



**FACULTY
OF INFORMATION
TECHNOLOGY
CTU IN PRAGUE**

ASSIGNMENT OF BACHELOR'S THESIS

Title:	Analysis and Evaluation of Common Mobile-specific Marketing Techniques
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Study Programme:	Informatics
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Instructions

The aim of the work is to improve the selected app's revenues by applying common marketing techniques used by mobile developers. After reading this work, the reader will get a grasp on what techniques are really effective regarding improving acquisition, engagement, and user's lifetime value.

1. Describe the market of Health and Fitness mobile applications.
2. Choose and explain several marketing techniques used in order to improve the app's acquisition, engagement, and monetization.
3. Analyze the approach of the top mobile applications on the market.
4. Apply the particular marketing technique on chosen product.
5. Show how exactly was the technique implemented into given application.
6. Describe the results of the methods and discuss the effect.

References

Will be provided by the supervisor.

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Prague December 16, 2018



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Bachelor's thesis

Analysis and Evaluation of Common Mobile-specific Marketing Techniques

Martin Mazanec

Department of Software Engineering
Supervisor: Ing. Petra Pavlíčková, Ph.D.

May 15, 2019

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Declaration

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Abstrakt

Tato práce se zaměřuje na vylepšení akvizice uživatelů, retence a zvýšení celkových příjmů vybrané mobilní aplikace pomocí marketingových technik typických pro mobilní aplikace. Teoretická část práce zkoumá, popisuje a vysvětluje stav mobilního marketingu a byznysu mobilních aplikací.

V práci vysvětluji vybrané marketingové metody, sdílím názory ostatních odborníků a výsledky ostatních výzkumů. Kromě toho zkoumám a popisuji, jak je využívají nejlepší mobilní aplikace na trhu. Praktická část práce spočívá v experimentování a analýze těchto technik na aplikaci Fitify Workouts & Plans – fitness aplikaci firmy Fitify Workouts s.r.o. Tyto A/B testy byly vytvořeny a vyhodnoceny pomocí nástrojů Firebase Analytics, Google Big-Query a Google Data Studio.

Klíčová slova mobilní marketing, analýza marketingových technik, monetizace mobilních aplikací, techniky pro zvýšení retence, Google Play, App Store

Abstract

This work focuses on improving user acquisition, retention and revenue of selected mobile app by applying mobile-specific marketing techniques. The

theoretical part of the study is a combination of exploratory, descriptive and explanatory research about mobile marketing and the business of mobile apps.

In the thesis, I explain selected marketing methods, share the opinions of other experts and the results of other researches. Besides that, I observe and analyze whether and how the top grossing mobile apps use them. The practical part of this work consists of experimenting and analyzing these techniques on Fitify Workouts & Plans – a fitness app developed by Fitify Workouts s.r.o. These split testing experiments were created and evaluated with the help of Firebase Analytics, Google BigQuery, and Google Data Studio.

Keywords mobile marketing, marketing techniques analysis, mobile app monetization techniques, user retention, Google Play, App Store

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Introduction

On January 9, 2007, Steve Jobs introduced the iPhone. While it was not the first smartphone, it smoothly overcame the competition and launched the mobile revolution. Eleven years passed, and smartphones became an essential part of our everyday life. Over one-third of the world's population owns a smartphone nowadays and there is no doubt that this proportion will continue growing in the next couple of years.

Average US adult will spend 3 hours and 35 minutes per day on mobile devices in 2018. Moreover, most of the mobile “screen time” is happening in mobile apps. These apps can entertain us, educate us or help us facilitate our work and we are getting used to paying for these services. The world of mobile apps and games is now a multi-billion dollar market, and it keeps growing at a breakneck pace.

I had personally joined the mobile revolution as an Android developer about three years ago. In 2016 I launched my first mobile app “Foam Roller Coach” – a simple app to train people how to stretch their body using a foam roller properly. Couple months later I founded a startup called “Fitify Workouts s.r.o.” and became a full-time mobile app developer. Since the beginning, I was in charge of the design, the content of the app and user acquisition. I have been self-educating myself about mobile marketing for about two years, and I totally fell in love with this topic. In this work, I want to share some of my knowledge I wish I have to know when building and marketing our apps.

In this work, I am going to analyze common mobile marketing techniques used to retain, engage and monetize the user. After reading this work, the reader will get a grasp on what techniques are really beneficial and what he should spend his time on. I will select common mobile-specific marketing techniques and explain each of them. I will do some research on each one and will analyze the approach of top mobile apps on the market. I will even test some of these techniques on my own product if it is possible.

The aim of the thesis

The aim of this thesis is to improve the selected app's revenues by applying common marketing techniques used by mobile developers. After reading this work, the reader should know what techniques are really effective regarding improving acquisition, engagement, and user's lifetime value. In this work, I will describe the market of Health and Fitness mobile applications. I will choose and explain several marketing techniques used in order to improve acquisition, engagement, and monetization of the selected app. I will Analyze the approach of the top mobile applications on the market and finally, in the practical section, I will apply the particular marketing technique on the chosen product and test it. For all these marketing techniques I will show how exactly was the technique implemented and describe the results of the methods to the reader.

Structure of the thesis

This thesis consists of two main parts theoretical and practical one. In the theoretical part, I will explain how the app was selected and the reasons for that. I will also briefly introduce the world of mobile apps as well as mobile business and marketing. I will also explain the tools I used to measure and evaluate the subjected marketing techniques. I will define the technology stack I needed. The metrics I was relying on when testing the performance of the given method. And also I will explain the methodology behind the evaluation process. After reading the theoretical part, the reader should be prepared to understand the results of my work, which is described in the practical part.

The practical part consists of selected marketing techniques, their explanation, and data-based testing. The techniques are ordered, by the marketing funnel chronologically. First techniques are about the acquisition of the user. Acquisition techniques are followed by techniques used to boost engagement and retention and the last group is techniques to improve monetization and lifetime value of the user. Each of the techniques is explained first. After the explanation, I am sharing the testing data and the results of my testing.

App selection

As most businesses are about data these days, it is unthinkable to expect any company giving me their data to share them publicly in my bachelor's thesis. I do not need any user-level data, but even the anonymized data like retention, conversion rates, and revenues would be extremely valuable for the potential company and for their competition as well.

I have already mentioned that I am the founder of a start-up called Fitify Workouts s.r.o. – a mobile app development company, working on mobile solutions to simplify healthy lifestyle to the general public. Therefore I can use my own mobile apps to be the subject of my testings, and as these apps are fairly successful, I can hopefully achieve good accuracy of the tests by exposing the variants to hundreds of thousand users.

By the time I am beginning this thesis, Fitify Workouts s.r.o. (hereinafter referred to as the “developer”) has 14 fitness apps with currently over 5 million downloads and over 500 thousand monthly active users. The structure of all workout apps by the developer is presented in the following table.

Table 1.1: Apps provided by Fitify Workouts s.r.o.

App Title	Downloads	Rating	Release date	Android	iOS	Monetization
Foam Roller	50-100,000	4.52	2016-03-22	YES	NO	one-time payment
Kettlebell	100-500,000	4.73	2016-10-28	YES	YES	one-time payment
Stability Ball Workouts Fitify	50-100,000	4.69	2016-10-28	YES	YES	one-time payment
Suspension Workouts by Fitify	100-500,000	4.66	2016-12-09	YES	YES	one-time payment
Abs, Core & Back Workout	100-500,000	4.76	2017-03-29	YES	YES	one-time payment
Bosu Balance Trainer by Fitify	10-50,000	4.72	2017-04-15	YES	YES	one-time payment
Resistance Bands by Fitify	100-500,000	4.58	2017-05-02	YES	YES	one-time payment
Warm Up & Cool Down by Fitify	100-500,000	4.73	2017-05-07	YES	NO	one-time payment
Legs & Butt Workout	100-500,000	4.74	2017-05-26	YES	YES	one-time payment
Upper Body Training	100-500,000	4.73	2017-06-11	YES	YES	one-time payment
HIIT & Cardio Workout by Fitify	500-1,000,000	4.74	2017-06-20	YES	YES	one-time payment
Stretching & Flexibility Routines	1,000-5,000,000	4.68	2017-07-09	YES	NO	one-time payment
Medicine Ball Workouts by Fitify	10-50,000	4.81	2017-08-12	YES	YES	one-time payment
Fitify Workouts	100-500,000	4.73	2018-05-31	YES	NO	subscription

As we can see in the table 1.1 on page 4, the most recent app is called “Fitify Workouts & Plans” (hereinafter referred to as the “Fitify App”). It is also an app the developer puts the most effort in and is continuously improving user experience and adding new features. Therefore this app is going to be the subject of my thesis.

In order to understand the context of the marketing techniques used in the thesis, let me briefly introduce the product. Fitify Workouts & Plans is an ultimate workout app featuring over 800 exercises, personalized fitness plans adapting to the user’s ability, and gamification elements making exercise more fun and challenging.

The app was released in March of 2018, and users are paying a subscription fee for certain premium features of the app. By the time I am writing this work, the app was downloaded 350,000 times, and despite having a quite aggressive monetization scheme, it maintained a very high rating of 4.74 stars on Google Play. To get a sense of how the app looks like and what are the core features, please see the following screenshot from Google Play.

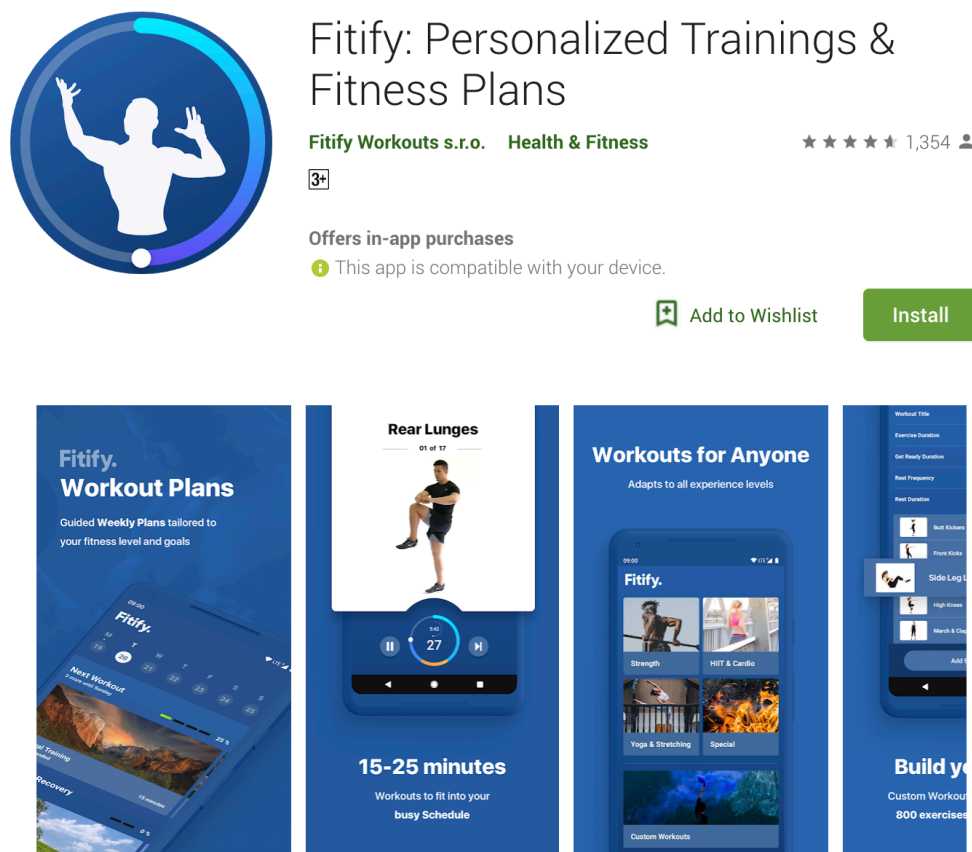


Figure 1.1: Presence of Fitify App on Google Play

Mobile business and marketing

Since the beginning of the smartphone era, the world of mobile apps was evolving, and now it seems like we have reached the point where there is basically an app for everything. According to Statista [11] there is currently about 2.1 million apps on Google Play and 2.0 million apps on the Appstore. The number of apps would naturally grow at a very high speed, however, in 2018 both Apple and Google took the necessary steps in order to decrease the number of apps available on their stores. While Apple became more strict in their manual app approval process, Google limited apps by the SDK (software development kit) version, in order to eliminate apps that were not updated for a long time.

