Wake-Up Task: Understanding Users in Task-based Mobile Alarm App

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ABSTRACT

Popular alarm apps are offering task-based alarms that do not allow the user to dismiss an alarm unless they complete a specific task (e.g., solving math problems). Because such wake-up tasks cause discomforts, their usefulness and necessity could vary among individuals and their context. In this work, we aimed to understand the characteristics of Alarmy (task-based alarm app) users who (dis) likes wake-up task in terms of alarm set usage. We grouped 8,500 US users into three according to the proportion of the task selection and investigated group-wise usage differences. We found significant usage differences among the groups in terms of (1) set frequency, (2) set time, and (3) set consistency, possibly caused by consistent needs and task difficulty. The results suggest promising directions for inconvenient interaction and behavior change research.

KEYWORDS

Mobile Alarm; Alarmy; Wake-Up Task; Inconvenient Interaction; App Usage Behavior

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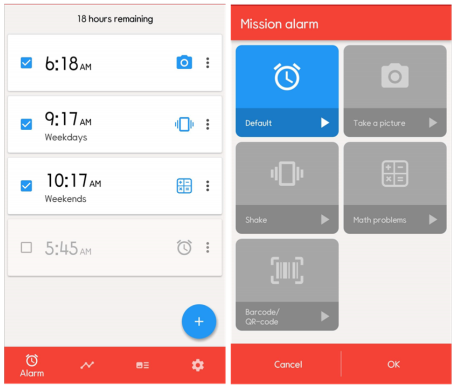


Figure 1: UI of Alarmy App

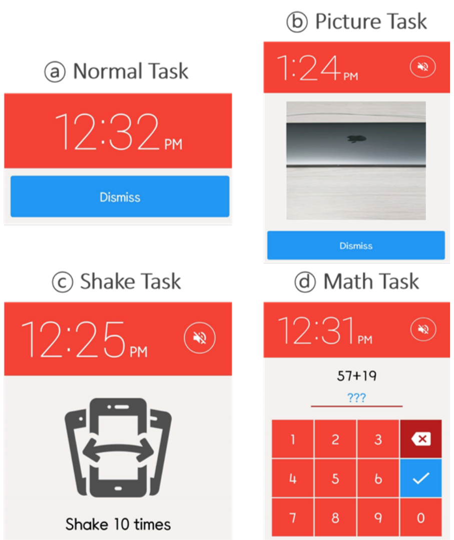


Figure 2: Dismissal Tasks in Alarmy

INTRODUCTION

The use of mobile alarm apps has grown due to the spread of smartphones [8, 11]. Interestingly, popular apps are offering task-based alarms that do not allow the user to dismiss an alarm until they complete a specific task. For example, some alarm apps ask the user to solve math problems or to take a picture of a self-designated place. These tasks certainly aggravate users by enforcing cognitive and physical efforts. Even so, many users prefer to conduct such tasks because they want to get up at the right time. In this paper, we will refer to mobile alarm app tasks for waking people up *wake-up tasks*.

Unique usage contexts of mobile alarms are well linked to the four principles for inconvenient interaction suggested in [12], and this may lead to effective wake-up tasks. For example, awakening on time with mobile alarms can provide *long-term benefits* such as having better wake up habits or rhythm of life. Also, awakening in bed is a daily behavior, which satisfies the second principle, *connecting everyday necessities*. Next, most mobile alarm apps including Alarmy provide diverse types of wake-up task and enable users to find a *balance between the benefits and the difficulty*. Finally, awakening by mobile alarm may provide *immediate satisfaction* because awakening can positively affect daily schedule and performance.

The wake-up task can be an empirical case of inconvenient interaction [12] (or uncomfortable interaction [2, 4]), but we also note another side that typical users who prefer a traditional dismiss method (i.e., touching a button) still exists. While prior studies [1, 3] addressed individual difference can affect the effectiveness and acceptance of inconvenient interaction, but it is still questionable how users show different behaviors over inconvenient interaction. In this work, we attempt to understand alarm app usage behaviors regarding the inconvenience imposing wake-up tasks.

