Notification Display Choice for Smartphone Users: Investigating the Impact of Notification Displays on a Typing Task

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ABSTRACT

Notification displays have the potential to make smartphone notifications easier to manage when a user is committed to a primary task. The authors investigate the impact of negotiating notifications with six notification displays on a typing task. The results from their lab experiment with 30 participants show that desktop pop-ups were preferred significantly most, the display choice that required the fewest actions to read notifications, and the most actions to respond. The notification bar was least preferred, which required the most actions to read a notification, and the fewest actions to respond. This work is a well-controlled pre-cursor to the application of notification displays in social scenarios. The results motivate the use of external notification displays to manage attention around a smartphone.

KEYWORDS

Lab Experiment, Negotiated Interruptions, Notification Displays, Smartphone Notifications, Typing Task

INTRODUCTION

Smartphone notifications provide awareness of important events and messages. However, without consideration of the context of a user in the physical environment, notifications can be distracting, and frequent interruptions can result in stress (Yoon et. al., 2014). Negotiated interruptions (McFarlane, 2002) let the user to decide the onset of an interruption, and is an approach to managing notifications that can improve attention to a primary task.

On an Android smartphone, users negotiate interruptions via the notification bar. The notification bar displays a list of recent notifications in a pull-down menu, and is always one step away when the device is in use. However, when the smartphone is not in use, the notification bar can require many actions to read the notification. Displaying notifications on the lockscreen can reduce the cost of reading a notification when the device is in hand but not unlocked. Compared to the notification bar, the cost of responding to the notification is increased, as the device has still to be unlocked. By making it simpler to consume notifications, but more difficult to act, notification display choice has the potential to encourage the user to focus on a task, and be less likely to engage in prolonged...
smartphone habits when attention is committed to a task, whether a co-located social situation or an individual typing task.

External displays create new opportunities to deliver notifications to the user. Smartwatches and smart eyewear allow users to read notifications when the device is not in hand, by looking towards the wrist or glancing upwards. Notifications can also be displayed on a monitor as desktop pop-ups, or on a situated display in the user environment. As new ways of reading smartphone notifications become available, it is important to consider the impact that they will have on attention to everyday tasks.

This work extends our study of six smartphone notification displays and their impact on attention to a typing task (Norrie & Murray-Smith, 2015b). Though in reality many notifications do not require a response or can be ignored (Sahami Shirazi et. al., 2014 and Pielot et. al., 2014), we compare an equal number to be ignored and acted on, and investigate the relative importance of each notification type on subjective opinion, performance and resumption lag.

RELATED WORK

The visual attention switch (Rashid et. al., 2012) to a private screen that is caused by a notification alert creates a barrier between smartphone users and other co-located persons or tasks. Furthermore, notification alerts can draw multiple people away from a social situation to engage with a private display (‘collateral disruption’) (Harr & Kaptelinin, 2007). Notification display choice will impact the interruption caused by managing smartphone notifications around a primary task. We review work related to interruption management and notification displays.

Interruption Management

McFarlane identified four strategies of managing interruptions (McFarlane, 1997): immediate (read the notification right away), scheduled (read at defined intervals), negotiated (read at user determined intervals), and mediated (third party decides when to read). McFarlane (2002) compares each approach to coordinating interruptions, and found that when people are forced to take immediate action, interruption tasks are completed quickly but more mistakes are made in the primary task, and more task switches are involved. In contrast, people perform very well when they can negotiate interruptions themselves, but providing control over the onset of an interruption will increase the time until the interruption task is attended to. This result motivates notification displays that support the negotiation of interruptions, and allow users to better manage the disruption to a primary task.

Notification Displays

Notification displays have been classified according to subtleness and publicity (Hansson et. al., 2001). It is considered desirable for notifications to be both subtle and public, to allow co-located people to be aware of the interruption without creating a disturbance. Private notifications are hidden to people nearby, and this can increase the risk of misinterpretation of a user’s reaction when they receive the private alert. In comparison, a public notification is transparent, and allows others to understand a response to a notification. Under this classification, auditory cues are considered public and intrusive, whereas tactile cues are subtle and private.

The Wearable Remembrance Agent (Rhodes, 1997) is a head mounted display that is considered to be both private and intrusive, since only the user can view the notifications but wearing a head mounted display can be seen as distracting to other people. NotifEye is a novel eyewear system that allows smartphone notifications to be negotiated while walking in public, using a subtle input device worn on the finger (Lucero & Vetek, 2014). Lucero & Vetek (2014) found that novel eyewear drew attention from passers-by during a study with the NotifEye system.

Notification displays that are considered to be subtle and public include: Active Wallpaper (Wisneski et. al., 1998), the Pinwheels (Dahley et. al., 1998), the Dangling String (Weiser & Brown, 1995) and the Reminder Bracelet (Hansson & Ljungstrand, 2000). A smartwatch can also be
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