2.0.1 Monetization of Apps

In my thesis, I will be mostly talking about freemium app monetization – more specifically about a free app with subscription payments for premium content as this is the model of the Fitify App. However, there are more opportunities developers can take advantage of:

- In-app Advertising
- Paid app (one single payment for downloading the app)
- Freemium app
 - Free app with one single payment for premium features
 - Free app with multiple payments for virtual items or virtual currency (typical for mobile games)
 - Free app with a subscription model

Of course, there are countless ways to monetize mobile apps, such as direct selling offline products, product placement, generating traffic or email handles

for your other product. Also, it is still quite common to do the black hat, and fraud techniques, like cryptocurrency mining on the background, various ad-fraud types, or even selling user’s data can be a huge business. All these monetization strategies are either not mobile app specific, or unethical and will not be used in this work.

2.0.2 Size of the app market

Nowadays, mobile apps can be installed on two dominant platforms – Android (owned by Google) and iOS (owned by Apple). In 2017, these operating system shared 99.8% of the market – 85.1% for Android and 14.7% goes to iOS [15]. However, despite having lower market share measured by active devices, iOS surpasses Android when it comes to the app revenues. According to this report by Appannie [16], the iOS App Store generates nearly twice as much revenues as Google Play. We can see how the proportion was evolving over the past few years in figure 2.1 on page 8.

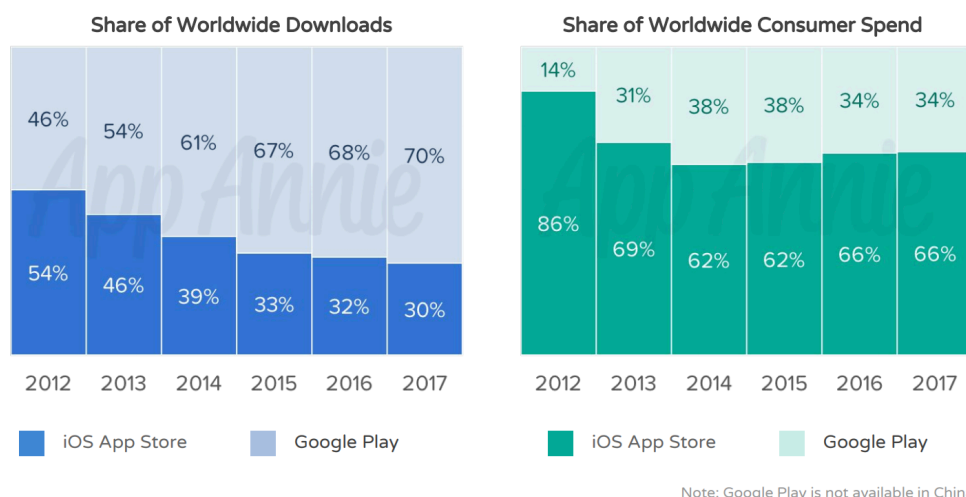


Figure 2.1: Download and revenue proportion of two major mobile stores – App Store and Google Play

Both major mobile app stores – Google Play and App Store share daily top grossing and most downloaded chart. Based on this data, app market analysis companies can estimate the relative revenues of any particular app. Furthermore, after partnering up with a couple of thousand developers who share their exact downloads and revenues, these companies are able to estimate the real revenues of these companies. Therefore they can even calculate the size of the markets pretty accurately. In this article [10], Sensor Tower shares the year on year growth of app revenues in the last two years. The most

important information from the report is that mobile apps generated *revenue of \$58.6 billion* and there was a massive year-over-year increase of almost 35 percent over the year 2016.

This does not mean that developers earned all the \$58.6 billion – before sending money to developer both Google and Apple take a 30% cut. On the other hand, there are two additional revenues that Sensor Tower cannot measure. First one are revenues coming from in-app advertising – having a banner, interstitial or even rewarded video ads is very common, especially in apps that have no In-App purchases. Another source not measured by Sensor Tower are purchases of goods and offline services – apps like eBay or Taxify have obviously huge revenues. While these revenues are being generated within the app, the payments are handled outside Google Play and Appstore. Furthermore, there are apps, such as Spotify or Head Space who also charge users outside the store in order to avoid the 30% cut. Apps leveraging these grey hat techniques are usually the top mobile apps on the market and therefore the revenue hidden from the Sensor Tower’s report [10] will play a significant role in the total size of the market.

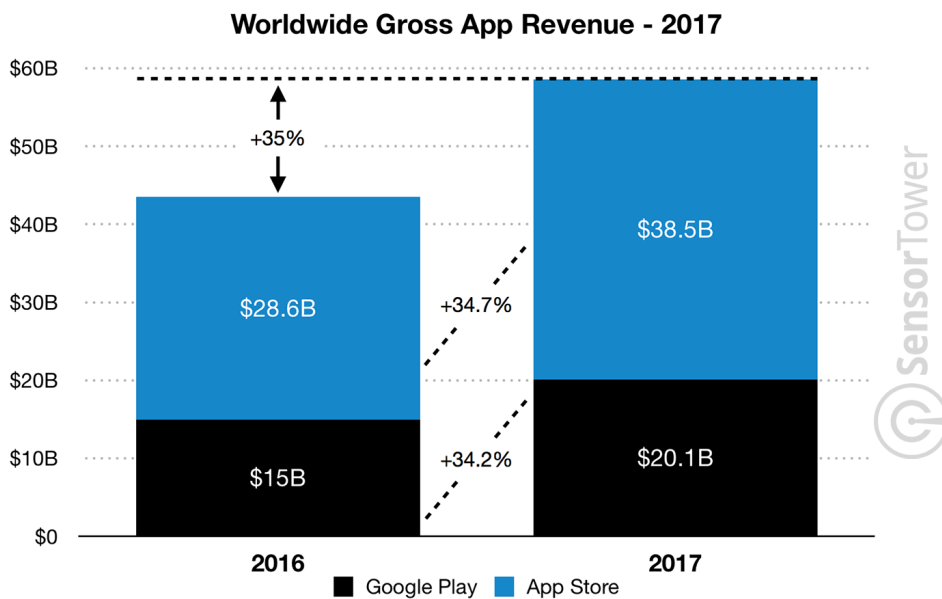


Figure 2.2: App Store and Google Play’s total revenues in the years 2016 and 2017

2.0.3 Health and Fitness Apps

As I have only been writing about the app market in general, let me also shed a light on the distribution of supply and demand over categories. At first, it is important to mention that apps can either be non-gaming apps or games. According to SensorTower [10], games represented nearly 82 percent of all mobile app revenues on Google Play. Another app store intelligence platform App Annie claims [16] this number is even higher and attaches information about the proportion of downloads – *Games account for 41% of downloads, but 88% of spend*. In the following chart, App Annie shows this numbers broke down by regions.

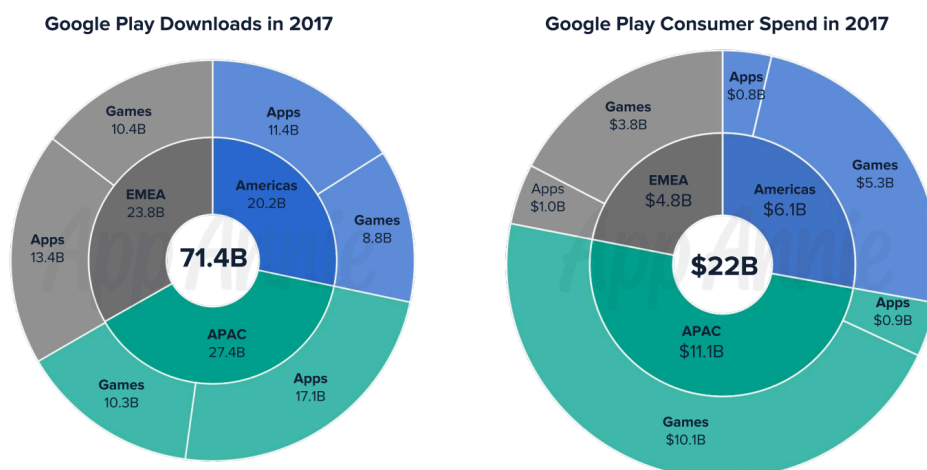


Figure 2.3: Gaming vs. Non-gaming apps performance on Google Play in 2017

In the past years, we have witnessed a precipitous growth of the whole Health and Fitness category. In the U.S. we could observe a 45% revenue growth in the last quarter. As seen in the figure below, U.S. revenue was more than 6x higher in Q1 2019 than Q1 2016. The data was captured using the premium version of Sensor Tower.

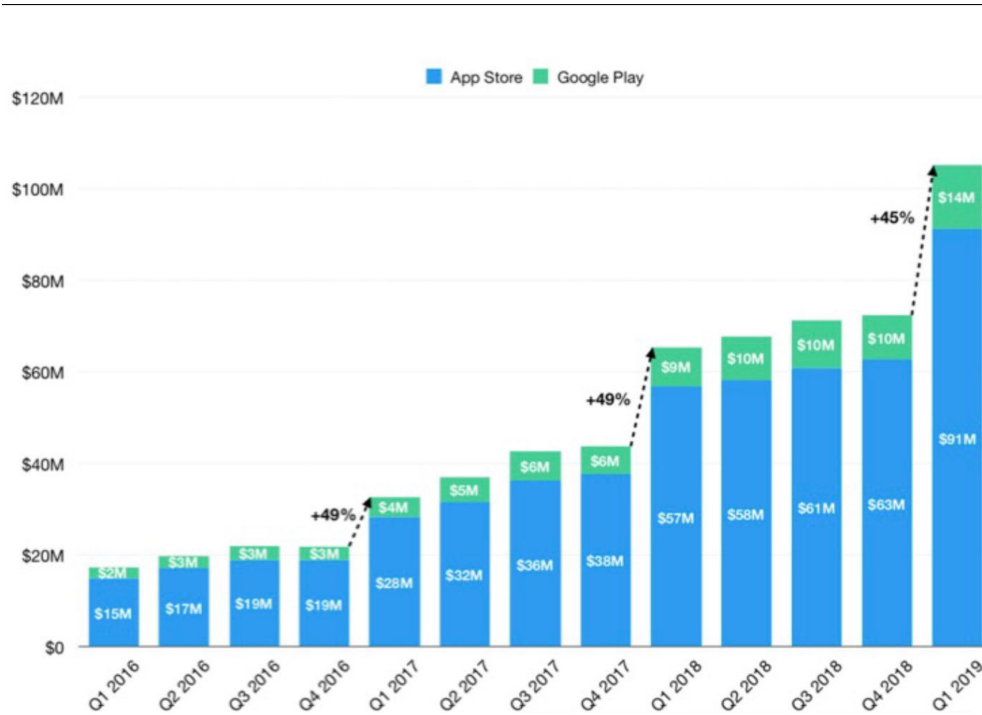


Figure 2.4: Quarterly U.S. revenue for Health & Fitness category

I have already introduced the demand for Health and Fitness apps. However, the supply was not explained yet. Regarding quantity, Health and Fitness apps are the 9th (out of 32) most represented category on Google Play. There are about 83,000 Health and Fitness apps with over 4,000 apps having over 50,000 downloads. A complete distribution based on data by is presented in the table 2.1 – the data are gathered from a report by AppBrain [9].