For doing this, we analyzed data from Alarmy, which is the most downloaded alarm clock app in 97 countries. We analyzed 8,500 US users' alarm app usage logs from January to May 2018, and these log data contains set and dismissed alarm events. We first present general alarm usage behavior based on eight variables in three categories: (1) set frequency, (2) set time, and (3) set consistency. Then, we grouped the users into three according to the proportion of their wake-up task use and investigated the differences in app usage among them. The results show that there were statistically significant differences in alarm set usage by the different user groups.

RELATED WORK

A majority of typical user interaction aims at reducing task time or effort to make us feel comfortable, but we can also find intentional discomforts and their necessities in our life [6]. Bungee jumping and roller coasters can be typical examples of intentional discomforts for entertainment [2]. Prior HCI studies have addressed the usefulness of inconvenient interaction in diverse domains. For example, inconvenient interaction can help develop technical skills [5, 7]. Kitagawa [7] has sought to improve user capabilities by incorporating inconvenient interactions into the navigation system. Also, Kawagami [6] addressed the benefits of inconvenient for emotional design, for example, assembling

Table 1: Alarm Set Usage Variables

Variable	Description
Set Frequency	
freq_use_days	The num. of the days using the alarm
avg_daily_alarm	Avg. number of alarms in a day
Set Time	
avg_ring_hour	Avg. of ringing hours
prop_weekday	Proportion of alarms set for weekdays
prop_in_30m	Proportion of the alarms set within 30 minute interval
Set Consistency	
sd_daily_alarm	SD of the number of alarms in a day
sd_ring_hour	SD of ringing hours
prop_recur	Proportion of the number of alarms set to recur weekly

the assembly kit instead of buying the finished electronics can increase a user's feeling of accomplishment and confidence. Furthermore, some studies showed the helpfulness of inconvenience in cognitive tasks such as transformative learning [4] or idea generation [10].

In this study, we investigate inconvenient interactions in a mobile alarm app, a widespread and practical application that many people start their day with it. Also, while most of the prior studies have focused on discovering a new type of inconvenient interactions and exploit their potential benefits. However, little is known about in-situ behaviors with the mobile system imposing discomforts. This study attempts to expand existing discussions on inconvenient interaction by analyzing a large number of alarm usage logs.

ALARMY DATA

In this work, we analyzed Alarmy, which is the most downloaded alarm clock app in 97 countries. Alarmy provides alarms with wake-up tasks, and the user is forced to perform a set task to turn off alarm sounds. Users can choose one of five dismiss methods for an alarm. The first one is touching a button. This method is the conventional method for alarm dismissal, and its task load is likely low. There are four other dismiss methods based on the wake-up task: (1) taking a picture of a particular place, (2) shaking the device, (3) solving math problems of addition and multiplication, and (4) scanning a QR code. These wake-up tasks require physical or cognitive efforts and users must specify detailed settings in advance. For example, a user can specify the difficulty of the math problems or the number of shakes. For the tasks of taking a picture and scanning a QR code, the user must register an image as a reference when setting the alarm.

In collaboration with the Alarmy provider, we accessed anonymous app usage log data from January to May 2018. The log data contains app installation id, alarm set information (e.g., ringing time, type of tasks, set to recur) and dismiss information (e.g., dismissing time, the number of snoozes) without any identifiable personal data. In order to examine the long-term behaviors, we targeted the population whose usage period (max - min of use date) is at least five months. A total of 8,500 users from the population were randomly selected and their usage logs were shared for this study. The sample size was determined based on the population size and 1% of the confidence interval.

We considered three categories to represent individual usage: (1) Set Frequency, (2) Set Time, and (3) Set Consistency. We measured eight variables in the three categories as shown in Table 1. Our statistics in Table 2, 3, 4 show general alarm usage behavior. First, we found that Alarmy users likely use alarms every day. The number of days with the alarm(s) was about 108 days on average, indicating that their alarm use tends to be frequent because we limited the period for the analysis (i.e., 108/150 days). The use frequency in a day was 1.6, showing that just one or two alarms were typically fired in a day. Second, the users' alarms were concentrated in the morning hours on weekdays, and 24% of the alarms had interval within 30 minutes. Third, most of the alarms (75.4%) of a user were set to recur weekly, but the ringing hours and the number of alarms in a day tended to be varied.

