Losing the Power of Defaults: Exploring Changing Patterns in Enabling Mobile Notifications

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Abstract
One of the primary ways that people interact with applications on their mobile phones is through notifications. However, Android and iOS treat notifications differently, one being opt-in and the other being opt-out. We explore, through two identical survey studies spaced 2.5 years apart, changing practices in choosing to enable or disable notifications for certain types of mobile applications and how the power of defaults has lessened over time. We conclude with implications for apps that wish to use notifications to increase engagement.

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Notifications, iOS, Android, Survey.

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H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
The ways that people interact with smartphones has changed dramatically since the introduction of push notifications. According to existing research, people receive an average of over 63 notifications per day and notifications are typically attended to in minutes. [7] This onslaught of interruptions has caused many people to choose to disable (or not enable) notifications for

particular applications. While several researchers have studied the quantitative patterns of notifications [7, 8], and others have addressed the increased engagement that can be gained from including notifications [1], we are not aware of any work that has quantified the notifications that people have naturally chosen to disable on the device, or that has tracked this behavior over time.

iOS and Android each have a unique way of allowing users to manage their notifications. iOS has an opt-in mechanism for each app, where users are shown a pop-up message from the application before notifications can be enabled. Importantly, this pop-up can only be shown once, and if the user declines, the app can no longer ask to turn on notifications. By contrast, the Android platform allows applications to do whatever they wish, with the general pattern being that users are automatically opted-in to notifications and must navigate to an application's specific settings page to alter these settings. The differences between the opt-in and opt-out behaviors of the two platforms raised additional research questions about actual in-the-wild settings of which applications people allow to send them notifications.

Specifically, we wanted to know:

1) Which applications do people choose to enable or disable notifications for?
2) How does this vary by operating system?
3) Have these numbers changed over time as new strategies have been developed to entice users to enable notifications?

To answer these questions, we conducted two surveys, spaced 2.5 years apart. Each survey sought to capture real-world settings on users' devices as well as demographic information. We will show significant differences between a person's choice to enable or disable notifications for a particular application on each operating system as well as show significant changes in behavior in the time between the two surveys.

Related Work

There are three main areas of background work relevant to our current research. We will first explore HCI research that focuses on interruptability and task performance when interrupted. We will then explore existing studies of received mobile notifications. Finally, we will explore related behavioral economics work on the power of defaults, which will be relevant to our discussion of differences observed between iOS and Android users.

Studying Interruptions

Czerwinski et al. [2] explored task interruptions in desktop systems. They found that after an interruption it takes users significantly longer to finish the task that was in progress compared to users who were not interrupted. They point to interruption-based prospective memory failure [11] as a main cause. While this research was conducted in the desktop work context, the findings are increasingly relevant as tasks of all types can be interrupted by a poorly timed mobile notification.

Salvucci et al. [9] explored differing types of lags that can be induced by an interruption. Both Interruption Lag (where a notification can cause the user to switch to a secondary task) and Resumption Lag (where the

person returns to their primary task after completing the secondary task) both contributed to inefficiencies compared to performing tasks sequentially. They later [10] explored the tendency for people to postpone secondary tasks when their workload was high, what they termed to be "deferrable interruptions." where less important notifications could be deferred to a time of lower workload.

Studying Mobile Notifications

Following on the desktop-based work above, other researchers began exploring notifications on mobile phones. These studies are mostly quantitative in nature and give a sense of the scope of the number of notifications that people receive each day on their devices. They also point to the tendency of people to respond to notifications quickly, a problem amplified by the types of lag identified above.

Pielot et al. [7] conducted a study capturing detailed notification data from fifteen participants showing that they received over 63 notifications per day. However, they only explored the notifications that were currently turned on and did not explore how their participants settled on the set of apps that were providing them notifications. Shirazi et al. [8] conducted a larger-scale study of over 200 million notifications from 40,000 people. As a part of their system they allowed users to "blacklist" applications to not deliver notifications to their desktop computer. However, they did not study people's existing behaviors of choosing which notifications to enable or disable on mobile phones and we will show clear differences from their data. Finally, Bentley et al. [1] explored how notifications could increase engagement in a health logging application. All of the above studies were conducted on Android. We were unable to find significant work discussing notification behaviors on iOS or comparisons between the platforms.