Table 2.1: Number of apps by category on Google Play

Category	All apps	Apps with >50K downloads
Education	219680	12627 (6%)
Business	166302	3150 (2%)
Lifestyle	164921	10485 (6%)
Entertainment	162446	16417 (10%)
Music & Audio	155650	8180 (5%)
Tools	131174	14335 (11%)
Books & Reference	126481	8531 (7%)
Personalization	112902	13273 (12%)
Health & Fitness	83389	4091 (5%)
Shopping	82379	3920 (5%)
Travel & Local	82021	3625 (4%)
Productivity	81881	4763 (6%)
Food & Drink	76010	1424 (2%)
Finance	66643	5924 (9%)
Communication	60348	3961 (7%)
Photography	59832	8400 (14%)
News & Magazines	56531	3501 (6%)
Social	52198	3582 (7%)
Sports	46816	2714 (6%)
Medical	37305	1385 (4%)
Maps & Navigation	33377	2652 (8%)
Art & Design	26833	867 (3%)
Auto & Vehicles	21142	980 (5%)
Video Players & Editors	16708	2980 (18%)
Beauty	16208	578 (4%)
Events	15420	110 (1%)
House & Home	15227	397 (3%)
Weather	9479	1357 (14%)
Libraries & Demo	7232	324 (4%)
Parenting	4206	355 (8%)
Dating	4094	486 (12%)
Comics	3575	553 (15%)

So there are over 83,000 apps in the Health and Fitness category, but are these apps actually for? The following list shows the most common types of apps from this category:

- Activity trackers (eg. Fitbit, Step Tracker, Samsung Health)
- Video workout apps (eg. Freeletics, Daily Yoga, Sweat with Kayla)
- Running and audio workout apps (eg. Runtastic, Endomondo, Aaptiv)

- Meditation and mindfulness (eg. Headspace, Calm, Simple Habit)
- Meal plan and food trackers (eg. MyFitnessPal, Mealime, Lose It)
- Sleep related apps (eg. Sleepcycle, Tide, Blue Light Filter)
- Other

To get a sense of the revenue and download distribution for these types of apps, see the table 2.5 of most downloaded and top grossing apps in US(United States) Google Play by Sensor Tower [18]. Please note Fitify belongs to the video workout apps category as well as BetterMe, Sweat, and Freeletics – three of the top 10 grossing apps in the table.





















	Free	Top Grossing
1	 Fitbit, Inc. Fitbit ★★★★★ (383,343)	Free +2  MyFitnessPal, Inc. Calorie Counter - MyFitnessPal ★★★★★ (1,959,766)
2	 Headspace, Inc. Headspace: Meditation & Mindfulness ★★★★★ (82,255)	Free  Headspace, Inc. Headspace: Meditation & Mindfulness ★★★★★ (82,255)
3	 Samsung Electronics Co., Ltd. Samsung Health ★★★★★ (582,250)	Free -2  Calm.com, Inc. Calm - Meditate, Sleep, Relax ★★★★★ (126,964)
4	 Calm.com, Inc. Calm - Meditate, Sleep, Relax ★★★★★ (126,964)	Free  FitNow, Inc. Lose It! - Calorie Counter ★★★★★ (72,719)
5	 Sweatco Ltd Sweatcoin Pays You To Get Fit ★★★★★ (55,716)	Free  Strava Inc. Strava Training: Track Running, Cycling & Swimming ★★★★★ (370,281)
6	 Health Group: Fitness, Eyes Protect, Drink Water. Step Tracker - Pedometer, Daily Walking Tracker ★★★★★ (91,902)	Free  Wombat Apps LLC Carb Manager - Keto & Low Carb Diet Tracker ★★★★★ (13,330)
7	 BetterMe BetterMe: Weight Loss Workouts ★★★★★ (19,862)	Free +3  BetterMe BetterMe: Weight Loss Workouts ★★★★★ (19,862)
8	 CVS Pharmacy CVS/pharmacy ★★★★★ (152,233)	Free +1  Sweat Sweat: Kayla Itsines Fitness ★★★★★ (17,215)
9	 Health Group: Fitness, Eyes Protect, Drink Water. Relax Music - Meditation& Sleep Music, White Noise ★★★★★ (21,132)	Free -1  Freeletics Freeletics: Personal Fitness Coach & Body Workouts ★★★★★ (139,667)
10	 MyFitnessPal, Inc. Calorie Counter - MyFitnessPal ★★★★★ (1,959,766)	Free +1  Noom Inc. Noom: Health & Weight ★★★★★ (170,695)

Figure 2.5: Google Play’s most downloaded and top grossing Health and Fitness apps on 16th December 2018

Measurement and technology stack

Most of the work behind this thesis is about the measurement of each selected technique on a real product on the market, let me introduce the key observed metrics, tools, and methodology used for the purpose of this work. In order to be able to measure the effectivity of any given metric, I needed a couple of data analysis tools to work with. I am using the following 3rd party tools.

3.1 Google Analytics for Firebase

Google Analytics for Firebase is a free mobile app analytics solution based on Google Analytics – the most popular analytics tool for websites. Google Analytics for Firebase (hereinafter referred to as the “Firebase Analytics”) provides insight on how your users behave in the app. It provides unlimited data collection and also simple analytic tools in order to turn the collected data into meaningful information.

Firebase Analytics integrates across Firebase, which is already being used by the developer for various other reasons, like database, user authentication, cloud messaging, crash reporting, etc.

Data collection with Firebase Analytics

Implementation of Firebase Analytics is quite a simple process. To connect the app to Firebase, we had to add the Firebase SDK. The data collection starts automatically, and it only takes few hours to see the data in the Firebase console.

Some events, like “first_open” are being collected automatically with no extra work from the developer. You can find the list of all such events in firebase documentation [1]. However, for most developers, it is also crucial

3. MEASUREMENT AND TECHNOLOGY STACK

to send custom events for tracking. In my case, the custom events were for example “onboarding_signup,” “workout_started” or “workout_rating”.

In some cases, it is necessary to enrich the event with special parameters. For example, the “workout_started” event does not tell the full information. It only lets us know that that the user clicked the “Start Workout” button. This information is not sufficient though, as I need to know what type of workout was started, what was the duration of the workout, or what equipment was used in the workout. Therefore the event “workout_started” is being sent with parameters listed in the following table:

Table 3.1: Example of event parameters sent to Firebase Analytics

Parameter Name	Type	Description
workout_title	string	Exercise set title in English
workout_duration	int	Workout duration in minutes
workout_duration_nominal	string	Workout duration in minutes
warmup	int	1 if warmup is enabled, 0 otherwise
tools_count	int	Number of tools enabled
tool_kettlebell	int	1 if kettlebell is enabled, 0 otherwise
tool_trx	int	1 if TRX is enabled, 0 otherwise
tool_swissball	int	1 if swissball is enabled, 0 otherwise
tool_bosu	int	1 if BOSU is enabled, 0 otherwise
tool_resistanceband	int	1 if resistance band is enabled, 0 otherwise
tool_foamroller	int	1 if foam roller is enabled, 0 otherwise
tool_medicineball	int	1 if medicine ball is enabled, 0 otherwise
tool_pullupbar	int	1 if pull up bar is enabled, 0 otherwise

Besides events, firebase also lets us log “User properties”. User properties are attributes you define to describe segments of your user base, such as language preference or geographic location [14]. Firebase automatically collects some properties, like age, country or a device model. Most developers take advantage of such properties and create their custom ones. In the case of Fitify App, custom properties are for example user’s height, weight, goal or various kinds of preferences and fitness skills.

Analyzing collected data in the Firebase Console

Firebase Analytics is not only a data collection tool. It can also help understand the behavior of your users within the app by providing several performance indicators, charts, funnels, and visualizations.

In order to get the most out of it, I had to set up custom user audiences. Custom audiences can be defined in the Firebase console based on device data, custom events, or user properties. These audiences can be used with other Firebase features when targeting new features, testings or notifica-

tion messages. We can also break down various metrics such as retention or conversion rate by custom audiences.

My recommendation to anyone trying to leverage custom audiences is to build as much as you can and start as soon as possible (as the custom audiences cannot be added based on past events).

Firestore A/B Testing

A critical part of Firestore Analytics for me and my thesis is a feature called Firestore A/B Testing. It gives me the power to test changes in my app's UI, features, or campaigns to see if they can positively affect my key metrics. A/B Testing is a feature built on top of the Firestore Cloud Messaging [3] and Remote Config [4]. Because of that, Firestore A/B allows me to test marketing messages as well as to turn on a certain feature to a defined proportion of the audience without updating the app in the store.

What is excellent about Firestore A/B Testing is that it can also measure the success of tested variants and it even lets you switch the metric used to measure it (these metrics can be for example revenue, number of purchases or retention). Furthermore, Firestore calculates a confidence interval and determine how likely each variant is to be a winner. In the figure below you can see an example of Firestore A/B test. In the test, we experimented with two different prices, and as you can see, the more expensive variant turned out to be the winner with a probability of 96%.

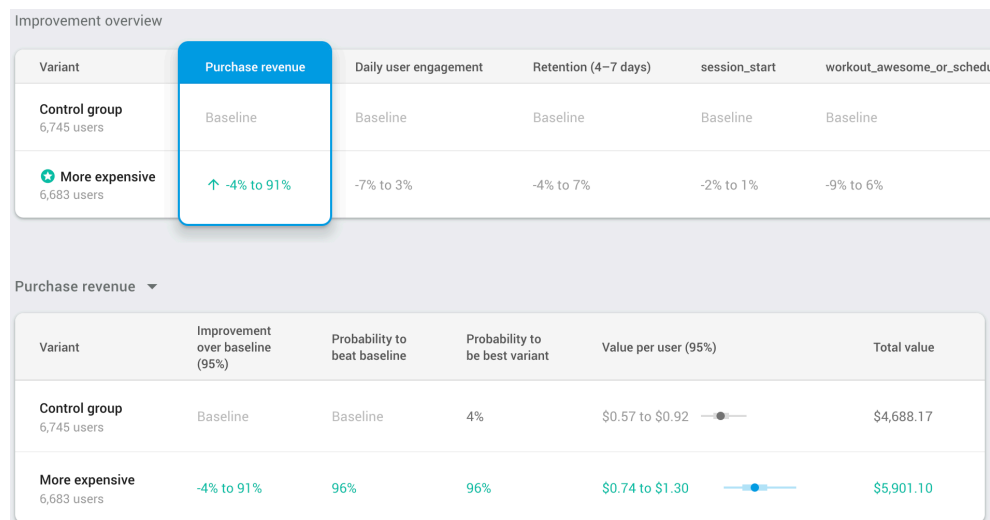


Figure 3.1: Example of a finished Firestore A/B Testing experiment

3.2 Google BigQuery

Firebase Analytics is quite a basic tool for smaller developers and unfortunately, do not fit all use-cases I have for the purpose of this work. The main limitations of Firebase Analytics are:

- Subscription Tracking – While Firebase can keep track of purchases happening in the app, there is no such possibility when it comes to tracking subscription purchases. Unfortunately, this kind of tracking is not even on plan according to multiple Firebase team members I asked during Firebase Summit in October 2018.
- Free trial recognition – Firebase can log an e-commerce purchase only, but it is not possible to separate free trials from actual purchases.
- Refunds – On both Appstore and Google Play, user can ask for a refund after the purchase. Unfortunately, there is no way to remove this purchase from Firebase.
- Audiences – Creating audiences in the Firebase Analytics tool is very limited, and there is no way to create an audience based on past events.

Fortunately enough, Firebase allows users to seamlessly export raw data from Firebase analytics to Google BigQuery – a RESTful web service that enables interactive analysis of extensive datasets working with Google Storage.

3.3 Google Data Studio

Google Data studio is a data visualization tool that helped me to make sense of the developer's BigQuery data. It was necessary because of the limitations of Firebase Analytics. Another great advantage is that Google Data studio can gather multiple data sources and visualize the data together. It was necessary for this work especially in the chapter 4.7 where we connected app analytics with orders data from Google Play.

Analysis and evaluation

This is a practical chapter where I am explaining, applying and evaluating selected mobile marketing techniques. Techniques are sorted chronologically by the user's journey – meaning they are sorted from user acquisition, over the engagement of the user to finally converting the user to pay for the premium version of the app.

4.1 Reducing the app size

App size used to be a problem since the beginning of the mobile apps era and there is no compelling resolution on the horizon. The reason is simple – device storage is one of the most expensive features of the phone. Not that it is expensive to create it, but because it is convenient for manufacturers to make two variants of the phone and charge extra money for the extended storage. Because of these pricing options, people are still sticking to small device storage sizes, and therefore are more likely to halt the installation process when they realize the size is too large. Moreover, when the device storage is full, the user cannot install the app until he clears some space. Here you can see the pricing [7] of three versions of iPhone XS from the official Apple's website:

Table 4.1: iPhone XS price by storage size

Storage	Price
64GB	\$999.00
256GB	\$1,149.00
512GB	\$1,349.00

Another issue with the app size is that people are converting from wifi to cellular data and they tend to keep track of the data usage as they usually have

limited data plans. The fear of running out of data can lead to a decreased conversion rate on the Google Play or App Store page as well.

