Application Overchoice: Preliminary Lessons from a Longitudinal Study

Lakshmi Manasa Kalanadhabhatta
Shiv Nadar University
Greater Noida, India
lm160@snu.edu.in

Rahul Majethia
Shiv Nadar University
Greater Noida, India
rahul.majethia@snu.edu.in

Akhil Mathur
Nokia Bell Labs
Cambridge, UK
akhil.mathur@nokia-bell-labs.com

Fahim Kawsar
Nokia Bell Labs
Cambridge, UK
fahim.kawsar@nokia-bell-labs.com

Abstract

In this paper, we investigate how smartphone users navigate the dilemma of application overchoice, i.e., the scenario of having multiple competing apps available to serve a similar purpose. We analyze app installs, app usage behavior and notification attendance behavior to paint an initial picture of app overchoice and to explore how overchoice is impacted by smartphone notifications. We hope that this paper will provoke discussions and more research in the UbiTtention community on developing systems that help users navigate the dilemma of overchoice.

Author Keywords

Smartphone Engagement; Notifications; Competing Apps

ACM Classification Keywords

H.5.2 [Information interfaces and presentation (e.g., HCI)]: User Interfaces; K.4.4 [Computers and Society]: Electronic Commerce

Introduction

With an ever-increasing number of smartphone applications being available to users through various app distribution channels, app developers are increasingly able to reach a larger audience. This has made it possible for many commercial service providers to find customers through mobile apps. It has also provided a larger content consuming base for social

media platforms to reach the millions of people now owning smartphones around the world. However, the ease of reaching consumers in such staggering numbers has also brought with it severe competition among app developers.

With the high degree of *overchoice* available to them, users are free to choose from products and services brought forth by an array of providers, each with their own smartphone app. This overchoice not only affects developers but also puts the user in a dilemma. Past studies in psychology and behavioral marketing have noted that the presence of too many choices, and being bombarded by constant attention-seeking alerts from competing apps, can make individuals refrain from making the choice (purchase) at all [6, 12]. In this workshop paper, we provide an early investigation into the prominence of application overchoice among users in India, which is the second largest smartphone market in the world [3]. In particular, we study the presence of overchoice in terms of app installs and app usage. By doing so, we aim to understand whether mere availability and installation of competing apps on a user's smartphone is an indicator of overchoice, or whether actual app usage is a better metric to quantify the extent of overchoice.

As apps compete for users' attention and time, the most common strategy adopted by developers is to entice users through smartphone push notifications. These notifications serve to deliver content awareness and brand promotion, and have been explored in prior research (e.g., [8, 9]). Despite the extensive research in this space, it remains to be determined how these notifications impact the dilemma of app overchoice experienced by the users. In this work, we address some of the research questions surrounding this dilemma – Do notifications aggravate the overchoice problem, making it more confusing for users to choose an app?

What strategies, if any, do users adopt to interact with notifications from multiple competing apps?

Our findings show that a very high number of competing apps are available to, and have been installed by, the users in our dataset. However, the actual usage of apps was highly skewed towards mostly one app in each competing category. Moreover, we found that smartphone notifications are effective cues for applications that do not enjoy the primary user share in their respective category.

Related Work
App Overchoice and Competing for User Attention
The ease of entering the app marketplace today has lead to many competing apps with similar features. With the aim of finding differential features amongst such apps, authors in [11] analyzed textual reviews of top 25 apps to solve the overchoice problem for app users and help spot missing features for app developers. The competing environment has opened up avenues for app recommender systems, which have previously been evaluated on metrics of user engagement by Böhmer et al. in [2]. It has also been noted previously by authors of [15] that the official Android app marketplace, Google Play, is in fact dominated by a few key applications in terms of number of downloads, rather than a set of niche apps together amassing a significant portion of popularity. However it is important to note that, once downloaded, external cues can also affect a user's choice in the actual usage of apps. Specifically for Shopping applications, prior research on Indian consumers has suggested a purely product quality driven approach on part of the consumers, rather than consideration for other service factors [7]. It would be interesting to note whether smartphone notifications can influence this behavior, enabling businesses to gain customers on grounds other than the product quality.

