

# Digital Marketing Analytics

Group Assignment 2

## A/B Testing - Business Report

*Team members: Rada Georgieva - CID 01939931, Gabriela Garcia - CID 02011028,  
Nema Alakhwan - CID 02013509, Raul Martinez-Oviedo CID: 01867460*

### Introduction

A/B tests are very important when it comes to determining optimisations which thus leads to maximizing revenues in digital businesses. A/B experiments are rather simplistic and are mostly leveraged for design questions; thus, this technique works quite well in an online setting as parameters of interest can easily be changed, allowing us to conduct trials in order to justify business decisions. A/B testing provides the ability to test web design changes and sense users' reaction to those changes before deploying them.

For this report we will create a website for a small Food & Beverages business called "Drops of Heaven", which originated in Brazil and has now relocated to London, where it offers a range of baked goods all based on the typical Brazilian fudgy sauce "Brigadeiro". Apart from the typical fudgy Brigadeiro balls, Drops of Heaven offers Brownies and the emblematic Volcano cake. Orders are placed through direct messages on their Instagram channel. Hence, the listing of products on our website will include buttons redirecting the user to this channel.

The website was created via Weebly, and can be found using the following link: <http://dropsofheavenbrigadeiros.weebly.com/>. It consists of a Home Page, a Product Page and a Blog Page. The Home Page introduces the products, containing buttons linking to the Products page. The Product page provides assortment, pricing information and contains "Order" buttons that take the visitor to the direct messages of the Instagram Account of the business. The Blog Page introduces the story behind the goods, and allows visitors to interact and leave comments.

All of these pages can also be accessed via the navigation bar:

DROPS OF HEAVEN

HOME PRODUCTS BLOG

Each product category is described on the Home Page with a button linked to a corresponding post on the Instagram Account of Drops of Heaven.



BRIGADEIROS

The brigadeiro is a typical and very famous Brazilian sweet, made from condensed milk, powdered chocolate and butter and wrapped in soft granulated chocolate.

Order a box and make your life sweeter!



BROWNIES

Brigadeiro cakes are traditional Brazilian birthday cakes, inspired by the famous Brazilian fudge balls - moist and fudgy they suit any occasion, even an ordinary weekend.

Order one today and enjoy a piece of happiness!

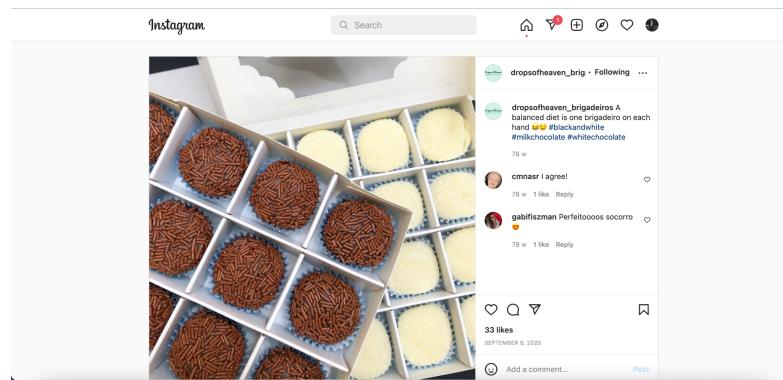


VOLCANO CAKE

Valentines Day, Halloween, Christmas, Easter, Birthday party or a Wedding - every celebration deserves a special Brigadeiro dessert to match the occasion.

Place your special order and make your event as sweet as it gets!

For example, if a visitor clicks on the button with text “Brigadeiros”, that would take them to the following instagram post:



At the bottom there is a Call to Action button that takes the visitor to the Product page:



BRIGADEIROS

The brigadeiro is a typical and very famous Brazilian sweet, made from condensed milk, powdered chocolate and butter and wrapped in soft granulated chocolate.

Order a box and make your life sweeter!



BROWNIES

Brigadeiro cakes are traditional Brazilian birthday cakes, inspired by the famous Brazilian fudge balls - moist and fudgy they suit any occasion, even an ordinary weekend.

Order one today and enjoy a piece of happiness!



VOLCANO CAKE

Valentines Day, Halloween, Christmas, Easter, Birthday party or a Wedding - every celebration deserves a special Brigadeiro dessert to match the occasion.

Place your special order and make your event as sweet as it gets!