Last year there was exciting research presented on Google Play’s official blog [17]. It revealed the negative impact of APK size based on a very reliable source – Google Play’s internal data. Quoting from the article – “For every 6 MB increase to an APK’s size, we see a decrease in the install conversion rate of 1%”. It was also interesting to see the impact on conversion rate by country. As you can see on the figure below, increasing APK sizes was more influential in emerging markets (like India and Brazil), than in the case of other countries (like Japan and the USA).

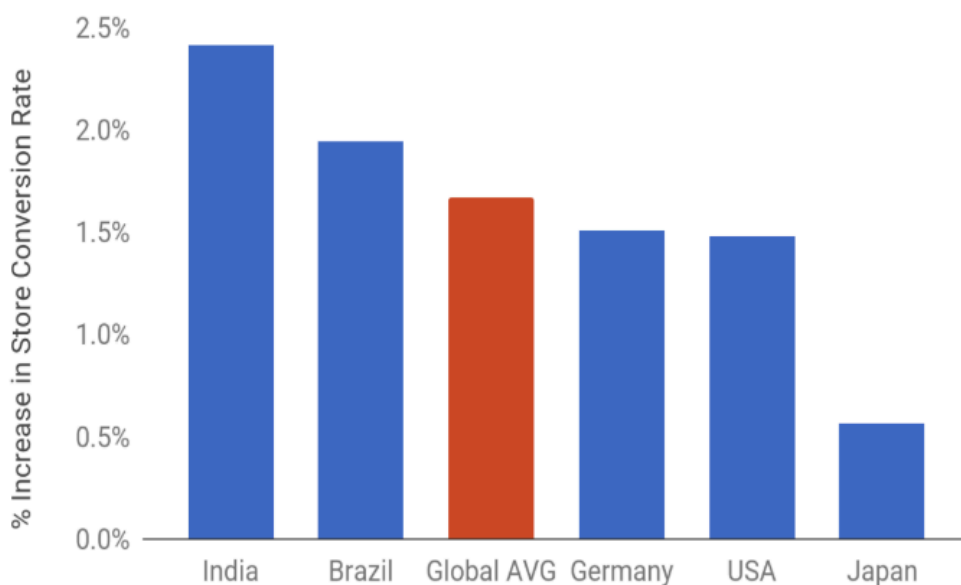


Figure 4.1: Install conversion rate increase per 10MB decrease in APK size by select market

When Fitify App was launched, the APK (Android Package Kit – file format used for Android Apps) size was about 99MB. As the limit was 100MB, it was obvious that the size is outstanding in a negative way and it was clear that it can discourage potential users from installing it. The source of the size problem was not the code, libraries or UI assets. About 85% of the size was caused by workout video assets which were the cornerstone of the user experience. There were two solutions to consider – render videos with a higher compression rate or postponing the download of videos to the onboarding of the app. The developer decided to lower the quality of videos and the app was decreased from 99MB to 57MB.

Testing and evaluation

Unlike Google Play listing (texts, graphics, and videos), different APK versions cannot be A/B tested, the only option to test different APK sizes was sequential testing. This simply means that the developer released a new version on one day and I compared the conversion rate before and after the change. As you can see in the following figure, the change is publically visible on APKpure [5], an alternative Android app store.

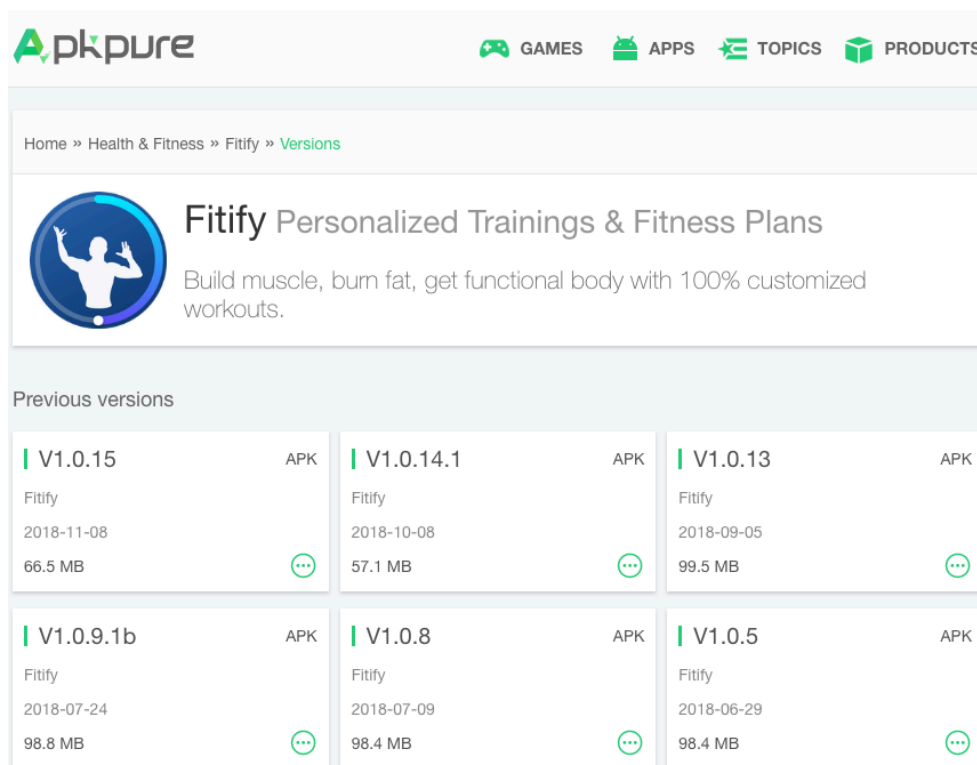


Figure 4.2: Full body Workout update version history including APK sizes

The day was 8th of October 2018, and because the APK size was slightly increased again (from 57MB to 67MB) on the 8th of November, I decided to compare 28 days before and 28 days after the change so the result would not be affected by the change in November. The day of the update, the previous and the next one will be excluded from the source data. The reasons are the uncertainty of Google Play's data collection for various time zones as well as the possibility of cached APK versions on Google Play's server for a couple of hours. Therefore the date ranges considered were 9th of September – 6th of October and 10th of October – 6th of November (including endpoints).

The metric I was comparing was a conversion rate – a proportion of in-

stallers from all store listing visitors. All this data is provided by the Google Play Console. In order to be able to compare exact date ranges, it was necessary to download .csv reports and compute the average conversion rate.

Table 4.2: Store listing visitor to installer CVR worldwide

BEFORE			AFTER			
Visitors	Installers	CVR	Visitors	Installers	CVR	Relative Uplift
78334	15152	19,3%	97854	18855	19,3%	-0,4%

The result was 15152 installers from 78334 store listing visitors for the first date range and 18855 out of 97854 for the smaller APK date range. This means that the original APK had a conversion rate of 19.34% while the shrunk APK achieved a conversion rate of 19.269%. So reducing the app size actually led to a relative decline in a conversion rate of 0.38% and therefore we cannot say that the technique of reducing APK size significantly improved the conversion rate of the Fitify App.

Table 4.3: Store listing visitor to installer CVR in India

BEFORE			AFTER			
Visitors	Installers	CVR	Visitors	Installers	CVR	Relative Uplift
6742	1328	19,7%	12154	2360	19,4%	-1,4%

India was the most app size sensitive country in the paper from Google Play’s official blog. Therefore I measured the influence solely for this country. Surprisingly, the relative CVR improvement was even lower, and most importantly negative as well.

4.2 Store listing localization

Localization is the process of customizing an app to work in languages other than the default. The reason is obvious. According to Sensor Tower [19], there are 8 out of the top 10 countries by mobile app downloads where people do not use English as an official language. Because of that, having your product only in one language can keep your app down on downloads and massively limit your business as such.

Both the Google Play Store and Apple App Store are now present in more than 150 countries and over 50 different languages. App developers should benefit from this global audience and prepare their app to reach new users. Localization of the Google Play and Appstore listing page is a part of the process, and it can significantly increase app downloads. It is not only the text assets that can be localized. We can also localize screenshots, app icon, video, keyword field (on iOS) and a feature graphic (on Android) as well.

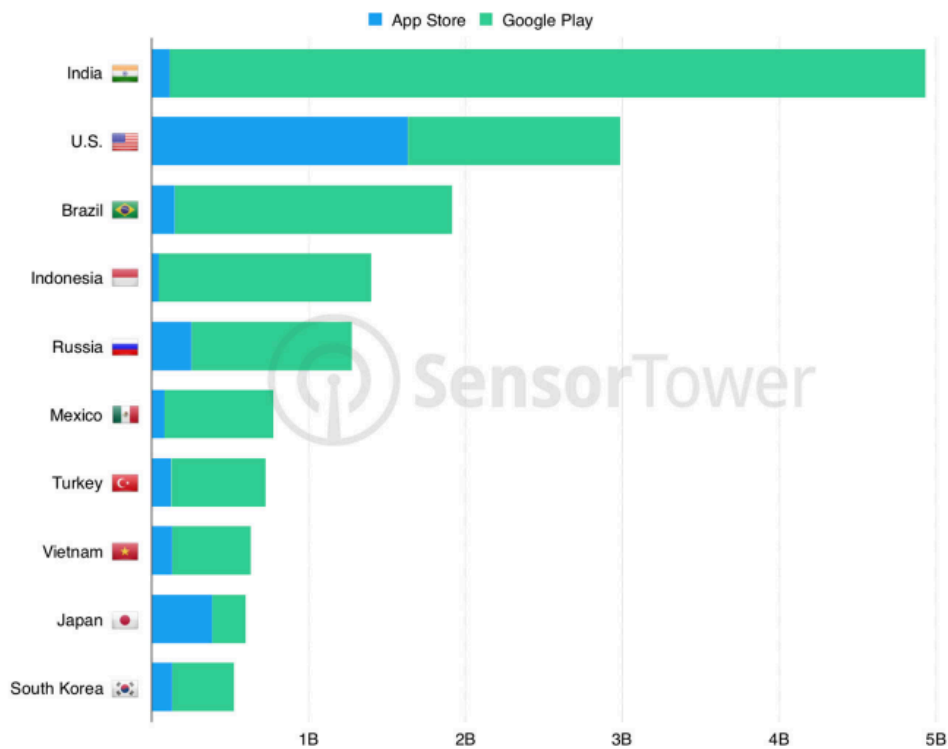


Figure 4.3: Countries by App Downloads in Q4 2018

There are two main reasons why store listing translation can help – conversion rate improvement and keyword optimization:

1. Conversion rate improvement

By having the listing page localized, your potential user is more likely to convert to the app. Some of them just do not understand your primary language, some are more comfortable in their native tongue and some of them are more likely to download because they feel like the app is more professional because of that. Increased conversion rate means more downloads obviously, but it can also lead to more impressions on the store as the search engine recognizes your app to be more relevant for certain search terms. Last but not least, people are more likely to download a translated app because they feel like they would be able to contact your support team easily.

2. Keyword optimization

The second reason is search engine optimization. By localizing your title and descriptions, you increase the chance to rank for search terms writ-

ten in the local language. This is quite hard to measure because it does not influence the conversion rate of the app. You can see an increased number of store listing visitors and installs, of course. However, it would be affected by external influences. In my case, the biggest problem was timing. The localization took place soon after the app launch, so it was apparent that the downloads and keyword rankings would have been growing anyway.

I have explained what localization is and why it is supposed to help with acquisition. However, the goal of my test is also to estimate some percentage of improvement – if you know, how the translation can improve the conversion rate, you can estimate the return on potential investment in localization. What is the cost of app store page localization though? In our case, the translation services were about \$30 for each language. The translation consisted of detailed app description, short description, and app title – altogether about 300 words. Along with that, you need to get screenshots of the app to upload to Google Play developer console. It can be done manually, but taking about ten screenshots for each language, then switching language can be very time-consuming. Especially if you want to keep the screenshots updated. Therefore you should count your developer’s work to build a fastlane script to create screenshots automatically and a script to upload images to Google Play automatically. We can assume this to be about ten hours of the developer’s time. With that said, we can assume localizing your app will require about \$30 per language plus about \$300 to build the scripts and manage the order. I encourage you to determine the ROI (expected revenue/cost of localization) for your app before localizing blindly.

Testing and evaluation

The developer decided to localize for the following languages: German, Spanish, Russian, Portuguese, Polish, Italian, Slovak and French. All of these changes took place between 29th of August and 31st of August.

To avoid the bias of seasonality, it would be possible to test for example the short description and measure the conversion rate simultaneously. However, it would not be possible to measure the whole translation altogether, so the test had to be sequential.