Table 2: Set Frequency

Variable	Mean	Median	SD
freq_use_days	108.7	111.0	25.7
avg_daily_alarm	1.72	1.62	0.63

Table 3: Set Time

Variable	Mean	Median	SD
avg_ring_hour	7.49	6.83	2.73
prop_weekday	0.83	0.83	0.11
prop_in_30m	0.23	0.14	0.23

Table 4: Set Consistency

Variable	Mean	Median	SD
sd_daily_alarm	0.61	0.62	0.34
sd_ring_hour	2.22	1.77	1.67
prop_recur	0.76	0.96	0.36

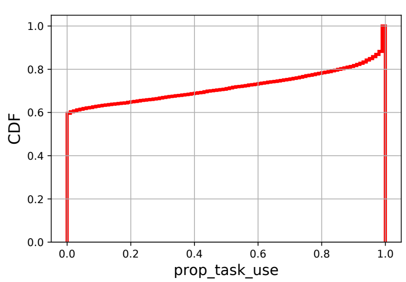


Figure 3: CDF of the Proportion of Wake-Up Task Use

USAGE PATTERNS OVER WAKE-UP TASK SELECTION

We observed that the proportion of wake-up task use was varied depending on an individual. The cumulative distribution function (CDF) of wake-up tasks usage ratio is shown in Figure 3. On average, 28.9% of the total alarms by each user were based on wake-up tasks. 41.2% of the users used wake-up tasks at least once, while 58.8% never used wake-up tasks at all.

To understand how usage patterns differ depending on the task preference, we first divided the users into three groups according to the proportion of the wake-up task use: (1) *normal group* who likes to use the normal dismiss method, i.e., touching a button ($n = 4989$), (2) *task group* who likely select the wake up tasks such as taking a picture or solving math problems ($n = 2663$), and (3) *mixed group* who selectively uses one of the dismiss methods ($n = 848$, The mixed group users chose the wake up task with a chance of 58.9% on average). Next, we performed a series of Kruskal Wallis H tests on the usage variables (i.e., set frequency, set time, and set consistency). We adopted the non-parametric method, considering the unequal sample sizes of our dataset. Dunn test was used as post-hoc test for multiple comparisons.

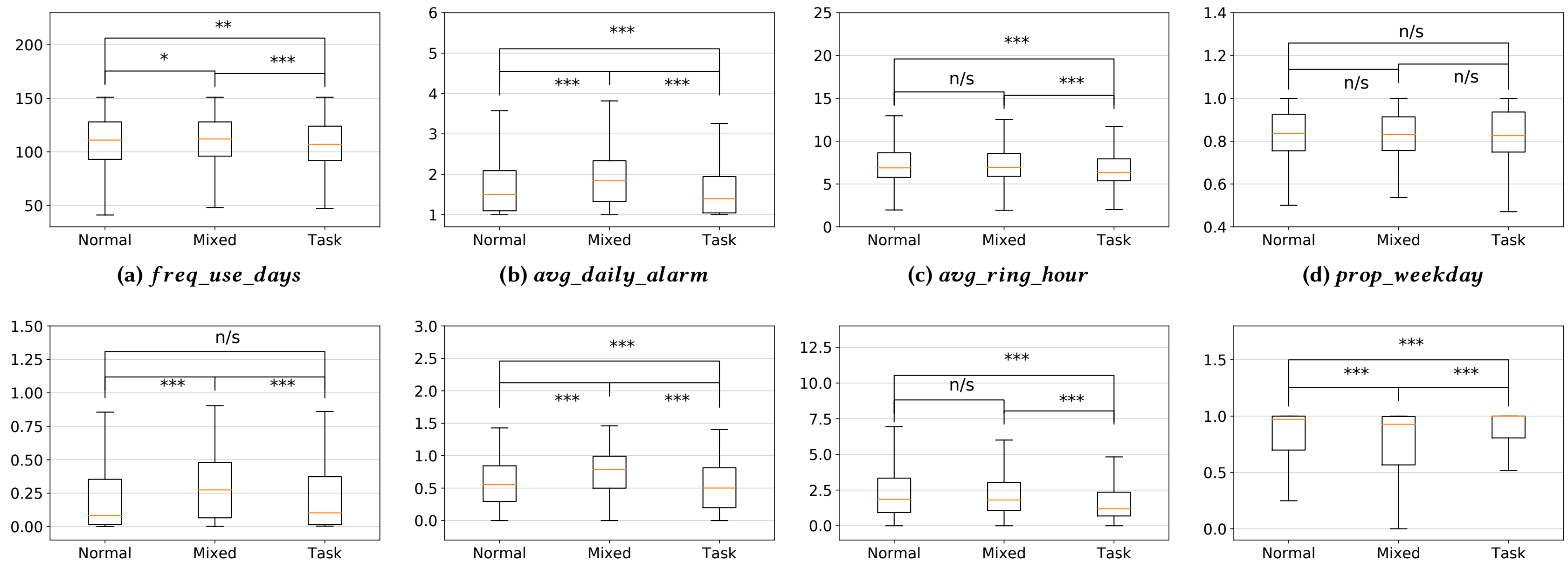
Figure 4 presents our hypothesis test results. First, we found a significant difference in the set frequency variables by different user groups (*freq_use_days*: $\chi^2(2) = 17.33$, $p < 0.001$ and *avg_daily_alarm*: $\chi^2(2) = 312.25$, $p < 0.001$). The post hoc test results show that the mixed group tended to set alarms most often, and the task group had the lowest value.