Costs of Defaults

Finally, in the area of behavioral economics, Madrian and Shea [5] showed the differences in behavior that people exhibit when decisions were presented as opt-in (where action is needed to take part in an activity) and opt-out (where people are automatically enrolled and need to take action to drop out). Traditional economic thought would state that people's preferences would win out in either case, and participation rates would be identical, but this work as well as later work by Thaler [12] on opt-out retirement plans with increasing contributions, and studies by Johnson and Goldstein on organ donation [4] show the power of defaults in decision making.

iOS and Android take different default stances on notification settings. iOS requires each app to ask for permission at runtime, and for users to explicitly opt-in via a dialog box. Android, on the other hand, enables notifications by default, and users must find the settings to opt-out if they would like to turn off notifications. Given the work above, we expected to see a significant effect on the notification strategies of users between the platforms.

We fill a gap in the related work by exploring current practices of enabling or disabling notifications on both iOS and Android as well as changes over time. As the existing work analyzes only notifications that are currently enabled, it misses the wide range of notifications that are currently disabled for applications that are installed on the device.

METHODS

We were interested in capturing real-world notification settings from a large number of users. To do this, we created a survey that provided users instructions on how to access the list of applications in the notifications settings on iOS or Android. On both platforms, this shows all of the installed applications and if notifications are allowed or restricted for each application on that device. The survey then displayed a list of applications (or categories of applications, such as Personal Email where a user could use Gmail, Yahoo Mail, Outlook, etc.) and asked the user two questions:

1) Do you have this application/an application in this category installed on your phone?
2) For the application in this category that you use the most, do you have notifications enabled?

We fielded this survey in February of 2016 and again in July of 2018. Each time, we used MTurk to recruit a sample of 150 diverse respondents from all over America. In the initial survey, 60% percent of participants used Android devices, while the rest used iOS, and 33% were female. Participants ranged in age from 18-65 and held quite varied occupations (e.g. receptionists, hotel clerks, engineers, plant managers, bike mechanics, accountants, musicians). In the more recent survey, 62% used Android, 36% were female, and they ranged in age from 18-65.

App Name	% With App (2016)	% With Notifications On (2016)	% With App (2018)	% With Notifications On (2018)	Change
SMS/iMessage	100%	98%	100%	88%	-10%
Personal Email	97%	72%	94%	73%	1%
Facebook Messenger	67%	63%	73%	71%	8%
Facebook	73%	62%	78%	60%	-2%
Work Email	74%	55%	65%	73%	18%
Snapchat	37%	49%	54%	64%	15%
Instagram	51%	42%	69%	60%	18%
Fitness	57%	40%	62%	42%	2%
News	55%	28%	76%	43%	15%
Coupon	45%	21%	52%	31%	10%
Shopping	61%	20%	73%	41%	21%

Table 1: Overall changes in users with each app and in their notification settings.

App Name	Android (2016)	Android (2018)	Change	iOS (2016)	iOS (2018)	Change
SMS/iMessage	98%	91%	-7%	98%	87%	-11%
Personal Email	82%	77%	-5%	58%	69%	11%
Facebook Messenger	63%	70%	7%	64%	76%	12%
Facebook	72%	63%	-9%	50%	59%	9%
Work Email	62%	82%	20%	47%	59%	12%
Snapchat	46%	64%	18%	50%	68%	18%
Instagram	46%	59%	13%	37%	64%	27%
Fitness	40%	37%	-3%	38%	50%	12%
News	25%	39%	14%	32%	50%	18%
Coupon	24%	27%	3%	17%	38%	21%
Shopping	20%	38%	18%	20%	47%	27%
Average	53%	59%	6%	46%	61%	14%

Table 2: Notification settings by operating system, with changes over time.

FINDINGS

In this section we will explore the data from the two surveys and examine how notification settings have changed in the past 2.5 years.

Study 1: February, 2016

The overall likelihood for people to have different notification types enabled is shown in Table 1. We observed a wide range of notification settings, from SMS, that 98% had enabled down to Shopping Apps which only 20% enabled. We see much higher rates of

disabling notifications on the device than Sahami et al [8] saw in their desktop platform experiment, where they saw a maximum of 10% of people disabling notifications in a given category. This was likely because participants had already disabled many of the notifications on their devices in their study and they were not able to study people's true preferences when it came to all notifications that could have been presented to them.