App Categories

App Categories
Food Delivery (e.g., Foodpanda)
Mobile Wallet (e.g., PayTM)
Shopping-Fashion (e.g., Jabong)
Shopping-General (e.g., Flipkart)
Social (e.g., Facebook)
Transport (e.g., Uber)

Table 1: Categories of applications (and exemplar apps) considered for analyzing overchoice.

Notification Analysis

To maximize the utility of notifications, expansive research has been done on delivering them to the user at the most appropriate time. For instance, Okoshi et. al. in [9] propose a middleware to deliver notifications adaptively at breakpoints in the users' attention, which has been shown to significantly reduce users' frustration. Similarly, Exler et.al. [5] explored interruptibility based on the location context of the user. Studies such as [8] have also sought to understand the receptivity of users towards mobile notifications. To this end, interruptibility aware notification delivery has been proven to increase user engagement [10]. Research has also explored utilizing the Internet-of-Things to attract user attention by means of ambient notifications [14] and in multi-device environments [4, 13]. However, to the best of our knowledge, there has been no work exploring the direct implications of notifications on the overchoice problem, which we aim to address in this paper.

Study Methodology

Identifying Competing Applications

While application overchoice is a universal problem, it can manifest itself differently in diverse geographic domains due to social, cultural and economic differences. Therefore, in order to control for geographical variations, we focused our study on smartphone users in India. Subsequently, we identified categories of applications that tend to compete for a user's attention in an Indian app usage context, whether in terms of business distribution or time spent browsing a particular app. We focus our analysis on the six app categories mentioned in Table 1, where we observe the most prominence of competing apps.

In each of the aforementioned categories, we consider for our analysis the applications that (a) have over 500,000 Google Play downloads, (b) have been installed and are used by at least 20% of target users, and (c) have sent push notifications to users' devices that have led to at least 10 session initiations.

*Data Collection, Deployment and Participation*

We base our study on a smartphone usage dataset collected through an Android application running on smartphones with Android 5.0 and above, released on Google Play. The design choice of focusing on Android users was driven by the operating system's pervasiveness among Indian users - currently, Android commands a 97% market share in India [1]. The application runs as a background service on the participants' smartphones, collecting usage data as well as contextual information. The data points pertinent to this study included application session logs (application name, *app_open* and *app_close* timestamps) and notification logs (timestamps indicating notification *arrival*, *access* or *dismissal*, name of sending application).

After publishing the application on Google Play and soliciting participation from users on forums and mailing lists of various universities and organizations in India, we collected usage logs over a period of 8 months spread over 2016-17. Over the course of our study, we collected usage data from 215 Android smartphone users in India with ages ranging from 18 to 38 years. Of these users, we consider for our analysis only those users having more than one competing app installed from each of the defined categories listed previously. The final dataset consisted of 96323 sessions of application usage and over 44365 notifications from competing apps, collected from a group of 190 users.

Preliminary Results

Investigating Overchoice Across Categories

In order to understand the degree to which application overchoice purports itself, we first examine our participant set
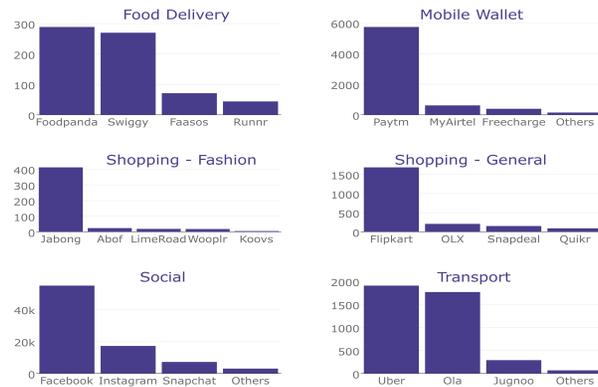
Figure 1: Distribution of Application Sessions

Figure 2: Distribution of Application Usage Duration

for installation of multiple competing applications. It was observed that 190 users (88.4%) had more than one application installed from each of the six app categories under consideration. Further, 76 users (35.3%) had three or more apps installed from each category.