Next, there were statistically significant differences in the alarm set time. The task group's ringing hours tended to be earlier than those of the other groups (*avg_ring_hour*: $\chi^2(2) = 51.20$, $p < 0.001$), and the mixed group set alarm more frequently within short intervals (*prop_in_30m*: $\chi^2(2) = 379.65$, $p < 0.001$). However, we could not examine any significant difference in the proportion of alarms set for weekdays ($\chi^2(2) = 3.92$, $p = 0.141$).

Finally, the results reveal the statistically significant difference in the set consistency variables. Overall, the task group tended to show strong consistency in the alarm set behavior. The task group users more likely use recurred alarms compared to those in the other groups (*prop_recur*: $\chi^2(2) = 149.54$, $p < 0.001$). Also, the task group showed relatively lower variability in the frequency and ringing hours of the alarms (*sd_daily_alarms*: $\chi^2(2) = 449.22$, $p < 0.001$ and *sd_ring_hour*: $\chi^2(2) = 119.71$, $p < 0.001$).

DISCUSSION AND FUTURE WORK

First, our study reveals that the task group's usage tends to be consistent relatively more than those of other groups. The users in the task group had regular needs of strong alarm settings possibly because of their repeated schedules (e.g., going to work), considering that most of the alarms were concentrated in the morning hours on weekdays. This is well linked to prior studies. For example, daily lifestyle affects awakening patterns [9]. In addition, the wake-up task could attract these users because these were fitted to everyday necessity, one of the key principles for inconvenient interaction [12].



(a) *freq_use_days* (b) *avg_daily_alarm* (c) *avg_ring_hour* (d) *prop_weekday*

(e) *prop_in_30m* (f) *sd_daily_alarm* (g) *sd_ring_hour* (h) *prop_recur*

Figure 4: Differences in Set Usage Behavior by Different User Groups (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

Second, our study addressed that the difficulty of the main task (e.g., awakening), as well as its necessity, should be considered in designing inconvenient interaction. In our study, the more difficult contexts (e.g., early hours) for awakening were given, the more difficult tasks tended to be preferred. The difficulty of the task can help users to overcome a given challenge. This is possibly because the main task and inconvenient task in the mobile alarm context were closely related.

Finally, we would like to note that this study has the potential for contributing to mobile HCI and various aspects around behavior change support system based on inconvenient interactions. Further studies can improve understanding toward designing for more personalized and effective wake-up tasks. For example, it will deepen the knowledge regarding the alarm app users with wake-up tasks if inter-personal data such as demographics and personality can be cross-analyzed with the usage data. Also, further analysis can be performed on the wake-up task of different task types. For example, comparative analysis between solving math problems (i.e., cognitive task) and taking a picture (i.e., physical task) can deepen the understanding toward designing for more effective wake-up tasks.

Another promising direction is to analyze mobile alarm usage regarding behavior change. The alarm app includes diverse design elements of behavior change support system such as goal-setting and self-limiting. Further study can be performed toward how such elements really work in the alarm domain. Also, it will be interesting to understand how inconvenient interaction can contribute to improving behaviors. For example, it is possible to analyze whether and how a user's awakening behavior changes over time as (not) taking the inconvenience or what usage patterns are significantly related to maintaining anticipated behaviors.

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