The metric I used for evaluation was conversion rate from store listing visitors to installers. I was comparing 30 days before and after the change, so the control date range was 30th of July – 28th of August and the tested range was 1st of September – 30th of September (including endpoints).

Google Play provides app developers with quite limited reports, so the data for some countries are not available (or are listed as “other”). Therefore I was only measuring German, Spanish, Russian, Portuguese, French and Italian. Another limitation worth mentioning is that Google does not provide

the data per language, but per country. You can see the results per particular countries in the following table.

Table 4.4: Store listing visitor to installer CVR by country

	BEFORE			AFTER			Relative Uplift
	Visitors	Installers	CVR	Visitors	Installers	CVR	
RU	2927	303	10,4%	2209	402	18,2%	76%
IT	2299	484	21,1%	1995	385	19,3%	-8%
BR	2638	342	13,0%	2831	428	15,1%	17%
FR	2965	605	20,4%	1848	388	21,0%	3%
DE	3256	496	15,2%	2611	553	21,2%	39%
MX + ES	3141	580	18,5%	3071	497	16,2%	-12%
Total	17226	2810	16,3%	14565	2653	18,2%	11,7%

As we can see, the localized variation observed a conversion rate of 18.2%. It was 11.7% higher than the original variant's CVR of 16.3%. We can be more than 99% confident that the localization improved the conversion rate and it is not a result of random chance.

4.3 UI Localization

In the previous chapter, we have talked about localization for user acquisition part of the product. In other words, we have localized the user experience only in one part of the funnel - getting the user into the app. Although, there may be even more friction going down the funnel. And that is what I want to measure in this chapter, so let's shed some light on the localization of the app interface itself.

In mobile apps, localization can include different variations and dialects of the same language, which are referred to as locales. For example these are all locales for Spanish speaking countries supported by Android: Latin America, Argentina, Bolivia, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ceuta and Melilla, Ecuador, Spain, Equatorial Guinea, Guatemala, Honduras, Canary Islands, Mexico, Nicaragua, Panama, Peru, Philippines, Puerto Rico, Paraguay, El Salvador, United States, Uruguay and Venezuela.

Such a precise localization is not the case of our subject. In fact, Fitify App was merely localized to the top-level locales (which apply for all the sub locales). As the term localization sometimes means a more coherent process of adjusting graphic assets, different paywall design and sometimes even wholly different UX/UI design, I would like to clarify that by localization I mean mere translation of the texts in the app.

The translation process was handled using Lokalise.co platform, where the developer stores all his text strings. Each one includes a description and

screenshot of where the string would appear and what is the purpose of it. I can also select the style of the translation (Friendly or Formal), give the translator some intro to the project (what the app is about, who is a customer or where he can download it in case he wants to). Therefore the translation is much better than the old-school way of localizing in excel sheets or .xml files without knowing the context of the word.

To prove the quality of the translation is very good, I decided to **meet a few native speakers in person** to proof-read and find all the potential mistakes. I met with German, Russian and Spanish exchange students. During the 2-hour meetings, we ended up rewriting about 10-20 strings for each language. Therefore we can assume the translation quality was pretty high and close to having a native speaker working on it for multiple days.

The languages we translated were the following: **German, Spanish, Russian, Portuguese, Italian, French and Polish**. All of them were launched simultaneously on the 7th of September.

The reason for this kind of testing is simple – if you know, how the translation can improve your engagement, you can predict the return on investment based on that. The second part of the equation is obviously **the cost of app translation**. In our case, the translation services were about \$1500 for the 7 languages mentioned above. The translation consisted of about 2500 words and the price per each language is more or less the same, so the price per language is about \$215. Another cost can be the management of the translated files. Most of this is done by Lokalise.co where the price for a project like Fitify is currently \$40 per month. Along with that, you should count your developer hours. The string management is not very time consuming, but you can count on a few man-hours a month spent for updating newly translated strings, solving UI issues with strings being too long in some languages or handling right-to-left languages like Arabic. This being said, you can assume localizing your app will require about \$215 per language. Then you should count about \$500 for the infrastructure and about 20-80 man-hours of your development team per year. My estimation is that for the **first year we have paid about \$3.000 to localize these seven languages**. The price to keep the product updated would be about \$1.000 for each following year.

Testing and evaluation

In order to measure the engagement before and after the change, I set key metrics to observe.

The first metric in the funnel was an event called “first_open.” This means the user opened the app for the first time (not that he installed the app).

Going down the funnel, I have set another conversion “onboarding_signup” which means the user has gone through the whole onboarding. The onboarding consists of 7 screens asking the user about his personal information, physical condition and goals he wants to achieve. Going through all these questions

shows the user what to expect from the app and the fact he still wants to continue, is quite meaningful for the engagement process.

The most important metric I am using is “workout_finished.” Knowing the user have completed a whole workout means he started and was engaged enough to keep working out until the end. This user is very likely to stay in the app and hopefully even convert to a premium user.

You may expect a conversion like purchase or sum of total revenues. Unfortunately, there will not be enough conversions to get a significant result so I decided not to exclude this event from testing.

All these metrics were measured for 30 days before and 30 days after the change. In order to minimize the impact of a staged roll-out, as well as the number of users who had the app installed but never opened, I have excluded ten days before and after the change was 100% released. To be more specific, the date ranges I have considered are 29th of July – 28th of August and 17th of September – 17th of October (including endpoints).

You already know the metrics I was using in the test. In the following chart you can see the impact on the conversion rate from opening the app to finishing the onboarding:

Table 4.5: First Open to Sign In Screen CVR by language

Language	BEFORE			AFTER			Relative Uplift
	Open	Sign In	CVR	Open	Sign In	CVR	
DE	987	973	98.6%	1215	1091	89.8%	-8.9%
ES	995	900	90.5%	1008	898	89.1%	-1.5%
FR	1340	1246	93.0%	879	788	89.6%	-3.6%
IT	840	781	93.0%	843	765	90.7%	-2.4%
PL	337	311	92.3%	292	264	90.4%	-2.0%
PT	740	639	86.4%	891	795	89.2%	3.3%
RU	665	564	84.8%	856	787	91.9%	8.4%
Total	5904	5414	91.7%	5984	5388	90.0%	-1.8%

To double-check the first metric, I compared the number of first openers to those who completed their first workout.

Table 4.6: First Open to Finished First Workout CVR by language

Language	BEFORE			AFTER			Relative Uplift
	Open	Finished	CVR	Open	Finished	CVR	
DE	987	353	35.8%	1215	387	31.9%	-10.9%
ES	995	278	27.9%	1008	254	25.2%	-9.8%
FR	1340	403	30.1%	879	229	26.1%	-13.4%
IT	840	285	33.9%	843	259	30.7%	-9.4%
PL	337	111	32.9%	292	81	27.7%	-15.8%
PT	740	199	26.9%	891	236	26.5%	-1.5%
RU	665	182	27.4%	856	223	26.1%	-4.8%
Total	5904	1811	30.7%	5984	1669	27.9%	-9.1%

The result was a negative uplift of -1.8% for open to signup conversion rate and even worse drop of 9.1% in open to finish workout CVR. So localizing the app led to a relative drop in both measured conversion rates. And therefore it does not worth testing the hypothesis I was moving towards (localization improves engagement in the app after installing), and we definitely cannot say that translation of the app significantly improved engagement in the app.

To avoid doubts about different traffic sources – the developer did not run any marketing campaigns and the traffic coming to the app was stable and organic. The reason for Localization not being helpful is probably that users who are not comfortable in English are filtered out during the acquisition process (4.2). It makes a lot of sense as the localization on Google Play took place in between the date ranges we observed.

4.4 Design Experiments

A good design often separates successful apps from unsuccessful ones. As mobile apps have matured, mobile users expect a lot more than they used to. Delightful yet straightforward design and good UX is essential in the competitive world of mobile apps. Therefore testing both UI and UX design of the app definitely makes sense and so I did for the sake of this work.

Competitive Research

A convenient way to find the design that works is observing the competition. By being a beta tester of similar apps, you can be the first one to know what your competition tests and even see what variant was applied after the test is finished. This approach saves you from wasting time and resources needed to create and implement new designs just for the sake of testing. Another great way to see the evolution of other apps is to download their old APK files and to compare with the newest versions.

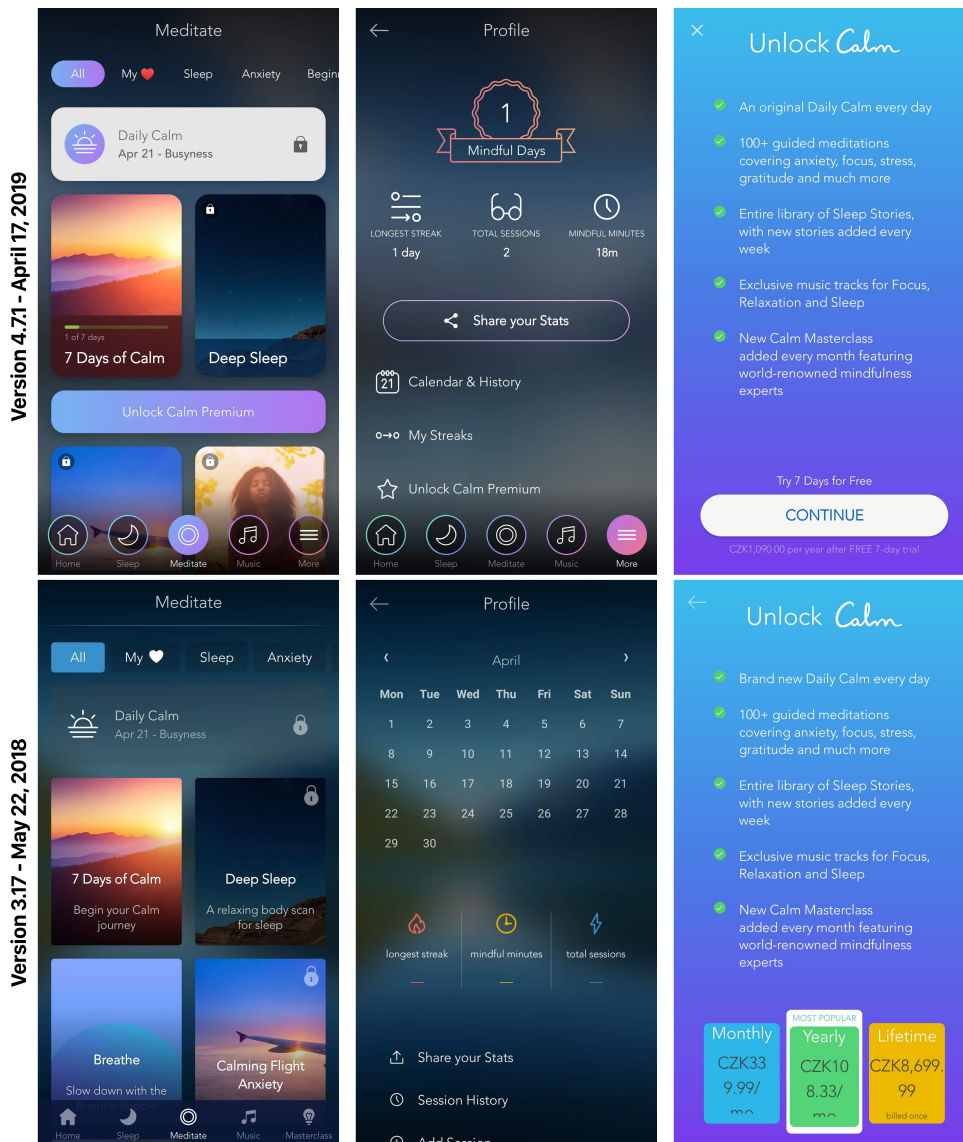


Figure 4.4: Calm app UI progress – May 22, 2018 vs. April 17, 2019

On figure 4.4, we can see an old version of the Calm App compared the newest version. Calm is the #1 top grossing app in 2018, so there is no doubt their design works and improves over time to deliver better performance.

From the screenshots, we can notice for example that the tab bar was colored and got bigger. The Daily Calm feature got highlighted as it is probably the feature that converts most of the users. Also, there is an entirely new button “Unlock Premium” – clicking one of the locked sessions maybe was not obvious enough for some users. The session descriptions disappeared

so there is only the title of the practice.