Next, we investigate whether the mere presence of multiple competing apps on users' smartphones indicate that the users face an overchoice dilemma. In this vein, we study the application usage patterns (distribution of application sessions and session durations) of the competing apps in our dataset, the findings of which are shown in Figure 1 and Figure 2 respectively.

It is evident that mere installation of competing applications does not imply a proportionate usage. In fact, over 80% of sessions in the Mobile Wallet and Shopping - Fashion categories were attributed to only one application. The same is true for 78.8% of sessions in Shopping - General and 66.66% of those in Social. A slightly more competitive scenario was observed with 2 applications contributing the majority of ses-

sions in the Food Delivery (42.8% and 40% sessions from top 2 apps) and Transport (47.29% and 43.84% sessions from top 2 apps) categories. A similar pattern is exhibited in terms of the total session durations of each application across the relevant categories.

The key takeaway from this result is that while Indian users tend to install multiple competing apps on their devices, perhaps triggered by recommendations from app distribution channels (e.g., Google Play) or their social network, this does not translate into proportional application usage. As such, any study of app overchoice should take into account the actual app usage patterns, rather than the presence of competing apps on the user's device.

Impact of Notifications on Overchoice
We now proceed to investigate the influence of notifications on users' choice of application. To this end, we examine the app usage sessions initiated in response to a notification from the corresponding app. Figure 3 shows the distribution of reactive (i.e., notification initiated) sessions by to-

tal number of sessions across each category. Firstly, it is evident that reactive sessions constitute a fair percentage in the Shopping categories, with 5 applications owing more than 20% of their sessions to notifications. Interestingly, the highest percentages of notification induced sessions were exhibited by Shopping apps such as Wooplr (38.89%), OLX (37.98%) and Quikr (35.87%) which demonstrated comparatively low share of user interest in their respective categories (see Figure 1). An analysis of correlation between number of sessions and percentage of reactive sessions in Shopping applications gives a negative correlation, with Pearson's $r = -0.33$. Social applications with lower number of total sessions also demonstrate higher responsiveness ($r = -0.74$). These observations imply that notifications prove to be effective cues that draw user attention towards Shopping and Social apps with low visibility. On the other hand, multiple apps in the Food Delivery, Mobile Wallet, and Transport categories show percentages of reactive sessions as low as 1-2%, leading to the conclusion that apps in these categories are opened mostly on an "as and when needed" basis, with users not being influenced much by notifications.

Conclusion and Future Work

Our study of application overchoice and preference among Indian users provided useful insights which could be incorporated in future applications to better engage users. Firstly, we discover that while there is overchoice in terms of available apps and services, user preference tends to gravitate towards mostly one or at most two apps in each category. Secondly, we find that in some categories (notably Social, Mobile Wallet and Shopping apps), notifications tend to lead to a higher percentage of reactive sessions for lesser used apps.

It would be interesting to further study whether user context and demographic factors influence the impact of notifications
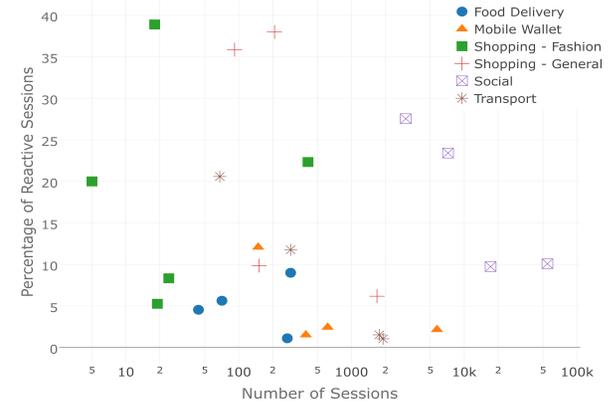
Figure 3: Percentage of Reactive Sessions by App Popularity (i.e, number of sessions, represented here on a logarithmic scale)

on user decisions when faced by scenarios of overchoice. As noted in this work, it is important to separately analyze overchoice in each category and to explore the manifestations of this situation with respect to other competing categories of applications. We hope that this work will encourage wider discussions on the possible responses to overchoice which would have the potential to shape developer decisions in the future.