ENTER THE STORE

When clicked on, it presents a listing of all products, their assortments and prices, together with "Order" buttons that help the visitor land to the Order Channel - the Instagram Business account of the Drops of heaven ([https://www.instagram.com/dropsofheaven\\_brigadeiros/](https://www.instagram.com/dropsofheaven_brigadeiros/)) :

To track the clickstream we implemented a tag management system to collect analytics on a webpage. It consists of a couple of Google Analytics Tags, which we then manually add to the header and footer of each page of the website.

The first two tags are used to interact with the website without interfering with the server optimization. They enable us to view and analyze clickstream data real time in Google Analytics:

The Google Optimize Tag is also placed in the header of the html code to link the A/B test we will construct to the website's homepage. In this way, we ensure we can track the pageviews and other conversion metrics for the original website (controlled), as well as all other variants we would like to test . Each variant includes one design change, which we believe influences conversion rates. Then we track the latter in terms of pageviews, that is, the average number of pageview events per user in the experiment. This is the best inbuilt metric we could track on Google Optimize given that our website is not of an e-commerce essence. After enough users have interacted with each variant we can look at the readily available A/B test results on Google Optimize and can download the raw data to run our own Hypothesis Analysis.

Crazy Egg is an alternative to Google Optimize which enables us not only to run A/B tests, but also to look at heatmaps to help us understand how impressions vary across the position on the landing page. It also enables us to define custom goals such as the clicks of a specific button.

## Test Design, Rationale and Implementation

The question we want to test for our website is **what is the optimal color for our Call-to-Action button that leads to a higher conversion rate**. We use the predefined Google Optimize objective **Pageviews as a conversion goal**. This will help us answer **which CTA button color leads to a higher average number of pageview events per user in the experiment**.

As the end goal of each conversion rate optimization is to translate into revenue, we will **test the button that is most closely related to our business' bottom line**. In this case, we use the button with text "**Enter the store**" at the **button of the Homepage**. This button takes the visitor to the Product listing page, that in turns directs the visitors to the Instagram Sales Channel where orders can be placed.

For comparison purposes, we use our Original website, where the CTA button is transparent, as control. In addition, we also have a Variant 1 of the site page where the button is light blue. This is shown in the figures below.

### Original website (Control)

The screenshot shows a website for "DROPS OF HEAVEN". At the top, there is a navigation bar with links for HOME, PRODUCTS, and BLOG. Below the navigation, there are three product cards:

- BRIGADEIROS**: An image of a tray of brigadeiro chocolates. Below the image is a button labeled "BRIGADEIROS".

The brigadeiro is a typical and very famous Brazilian sweet, made from condensed milk, powdered chocolate and butter and wrapped in soft granulated chocolate.

Order a box and make your life sweeter!
- BROWNIES**: An image of a brownie cake. Below the image is a button labeled "BROWNIES".

Brigadeiro cakes are traditional Brazilian birthday cakes, inspired by the famous Brazilian fudge balls - moist and fudgy they suit any occasion, even an ordinary weekend.

Order one today and enjoy a piece of happiness!
- VOLCANO CAKE**: An image of a volcano-shaped cake. Below the image is a button labeled "VOLCANO CAKE".

Valentines Day, Halloween, Christmas, Easter, Birthday party or a Wedding - every celebration deserves a special Brigadeiro dessert to match the occasion.

Place your special order and make your event as sweet as it gets!

At the bottom of the page, there is a blue footer bar with the text "POWERED BY: weebly". To the right of the footer bar is a button labeled "ENTER THE STORE".

## Variant 1 (CTA Button Blue instead of transparent):

DROPS OF HEAVEN

HOME PRODUCTS BLOG

**BRIGADEIROS**

The brigadeiro is a typical and very famous Brazilian sweet, made from condensed milk, powdered chocolate and butter and wrapped in soft granulated chocolate.

Order a box and make your life sweeter!

**BROWNIES**

Brigadeiro cakes are traditional Brazilian birthday cakes, inspired by the famous Brazilian fudge balls - moist and fudgy they suit any occasion, even an ordinary weekend.

Order one today and enjoy a piece of happiness!

**VOLCANO CAKE**

Valentines Day, Halloween, Christmas, Easter, Birthday party or a Wedding - every celebration deserves a special Brigadeiro dessert to match the occasion.