In the older version, the app used the “Navigation Drawer” – side navigation vastly used on the Android platform. The new version is more iOS style and uses the tab bar as the only navigation component in the app. The profile screen now has a prominent place as one of the tabs. On the middle screen, we can see that the profile screen was changed as well. The calendar disappeared, and there is a new achievement badge instead. The share button got much higher visibility to boost virality, and there is a new button to unlock the pro version. I assume that the button is not here solely to bring conversions but also to make users feel cheap when sharing a screenshot with the “Go Pro” button on it.

Last but not least there is a paywall screen, which I am going to test in the Testing and evaluation section. Surprisingly there were not many changes going on in the descriptions of the pro version or the graphics. However, there was a huge difference in the pricing. Calm switched from three different options to just one annual payment. The price is about 20% lower, and there is a 7-day free trial now. The actual price may be seasonal, or the decline is caused by localized pricing. My guess though is that Calm got less expensive due to the \$88 million funding[2], making their goals more long-term.

Testing and evaluation

The screen we tested was the “Go Premium” screen. This one can be crucial for converting the user to the pro version. The goal of the design here is to explain the benefit of going pro and should persuade customers to pay the subscription or start the free trial. There is a lot to say, but sometimes less is more – and that is exactly what I tested. The first screen (shown to the control group) was very simple and basically only revealed four features that would be unlocked. The alternative variant was more exhaustive, so besides the locked features, it was showing happy customers, and their success stories. There is also more info about the payment, and the design is more interactive and playful. We can see the tested variants in the following figure.

4.5. Push notification messaging

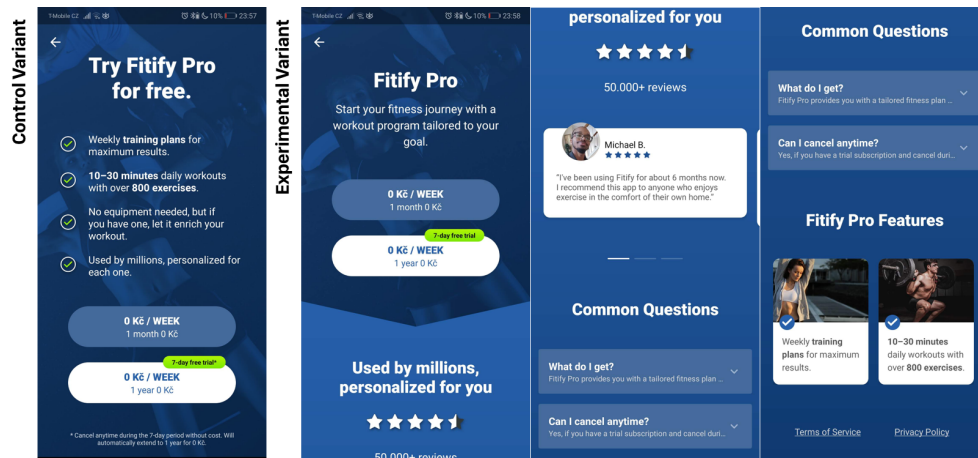


Figure 4.5: Tested variants of the paywall design

Both variants were equally spread to control and experimental groups with Firebase A/B Testing. Over 60 thousand users have undergone the test, but the result is still not clear. The simple (control) variant is slightly more likely to be better regarding the number of purchases. However, the probability of being the winning variant is only 53%. The leader was not found in this case, so I cannot recommend making the paywall design test a priority for mobile developers.

4.5 Push notification messaging

App developers spend most of time and resources trying to acquire new users that have never used their app before. Although, keeping the existing users in the app can be more cost effective and it definitely worths optimizing. Retention of the userbase can have a substantial impact on the user's LTV, and therefore it can often be the ticket to a positive ROI.

Push Notifications are one of the most impactful channels. Sending a push notification is almost free, and we do not need any permission by law like in the case of email. It can be well targeted, sent in the right time and it leads the user seamlessly to the app or the specific page we want. On top of that, we can easily measure the impact.

On the other hand, sending too many messages can annoy the user and can be harmful. A survey by Localytics[6] tried to measure how sensitive American users are to the number of messages sent by one app in a week. While people are getting used to it, the proportion of users discouraged by push notifications is surprisingly high.

4. ANALYSIS AND EVALUATION

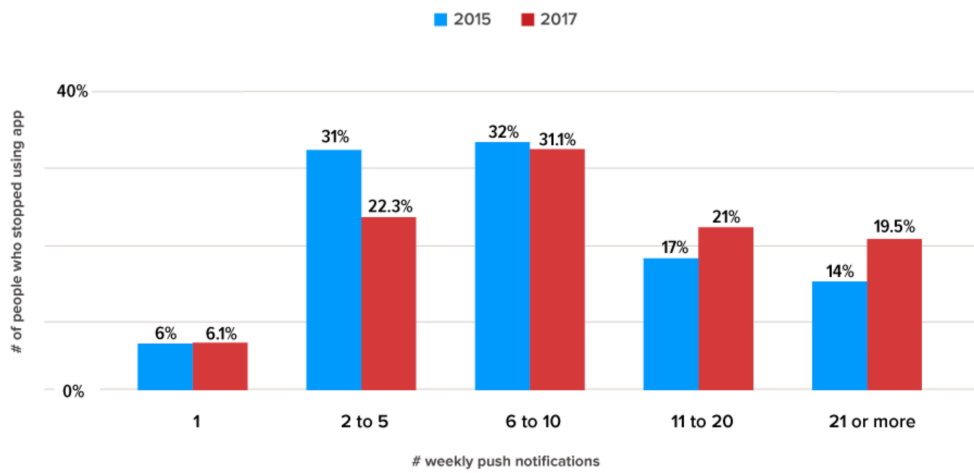


Figure 4.6: Number of weekly push notifications that make user stop using the app.

Competitive Research

To find out whether push notifications worth bothering for your mobile app, you can check what the approach of the leaders of the market is. For health & fitness apps, I decided to observe the leading workout and meditation apps in the category. As the push notification roadmap usually depends on events the user performs, I decided to cover only one, yet the most important use-case. User opens the app, answers onboarding questions, and signs-up if required. After that, I did not take any further action like starting a training session or checking the payment screen and just closed the app and never opened it again. Then I was observing what notifications the app sends to get me back. To clarify, the experiment took place in Q3 2018 on two devices (Android phone and iPad), and the notifications were always allowed.

Table 4.7: Push notification strategy by leading health & fitness apps.

	8ft	Asana Rebel	Better Me	Calm	Daily Yoga	Freeletics	Headspace	Runtastic Results
Day 1								Engagement
Day 2					Discount			Engagement
Day 3								Engagement
Day 4								Engagement
Day 5								Engagement
Day 6							Engagement	Engagement
Day 7					Engagement			
Day 8					Discount			
Day 9								
Day 10					Discount			
Day 11					Discount			Engagement
Day 12								
Day 13								
Day 14								
Day 15								
Time						Seasonal		
Independent						Discount	30%	

4. ANALYSIS AND EVALUATION

As we can see in the table 4.7, only half of the apps sent at least one push notification to the non-engaged user. In the case of the Freeletics app, the only notification seems to be time-independent. So basically everyone except paying customers receives it no matter what his history with the app is or how likely he is to churn or pay.

Most coherent notification roadmap was seen in the Runtastic Results app. Their push notifications looked very personalized as they always include the user's name. Most of their messages were telling the user to start the training plan or explaining how easy it is to improve his lifestyle. On the figure below you can see what the notifications were like.

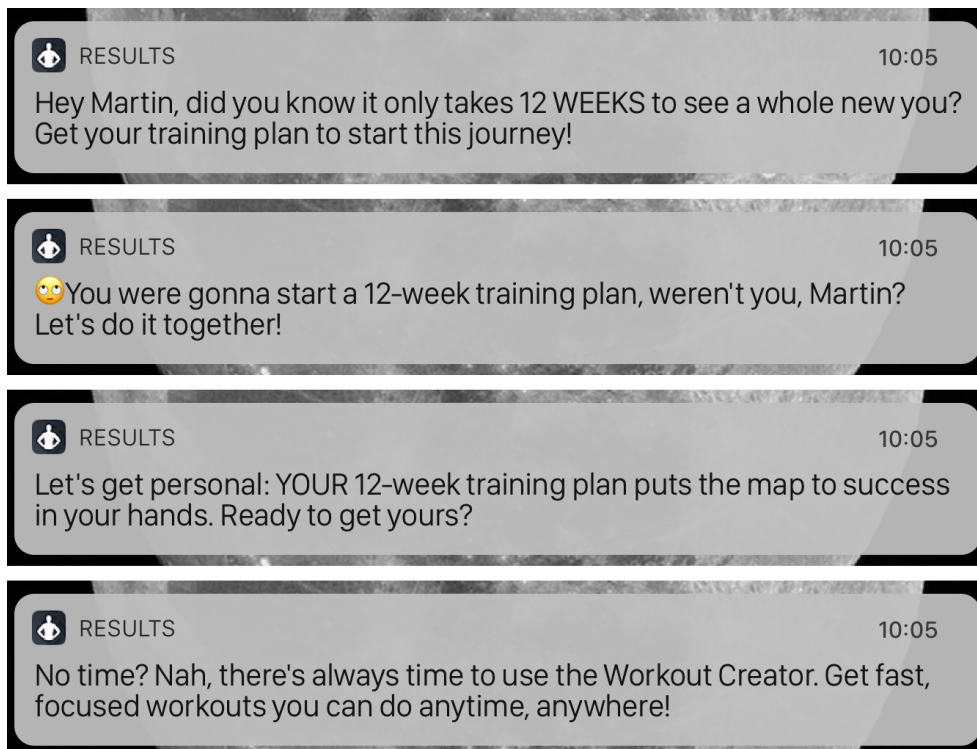


Figure 4.7: Example of re-engagement push notifications sent by Runtastic Results app.

I have even captured one gender-specific message. You can see the difference in communication with male and female audience in the following figure.

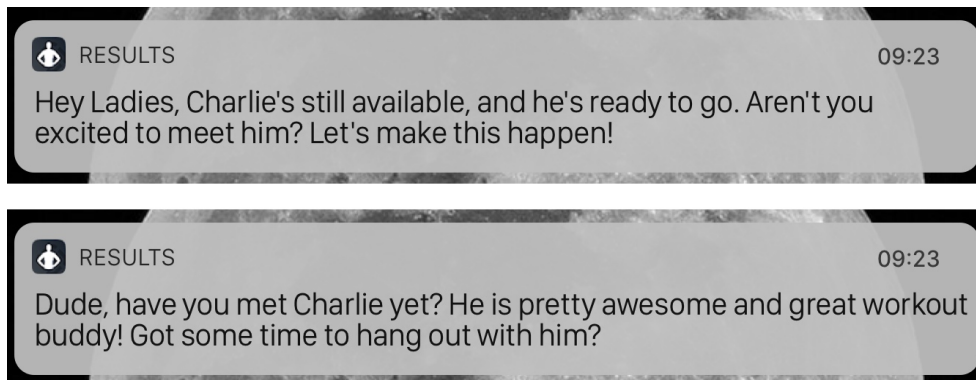


Figure 4.8: Example of a gender-specific push notification.

It is not clear why most of the apps did not take advantage of push notifications. But as most of these companies definitely have the budget and headcount to experiment, I assume that they have tested notifications earlier, but the results were not satisfactory. This method of observing competition is quite time-consuming, and you need some extra device to test on. However, it can give you some idea of how many push notifications you should send to your users and when. You will also see many creative messages that can inspire you when building your own push notification strategy.

4.5.1 Testing and evaluation

In order to send messages that are relevant and have the potential to improve user's engagement, the developer should define the structure of his notifications. As mentioned earlier, I have done some research on the competitor's strategies. Making decisions based on competition's best practices is not very reliable and therefore a split test could be very beneficial for many developers.

The developer of Fitify App created a simple push notification roadmap consisting of four messages. You can see the messages in the following figure. The message took the user's name into account as well as gender. For male users, there was an image of Jackie (male coach at Fitify), and for female users, there was Adele (Fitify's female trainer).