We found the OS-related differences to be quite interesting. While 82% of Android users had personal mail notifications enabled, only 58% of iOS users did ($t=3.21$, $p=0.002$). A similar effect was seen for Facebook notifications, where 72% of Android users had notifications enabled, but only 50% of iOS users did ($t=2.38$, $p=0.019$). As the participants in our study did not have major demographic differences between OS types, this fact can likely be attributed to the opt-in vs. opt-out nature of notifications on each platform. The Android users who would have preferred notifications off likely did not spend the time to discover how to turn them off.

We did not find a significant gender difference in the likelihood that personal mail notifications were enabled, something that we had anticipated from previous qualitative research. We did observe gender-specific differences in the likelihood to enable notifications for participants who had installed fitness apps, 60% of Women vs. 31% of Men ($t=2.48$, $p=0.017$) and shopping apps, where 38% of Women vs. 12% of Men ($t=2.48$, $p=0.017$) enabled notifications.

Study 2: July, 2018

We now turn to the newer dataset, captured in July, 2018 using the same procedures as the original survey. We can see many differences that have emerged in the time between the surveys. Before exploring notification differences, it is interesting to note from Table 1 that many applications greatly increased in popularity in this time. Specifically, Snapchat and Instagram, which were still fairly new in 2016 have become much more prevalent. Also interesting is the large increase in news applications, from 55% of our early 2016 sample to 76% of our 2018 sample. This can be due to the Apple News launch as well as increased news awareness from the fall 2016 US presidential election and its effects.

Looking at notification settings, users are receiving notifications from more applications in 2018 than they did in 2016. On average, our 2016 participants received notifications from 3.9 applications/categories on our list, and our 2018 participants received notifications from 4.8 ($t=3.48$, $p=0.0006$). We see additional changes when looking at Android compared to iOS in Table 2. Overall, both platforms showed increases in enabling notifications, but more "core" applications on Android (such as SMS, personal email, and Facebook) saw declines. iOS notifications increased more than twice as much as Android notifications over this time, a point we will return to in the discussion.

Interestingly in this dataset, several significant trends disappear from the 2016 dataset. Gender differences in shopping and fitness apps have gone away and the iOS vs. Android differences in personal email and Facebook are no longer significant, with iOS rapidly increasing and Android decreasing in percent of users with notifications enabled.

LIMITATIONS

This study was conducted in the United States. Use of notifications may differ by country and further research is needed in other countries in order to determine if these trends continue on a global scale.

We used Mechanical Turk to gain access to participants. We have found that this platform is quite reliable in understanding technology use [14], but if the types of participants that use MTurk have changed in these 2.5 years, the sample may be slightly different. The fact that the percent of users enabling personal email notifications stayed relatively constant, which we have also observed in much bigger data, helps us to have confidence in this dataset.

DISCUSSION

While the power of defaults was very clear in our early 2016 dataset, differences between iOS and Android have shrunken in the intervening 2.5 years. While iOS users have turned on notifications much more frequently, Android users have disabled notifications for core apps such as SMS, Email, and Facebook and have increased in other categories at a slower rate.

There are several key design strategies that have been implemented in this time that likely account for some of this difference. iOS developers have developed a strategy of "double prompting" – or asking for permission in an app-controlled dialog first, before using the one opportunity to show the system dialog. This allows the application to ask as many times as it would like about getting permission for notifications, instead of being limited to the one chance. More opportunities to ask then leads to a larger engagement.

In addition, applications have been getting smart about when to ask for notifications. For example, Yahoo Mail will ask after a user has sent an email, making it clear that they can get a notification when the recipient replies. Food ordering apps, such as Eat 24 ask after placing an order so that you can get updates for that order. This is becoming a common design pattern and can increase opt-in rates for notifications, especially when used in conjunction with double prompting above.

Also, some topics have become much more important since early 2016. For example, News notifications were up significantly on both iOS and Android with so much attention being paid to dramatic political changes worldwide in the past two years. Platforms such as Apple News have also gotten more aggressive about onboarding users and sending notifications on iOS.

We find it quite interesting that the power of the default on each platform has weakened over time, and that specific categories such as News saw such a large increase in install base and notifications settings in the past 2.5 years. Users are receiving more notifications now than ever, so the need to craft compelling notifications is even greater now to stand out in the crowd or buzzing that users experience throughout the day.

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