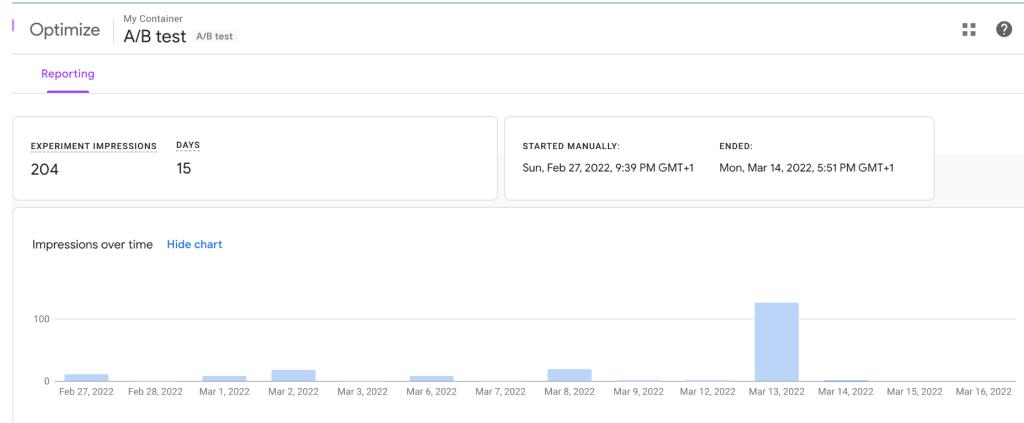
Place your special order and make your event as sweet as it gets!

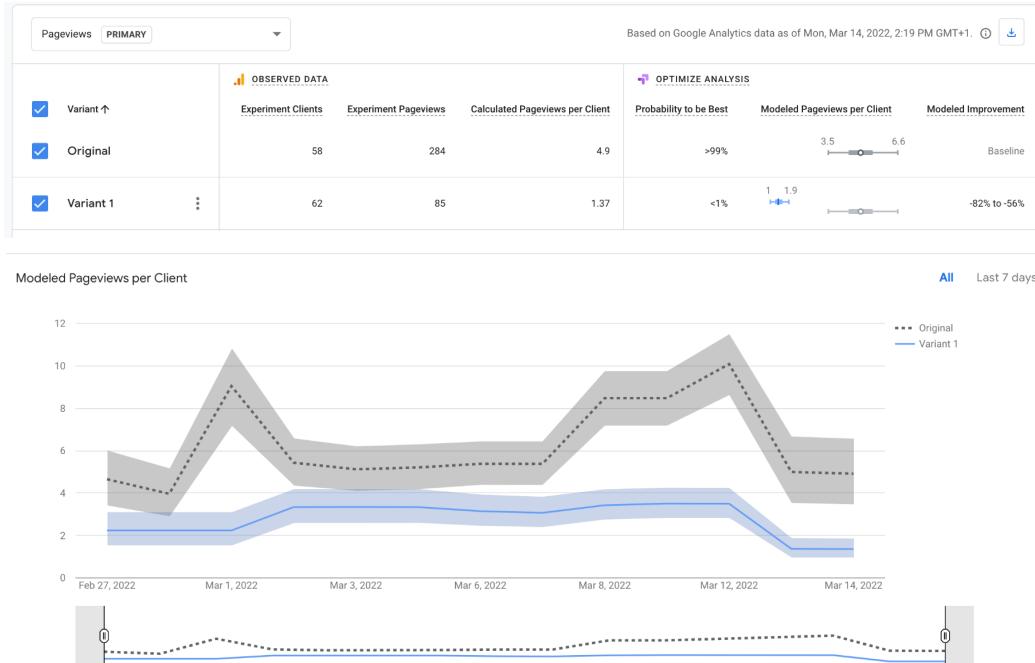
**ENTER THE STORE**

POWERED BY App Store

We believe that this test is directly linked to the bottom line of the business, as the higher number of pageviews leads to an increased likelihood of reaching the final sales channel and placing an order. More pageviews per user, would indicate a higher number of clicks of the “Enter the store” button. The reason we are comfortable with this assumption is that this is the only button linking to another standard page on the website. The rest of the buttons have links to external pages (e.g. Instagram post/page of Drops of Heaven). This button is also the only way the visitor can reach the product listing page of the website aside from selecting it directly from the navigation bar. Thus, this is the only button that directs a user to the only sales channel in our website.