4. ANALYSIS AND EVALUATION

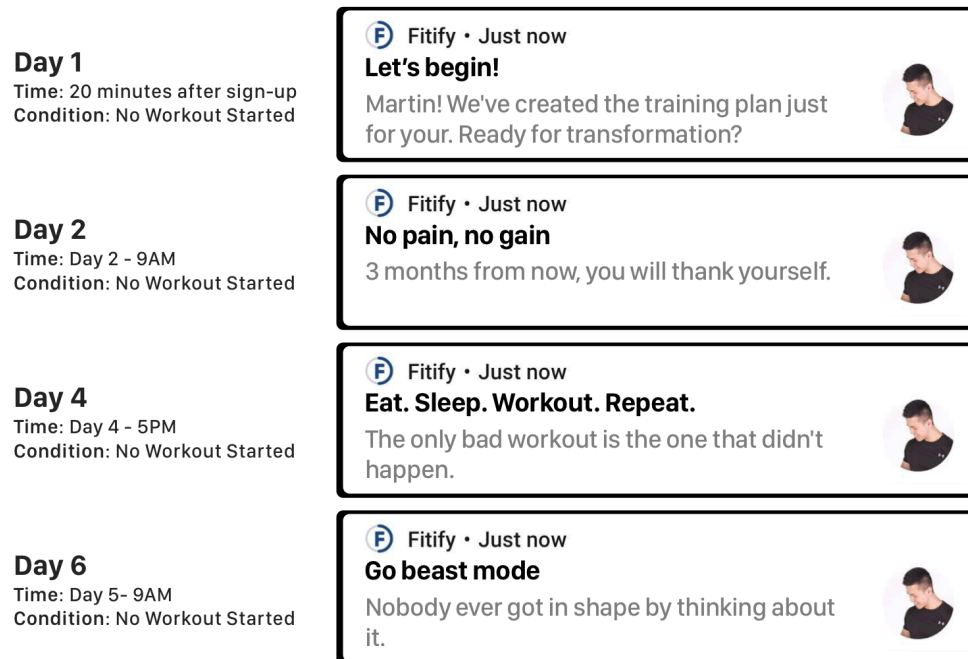


Figure 4.9: Tested notification roadmap of the Fitify App.

Using Firebase A/B testing feature, we defined the control group who did not receive any messages. The experimental group received all 4 messages. Only users who signed up were considered to avoid the bias from users who did not even go through the onboarding.

4.6. Premium content proportion experiments

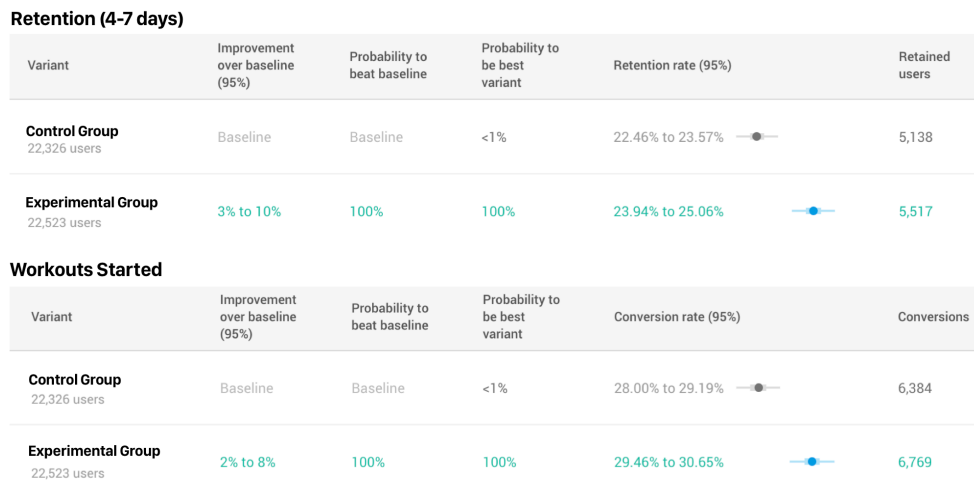


Figure 4.10: Effect of push notifications – chart from Firebase A/B testing

The most important information for us was the percentage of users who started the first workout and the 4-7 days retention. Both of these metrics were significantly improved. The proportion of users who began their first workout grew about 5% (median), and the retention grew by approximately 6%. For both of these metrics, we are more than 99% confident they were improved, meaning the experimental group is a clear winner and sending push notifications is beneficial for the Fitify App. The developer can improve the retention even more by testing frequency, times or the creative part of the message.

4.6 Premium content proportion experiments

I have already explained the general monetization principle used in the Fitify App in section 2.0.1. The app can be used for free, and the user can purchase the premium version on a subscription basis.

The core feature of the app is personalized training plans. The app asks the user for info about his body, physical condition, and goals. Based on this information, the app creates a training program tailored to the user's needs. Doing the workouts from the plans is not the only way to train in the app. The user can choose from about 30 standalone workouts. These workouts are divided into four different groups – Strength, HIIT & Cardio, Stretching & Yoga, and Special. About 70% of standalone workouts are free. Another way to work out for free is to build a custom workout. The user can select from more than 900 exercises and create a custom training session from it. The user has only one custom workout in the free version.

Testing and evaluation

The plans feature is by far the most important for the monetization of the app. In this test, we have tested the pricing of the Plans feature. Every day of the plan had one recommended workout, one shorter version and one variant for each fitness tool the user had. The second part of the day was a recovery part. It was a stretching session to recover sore muscles and to keep them functional. There were three variants of the recovery session – classic static stretching, yoga variant and a version with a foam roller.

The first approach was to make all the sessions completely paid. As some users were complaining, the developer decided to make one of these workouts (the recommended one) for free. Other variants of the workout and all recovery sessions remained behind the paywall.

We created an A/B test using the Firebase Remote Config feature. Half of the new users, from now on referred to as the Control group, was given the default conditions. The second half of the users (the Experimental Group) was given the one daily workout for free. The following figure explains the difference and shows how it was presented in the user interface.

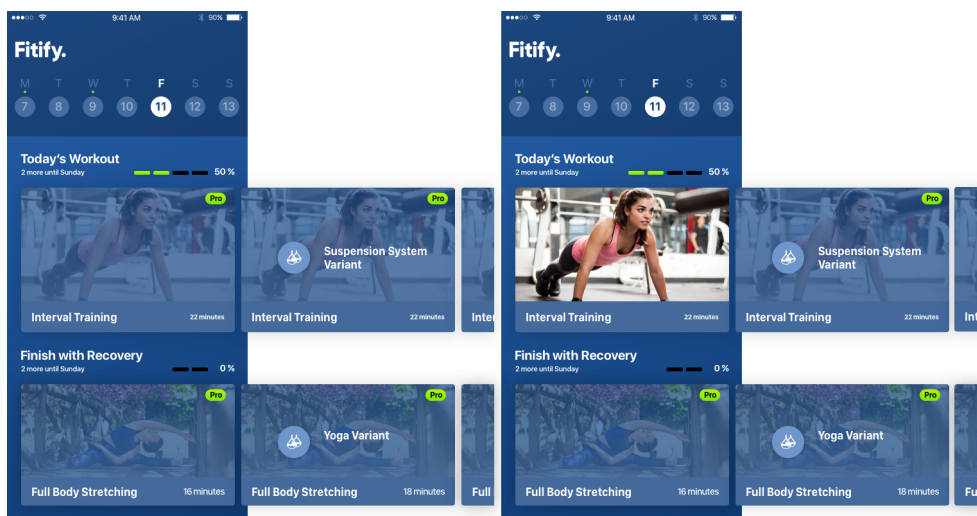


Figure 4.11: Control variant (on the left) interface compared to Experimental variant (on the right)

In order to compare the control and experimental variants, I set key metrics to observe.

The first metric was the revenue made by the tested variant. Revenues are measured by Firebase Analytics. The downside of this approach is that it cannot exclude free trials and refunded orders.

Another metric I observed was the day 4 to 7 retention. The user is con-

4.6. Premium content proportion experiments

sidered retained if he opens the app at least once between days 4-7 (including endpoints) after install.

The last metric was specific to Fitify and is called “workout_start.” This is the total number of workouts started by the variant.

The test was started on the 8th of November 2018 and stopped on the 15th of April 2019. There were more than 73 thousand users included in the testing. We can see the result of the experiment in the following figures.

Variant	signup	Purchase revenue	Retention (4–7 days)	workout_start
Control Group 36,128 users	Baseline	Baseline	Baseline	Baseline
Experimental Group 36,480 users	↓ -36% to -11%	↑ 33% to 41%	↑ 41% to 47%	

Figure 4.12: Results from Firebase A/B testing

Purchase Revenue					
Variant	Improvement over baseline (95%)	Probability to beat baseline	Probability to be best variant	Value per user (95%)	Total value
Control Group 36,128 users	Baseline	Baseline	100%	\$0.75 to \$0.93	\$29,616.36
Experimental Group 36,480 users	-36% to -11%	<1%	<1%	\$0.56 to \$0.71	\$22,017.84
Retention (4-7 days)					
Variant	Improvement over baseline (95%)	Probability to beat baseline	Probability to be best variant	Retention rate (95%)	Retained users
Control Group 36,128 users	Baseline	Baseline	0%	16.06% to 16.83%	5,940
Experimental Group 36,480 users	33% to 41%	100%	100%	22.12% to 22.98%	8,225
Workouts Started					
Variant	Improvement over baseline (95%)	Probability to beat baseline	Probability to be best variant	Conversion rate (95%)	Conversions
Control Group 36,128 users	Baseline	Baseline	0%	29.09% to 30.03%	10,679
Experimental Group 36,480 users	41% to 47%	100%	100%	41.95% to 42.96%	15,486

Figure 4.13: Firebase A/B testing – results per metric

Our goal was to decide which group generated more revenue. Regarding

revenues we had quite a visible result – by adding the free workout, there is between 11% to 36% decrease in revenues with the confidence of 95%. The control group was better in terms of revenue with more than 99% probability. On the other hand, with the same confidence interval of 95%, the experimental group had 33% to 41% higher retention, as well as 41% to 47% more started workouts.

After trying this technique, we have seen a significant decline in revenues, but a massive rise in engagement metrics as well. It is up to the developer to decide what metrics are more critical for the long-term vision of the product and what version he should prioritize. My suggestion would be to predict the revenue per retained user – to estimate the revenue I could make serving ads to this user, the value of WOMM he can make, the downloads I could get by improving retention rank on app store search engines or the amount he could spend in my other products. For the purpose of this work, the key takeaway should be that testing the proportion of premium content is important and can have a crucial impact on the product’s success. It is also essential to define the KPIs and what results will be sufficient to recognize the tested variant to be a winner.

4.7 Pricing experiments

There are many ways one can price a mobile app. In general, any product can be priced based on either value or cost. Business marketing managers traditionally focused their pricing strategy on cost related criteria, often without regard to the value of the product to the customer[8]. Pricing by cost often does not make much sense for mobile apps and software in general. Especially for those developers who tend to spend a significant part of the resources on marketing and strive to scale rapidly. The developer of Fitify App used value-based pricing, and that is why it makes much sense to test the performance in order to determine the perceived value of the product.

When it comes to building a new mobile app, setting the right price point is very often one of the first things the developer considers and especially small developers and small companies usually set the price much lower than what it should be (meaning what price is the most profitable).

The barrier to purchase software is quite high, mainly because people got used to free apps and most people never paid for an app so they would have to insert a credit card. Another issue is that people usually do not understand how the payment works and are afraid they would not be able to cancel the subscription. Some just do not want to give these companies access to their credit cards for security and privacy reasons. The problem is Apple’s and Google’s inability to communicate the payment options they provide as well as the inability to prevent fraudulent app behavior as described in this article[12] on Techcrunch. There are also many apps which send users

to external paywalls to avoid the 30% cut by Google and Apple. This way people do not have one place to manage their orders and their concerns grow.

When the user decides to pay for the product, he is likely to be familiar with payments through Appstore and Google Playstore. The price point is not as important then, and therefore many developers are surprised how high the right pricing can be for their app. This effect is disappearing gradually though and paying for apps will be probably perceived similarly to purchasing physical goods or services. To support this estimation, according to Business Insider[13], subscription app install-to-conversion rates increased by over 30% in 2018.

Another interesting research to consider when pricing an app and more specifically subscription one is research by Liftoff published on Forbes by Peggy Anne Salz, one of the most famous mobile marketers. Liftoff report breaks subscription apps down into three distinct groups based on the monthly subscription cost. Low: \$6.99 and below; medium: \$7-\$20; and high: \$20-\$50. It compares this to the conversion rates, defined as a measure of how app users view and value the app. The result showed interesting results summed up in the table 4.8. Apps in the medium price range had by far the highest conversion rate. In fact, the conversion rate is five times higher than the low-cost category and nearly six times higher than the low-cost category.

