)-15.46(6.62)h	2, 6, 0, 5
	Email (5)	0.20 (0.40)	1.40 (1.20)	7.40(6.56)-13.50(5.42)h	0, 4, 0, 1
	System (5)	0.40 (0.49)	0.20 (0.40)	0.00(0.00)-23.79(0.39)h	0, 0, 0, 5
	News (4)	4.50 (4.98)	0	0-24h	0, 0, 0, 4
	Media (1)	0	0	0-24h	0, 0, 0, 1
	Social (1)	0	0	15.00(0.00)-05.00(0.00)h	0, 0, 0, 1

Table 1: Overview of the generated rules for the three categories suppressing, summary, and snooze. App category and number of used *trigger words* (TW), number of used *exempt words* (EW), rule *activation times*, and *active weekdays* rule distribution (# rules active on a single day, weekdays, weekend, whole week).

different application categories within one week. Overall, 48 rules were created to suppress notifications automatically from 28 different applications, 26 rules were created to add notifications from 18 different applications to the notification summary, and 29 rules to snooze notifications from 15 different applications to a specific time. We present an overview of the created rules in Table 1.

Interviews

In this section, we present the qualitative feedback from our participants gathered during the interviews. We grouped the feedback based on the three different types of rules.

Suppressing Notifications. The suppressing notifications rule was mainly used to block notifications that annoy the participant. Participants used this rule to suppress chat notifications from group chats. Thereby they used the group name as a *trigger word*. Similarly, they also used this type of rule to avoid being disturbed during work through SMS/IM notifications. The participants used names of specific people as *trigger words* to remove their notifications. Further, they used *exempt words* to still receive important information about a particular subject. They reported that they were less annoyed and more concentrated. To remove email notifications, several participants created corresponding rules. Their intention was to remove spam email notifications. They used buzz words which are most likely included in spam emails as *trigger words*. They reported to be less annoyed, and that spam email notifications could be reduced. Seven participants that created a suppress rule stated that they wanted to remove system related notifications. Five of them said that they are annoyed by these notifications.

Notification Summary. Eight of the 16 participants created at least one summary rule. They mainly created these

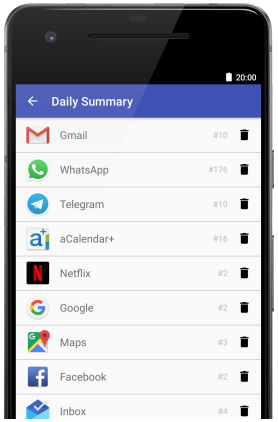

Figure 5: The notification summary with a list of apps of which at least one notification has been stored in the summary.

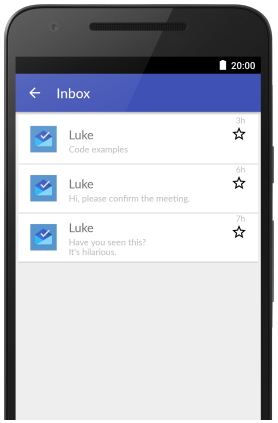

Figure 6: All notifications of an email app that are stored in the summary.

rules to add IM notifications to the summary. As a reason, they stated that they desired an overview of messages which they received during the day. Most participants preferred receiving this summary in the evening to reflect back on the notifications received throughout the day. Further, they argued that they do not need to switch to the app that issued the notification when reviewing the correspondence with one particular contact. Over-viewing notifications was mainly the reason why the participants created rules for calendar, social, update, and fitness notifications. The most common reviewing time was in the evening. The participants also stated that the summary supported them to remember events that occurred during the day. One participant created a suppressing rule to remove all notifications from a specific contact. To review these notifications later, this participant used the notification summary. Thus, the participant combined both types of rules.

Snoozing Notifications. For SMS/IM notifications participants created rules to snooze corresponding notifications to the evening. Group chat notifications or chat notifications from specific contacts were automatically snoozed to the evening to avoid distraction during the day or at work. Therefore, the group or contact name was used as *trigger words*. Further, the participants specified time ranges for the rules so that they apply when they are at work. As a benefit of the rules, they stated that there was no need to look for chat notifications manually. Some participants created rules that snooze notifications that are received at night to the next morning. As a reason, they wanted preserve night rest. Further, the participants appreciated being in control of the time when notifications are delivered. Rules that snooze email notifications were created to be reminded of private emails after work and work-related emails during working hours. Therefore, the participants used time ranges to configure the rules. Notifications were automatically snoozed to the evening if they were private or to the next morning if work-related emails were received after finishing work. The participants appreciated being reminded of these emails automatically. To distinguish between work-related and private emails, the participants configured the rules with work-related and private-related *trigger words*.

Implications

We extracted the following implications from the conducted user study.

1: A notification summary can provide a benefit to the user. From the qualitative feedback we learned that for many notifications the participants received throughout the day, it is sufficient to review them once a day. Users preferred reviewing them mainly in the evening. The participants in the study used this mechanism to avoid being distracted.

2: Users desire a fine-grained control of incoming notifications. The participants used buzzwords that occur in spam emails or names of contact or chat groups to suppress particular notifications from SMS/IM or email apps. Particularly contact names and chat groups, as well as system notifications, are the ones users prefer to defer. The participants configured notifications rules with a variety of *trigger* and *exempt words* to apply a fine-grained deferral to their notifications. Being in control of notification selection was highly appreciated.

3: Notification acceptance is related to the time of the day. To receive notifications when they are appreciated, the participants configured time ranges for particular apps to deliver notifications. The evening was chosen by many participants as a suitable time for several types of notifications. Further, participants created rules that only apply during

either the weekend or weekdays. Being in control of notification delivery time was appreciated.

4: A dedicated place to overview notifications is desired. Several participants desired a dedicated place where notifications are stored permanently and can be reviewed at any time. This also includes notification summaries presented once a day.

Conclusion

In this work, we investigated how notification deferral rules are created by users. We explored three different types of notification rules and provided quantitative as well as qualitative feedback on the user's usage behavior. Based on the finding from the study, we derived four implications that help designing notification deferral systems in the future.

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