REFERENCES

1. 2016. Strategy Analytics. https://goo.gl/pZJX5n. (2016). Accessed: July 15, 2017.

2. Matthias Böhmer, Lyubomir Ganev, and Antonio Krüger. 2013. Appfunnel: A framework for usage-centric evaluation of recommender systems that suggest mobile applications. In *Proceedings of the 2013 international conference on Intelligent user interfaces*. ACM, 267–276.

3. Saayan Chattopadhyay. 2017. Mobile News Apps in India. *Mobile Platforms, Design, and Apps for Social Commerce* (2017), 56.

4. Sarah Clinch, Jason Alexander, and Sven Gehring. 2016. A survey of pervasive displays for information presentation. *IEEE Pervasive Computing* 15, 3 (2016), 14–22.

5. Anja Exler, Marcel Braith, Andrea Schankin, and Michael Beigl. 2016. Preliminary investigations about interruptibility of smartphone users at specific place types. In *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct*. ACM, 1590–1595.

6. Sheena S Iyengar and Mark R Lepper. 2000. When choice is demotivating: Can one desire too much of a good thing? *Journal of personality and social psychology* 79, 6 (2000), 995.

7. Arpita Khare, Anshuman Khare, Sourjo Mukherjee, and Tanuj Goyal. 2016. Do consumer shopping styles influence consumer attitudes toward services offered by shopping websites? *Journal of International Consumer Marketing* 28, 1 (2016), 28–41.

8. Abhinav Mehrotra, Veljko Pejovic, Jo Vermeulen, Robert Hendley, and Mirco Musolesi. 2016. My Phone and Me: Understanding People's Receptivity to Mobile Notifications. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 1021–1032.

9. Tadashi Okoshi, Hiroki Nozaki, Jin Nakazawa, Hideyuki Tokuda, Julian Ramos, and Anind K Dey. 2016. Towards attention-aware adaptive notification on smart phones. *Pervasive and Mobile Computing* 26 (2016), 17–34.

10. Tadashi Okoshi, Kota Tsubouchi, Masaya Taji, Takanori Ichikawa, and Hideyuki Tokuda. 2017. Attention and engagement-awareness in the wild: A large-scale study with adaptive notifications. In *Pervasive Computing and Communications (PerCom), 2017 IEEE International Conference on*. IEEE, 100–110.

11. Faiz Ali Shah, Yevhenii Sabanin, and Dietmar Pfahl. 2016. Feature-based Evaluation of Competing Apps. In *Proceedings of the International Workshop on App Market Analytics (WAMA 2016)*. ACM, New York, NY, USA, 15–21.

12. Claudia Townsend and Barbara E Kahn. 2013. The âĂIJvisual preference heuristicâĂİ: The influence of visual versus verbal depiction on assortment processing, perceived variety, and choice overload. *Journal of Consumer Research* 40, 5 (2013), 993–1015.

13. Dominik Weber, Alexandra Voit, Philipp Kratzer, and Niels Henze. 2016. In-situ investigation of notifications in multi-device environments. In *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing*. ACM, 1259–1264.

14. Frederik Wiehr, Alexandra Voit, Dominik Weber, Sven Gehring, Christoph Witte, Daniel Kärcher, Niels Henze, and Antonio Krüger. 2016. Challenges in designing and implementing adaptive ambient notification environments. In *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing: Adjunct*. ACM, 1578–1583.

15. Nan Zhong and Florian Michahelles. 2013. Google play is not a long tail market: an empirical analysis of app adoption on the Google play app market. In *Proceedings of the 28th Annual ACM Symposium on Applied Computing*. ACM, 499–504.