Table 4.8: Install-to-conversion rate by monthly subscription price tier by Liftoff

	Conversion Rate
Low Cost	1.37%
Medium Cost	7.16%
High Cost	0.73%

Testing and evaluation

Since the launch of the Fitify App, there were two pricing tiers user could choose from – monthly payments and yearly ones. The yearly one had the advantage of the 7-day free trial, which required users to insert the card.

The developer of the Fitify App tested two different price points in order to get a grasp on the perfect price for the subscription. Experimenting with the price is quite easy to do with a subscription app. The developer set up a Firebase A/B test and split the users into two groups. The control group kept the previous price of CZK 1.199 per year and CZK 150 per month. The experimental group, hereinafter referred to as “More Expensive” was CZK 1.599 for annual and CZK 266 for monthly payment. All the prices mentioned in this chapter are not including tax, so the user usually has to pay a higher price. The 30% cut by Apple and Google is involved.

As the limitations of Firebase analytics would play a significant role in this measurement, I had to measure the payments from a more reliable source

4. ANALYSIS AND EVALUATION

which is Google Play Console data. This data is the most reliable as it tells exactly which purchase was refunded, which one is only a free trial and also reports subscription renewals. With the help of the developer we had to transfer this data to Google Data studio, and we created a custom dashboard from it.

As we can see in the chart 4.9 of the revenue made by each variant, the control variant is a clear winner regarding the number of new subscribers, which is quite predictable – the cheaper, the more purchases. The number we were more interested in was the total revenue made by each variant. The cheaper variant (served control group) was a clear winner here as well. It achieved a 20.0% higher revenue than the more expensive one.

Table 4.9: Pricing test results

	Subscribers	Revenue
Control Group (Cheaper)	149	\$3,829.1
Variant Group (More Expensive)	106	\$3,189.6

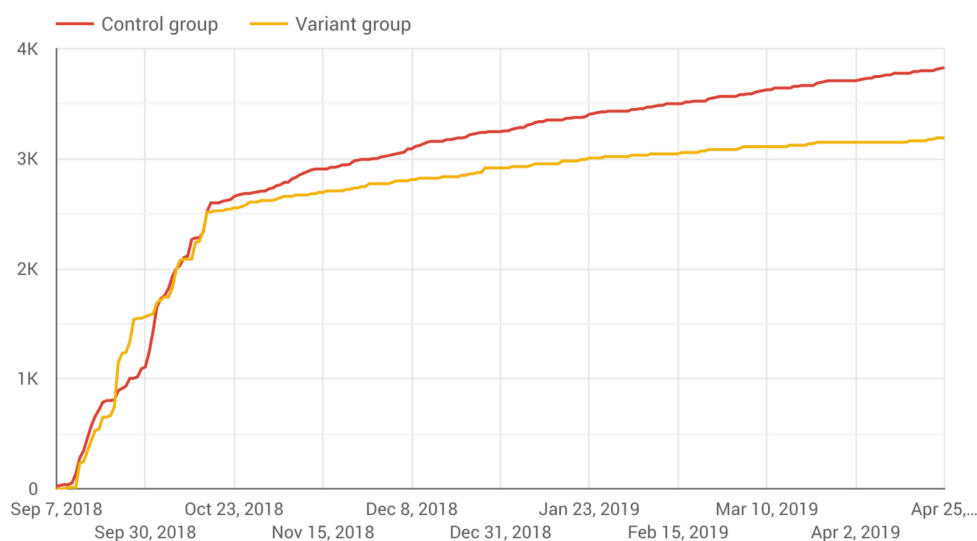


Figure 4.14: Revenue per pricing test variant

In the chart above we can see how the revenues made by each variant were evolving. The experiment was running from September 9th to October 10th, 2019. Although the revenues shown in the chart and used for evaluation are measured until April 25th, 2019. It is important to measure over a long

period of time as revenues coming from first purchases does not necessarily have to determine the winner accurately. The reason is that the premium plan retention may be different for tested versions.

Discussion

My goal was to improve Fitify App’s acquisition, engagement, and revenues using common marketing techniques. There were successful experiments, unsuccessful ones and experiment with no significant results.

The experiment with significant positive impact was especially the store listing localization 4.2 which caused a relative uplift of 11.7% in store listing visitor to install CVR. It is essential to say that this uplift was only seen on the markets where we tested, so obviously there was no uplift in English speaking countries (which were the primary source of downloads and revenues for the developer). It is also important to note that this experiment was not free at all. I estimate that localization will require about \$30 per language (for the translation) plus about \$300 for all languages to build the screenshot scripts and manage the order. The cost data are backed up by the developer’s experience with localization platforms and software engineers. I encourage the reader to estimate the cost and potential revenue before blindly localizing the store listing.

Sending push notifications 4.5 also brought a considerable increase regarding engagement metrics – the number of users who finished their first workout improved by 5% and the retention grew by approximately 6% for the group exposed to a sequence of push notifications. For both of these metrics, we are more than 99% confident they were improved. As the result was achieved with quite a simple notification strategy, the developer can hopefully improve the engagement even more by testing frequency, times, advanced targeting, or the creative part of the message.

There were also tests that may seem like a complete failure at first glance, but finding a loser variant only tells us that the particular technique can really move the needle and therefore we should go further and test other variants and hopefully find the winner. For a new app, it is also very likely that the original variant is the loser, so the result would be just the opposite (positive).

An example of such tests is the “Proportion of premium content testing” 4.6. We found out that increasing the proportion of premium content leads

to lower revenue. However, as the difference was very noticeable (11 to 36% decrease with a 95% confidence), this also means that putting even more content behind the paywall can possibly increase the revenue even more. It requires the developer to test again but can bring loads of benefits in the long run. The result is quite controversial as well. With the confidence interval of 95%, the experimental group had 33% to 41% higher retention, as well as 41% to 47% more started workouts. We have a great example of a result which has to be evaluated by the developer. Does higher revenue per acquired user lead to higher revenue in the long run? What if prioritizing engagement and retention could bring additional organic downloads we did not consider? And what if the value of a non-paying user is much higher than we think – for example when selling the company? These questions are very individual and are always important to answer. Preferably before even starting the test.

Experimenting with pricing 4.7 also resulted in decrease regarding the observed indicator. The original (cheaper) variant was a clear winner here as it achieved a 20.0% higher revenue than the more expensive one. The result actually says that changing the price can be very impactful and therefore the user should test a few more price points in the future.

Some of the tests did not show any significant results, so these marketing techniques should not have a high priority when evolving the product or creating split tests. Especially because the number of new users coming to the app is always limited and stacking A/B tests leads to bias caused by tests influencing each other.

In the case of the app size experiment 4.1, it was clear that reducing the APK size could only improve the conversion rate on the app store. In the test, we have realized it did not matter at all. In fact, reducing the app size led to a relative drop in a conversion rate of 0.38%. This result is in dispute with research presented on Google Play’s official blog [17], which found out that for every 6 MB increase of an APK size, there is a decrease in the install conversion rate of 1%. This is very interesting especially because Google featured this result on their Google I/O conference last year and I was the first one who tested it and publically shared the results.

When testing the paywall design 4.4, we did not find the winner despite having more than 60 thousand users in the test. The original variant was slightly better, but the probability was only 53%. The leader was not found in this case, so I cannot recommend making the paywall UI design test a priority. However, there may be some UX improvements that worth testing, like for example changing the number of pricing tiers as I captured while observing the Calm’s design progress in the chapter 4.4.

The UI localization 4.3 also did not end up well. In fact, we are more than 95% confident that the localization led to lower conversion to complete onboarding as well as finish the first workout in the app. The exact result was -1.8% for open to signup conversion rate and even worse drop of 9.1% in open to finish workout CVR. As we started the test simultaneously with localizing

the app store page, the reason may be that the audience was different as well. In the original variant, the user already knew the app is not localized as the app listing was not translated as well. And as these users wanted the app despite not being localized, we can assume they were really eager to use it. So the worse app store listing filtered out users who were not enthusiastic about the product enough. Another reason for the drop in engagement metrics could be that the translation quality was not as good as the English version, despite the relatively high quality of the translation described in chapter 4.3.

Conclusion

In the theoretical part of this work, I have introduced the state of mobile app business and mobile marketing. I have explained the most common monetization models and the size of the app market. As the product used in the practical part was a fitness app, I have also described the fast-growing market of health and fitness apps. More specifically, there was an introduction of the developer I worked with and their product called Fitify.

I have also introduced the tools needed to gather and visualize data from testing. These services were Firebase Analytics for data collection, Google BigQuery to store the raw data and Google Data Studio to visualize it. This technological stack is becoming an industry standard nowadays, and the reader can start using it for free, which I consider a great advantage for the purpose of this work.

Achieved Results

The goal of the practical part 4 of the thesis was to improve the selected app's revenues using common marketing techniques used by mobile developers. There were successful tests as well as the unsuccessful ones.

From the seven tested techniques, only two ended up with significantly positive results. There were two with a significant negative result as well, but in the end, it only means that these techniques should be tested before the others as we do not know whether our version is the winning one. The techniques that have the potential to move the needle are push notification re-engagement 4.5, store listing localization 4.2, changing proportion of premium content 4.6 and experimenting with pricing 4.7.

Three of the tested techniques did not show any significant results, and therefore my suggestion is not to bother by testing them at all or at least not making these tests a priority. These methods are reducing the app size 4.1 and improving the paywall design 4.1. Localizing the UI of the app did not bring any noticeable results as well. However, the UI localization was

probably necessary to keep users acquired after localization of the app store listing. Unfortunately, we do not have data on that, as we have tested these techniques simultaneously.

In the thesis, I have proved the impact of reducing app size questionable, despite Google itself recommending it, backing it up with their research and even promoting this technique on their events such as Google I/O. I was the first one publically sharing the results of applying this technique.

Besides the A/B testing, I have also done some research on leading mobile apps and explained how this research should be done. Especially observing the push notification strategies of other apps was really time-consuming, but it was the first time someone has publically shared such research. More importantly, I have explained how the reader can reproduce this observation and find a suitable re-engagement strategy for his product.

I have also suggested a way to enrich the design process in chapter 4.4 – Design Improvements. The core of this approach is comparing the app with an older version of the app and learning from improvements made by the competitor.

The goal of the practical part was to bring more users to the app and to achieve higher user LTV. I am glad I can say that both of these metrics were significantly improved. The number of monthly downloads **grew by almost three times** while I was working on the thesis. With the help of experiments shown in the thesis, the developer achieved first profitable paid PPC campaigns and hopefully is ready to scale up through paid user acquisition, especially after he launches on iOS.

Besides helping the developer, the purpose of this work was to educate the reader and to share exciting content with mobile developers and marketers. I decided to start a blog on Medium – <https://medium.com/@martinmazanec>. By the time I am finishing this work, only two of these techniques were shared publically, and as the blog was new, there were not many expectations. Despite that, my articles were featured by ASO Monthly – the most popular monthly digest about app store optimization and mobile marketing. The content from this work was also **shared and liked by marketers from companies such as Runtastic, King (Candy Crush) or 8fit.**

Future of the work

Regarding the educative part of the thesis, I will keep publishing the blog articles with techniques tested in this thesis as well as new tests and researches. Especially I want to keep publishing articles about app design with the information gathered by observing top mobile apps design evolution.

As I am a part of the development team of the Fitify App, I will surely continue finding new ways to improve the performance of the app. Some interesting techniques to try are for example localized (or personalized) pricing,

other design improvements and even tests of the workouts the app serves to the user. I will also continue scaling up the paid acquisition of the app in order to make a healthy lifestyle accessible to as many people as possible.

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Acronyms

API Application Programming Interface

APK Android Package Kit

CVR Conversion Rate

KPI Key Performance Indicator

ROI Key Performance Indicator

SDK Software Development Kit

UI User Interface

WOMM Word of Mouth Marketing

XML Extensible Markup Language

Contents of enclosed CD

README.txt	the file with CD contents description
└─ thesis	the directory of L ^A T _E X source codes of the thesis
└─ text	the thesis text directory
└─ BP_Mazanec_Martin_2019.pdf	the thesis text in PDF format
└─ BP_Mazanec_Martin_2019.ps	the thesis text in PS format