The information we would like to extract from the test is the experiment pageviews and the calculated pageviews per user on each version of the landing page. In Google Optimize Reporting Page of the experiment we get a table with this information together with modeled pageviews (the median and 95% of performance) and a graph with the modeled pageviews where the gray line represents the original page and the blue line represents the variant. The line represents the median of the performance range, while the shaded area is the 95% range.

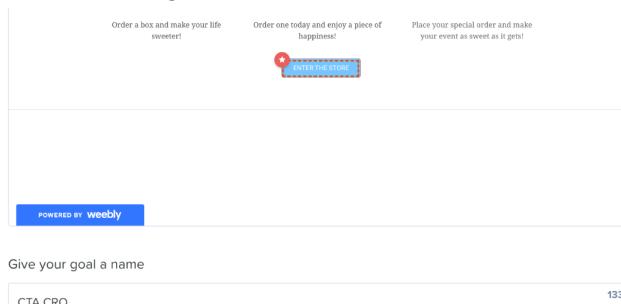




Moreover, in the Optimize Analysis section of the table, we are given a calculated Probability to be Best, which shows the probability that a variant consistently outperforms all others. The higher this number, the more confidence there is in results.

We will take these already available metrics into account but will also run our own One- and Two-Sided Null Hypothesis Analyses. In the Two-Sided test we will set the alternative hypothesis to be that the original landing page pageview per user mean is higher than the one of the variant landing page. As we have constructed the experiment thinking that the blue color of the button would increase the number of pageviews, our goal would be to fail to reject the null hypothesis showing that we have high certainty that its mean is smaller in the original version. In order to obtain a sufficient sample, we used word-of-mouth strategy (sending the link to our friends and families), sharing the link in our cohort's group, as well as posting it on one of our Facebook profiles. On the 15th day we had 204 experiment impressions, with 58 experiment clients in the original landing page and 62 in the variant one.

Furthermore, we leverage Crazy Egg A/B testing to set a custom conversion metric specific only to clicks of the button we have changed the color of.



Where the conversion of each variant is defined as the number of clicks of the Enter the Store button in each variant as a percentage of its experiment unique visits. We have chosen to perform an A/B test over multivariate testing, since an A/B test provides a relatively simple way to evaluate the performance of a button that leads to sales/purchases. Our website refers to a small business for which tracking sales is probably more important than other metrics, such as website traffic or volume, to enable growth. Thus, assessing the impact of changes on accessing our sales channel is relevant for the business.

## Data Analysis and Conclusions

### Optimize Analysis

The Report Page of our Google Optimize Experiment, shows that on the 15th day of our experiment the Original landing page is the definite winner.

ENDED

#### The original is the leader

The original has a >99% probability to be best. [Learn more.](#)

The modeled improvement when using Variant1 landing page, i.e., the difference in conversion rate – measured as a percentage – between the variation and the baseline, is on average -72%. This together with the smaller than 1% probability of Variant1 outperforming the baseline model, brings certainty that the Original landing page with transparent CTA button is better than the Variant1 landing page where the button is blue. The higher than 99% Probability to be Best of the Original landing page, gives us confidence that we should not implement the experiment changes included in Variant1.

### Hypothesis Test

We will use hypothesis testing to formally check whether the Original Landing page is better in generating pageviews per user compared to the variant. For this aim, we need to generate random data from each variant's distribution. The mean of the distribution is the calculated pageviews per client, and the standard deviation is calculated based on the 95% performance provided in our Google Optimize Report - we know that the lower bound of this range is two standard deviations smaller than the average, and the upper one - two standard deviations higher.

Leveraging the data on our Google Optimize Report Page, we know that on the 15-th day of our experiment, we had the following performance results, means and standard deviations for each variant of the homepage:

Variant	Experiment Clients	Experiment Pageviews	Mean	Standard deviation	Probability to be Best	Modeled Improvement
Original	58	284	4.9	0.7	>99%	0%

Variant 1	62	85	1.4	0.2	<1%	-72%
-----------	----	----	-----	-----	-----	------

We use this information to generate a random sample given the above sample size (experiment clients), mean(pageviews per user) and standard deviation in R in the following way:

```
{r}
original <- rnorm(n=58, mean=4.9, sd=0.7)
variant1 <- rnorm(n=62, mean = 1.4, sd = 0.2)
```

Based on this data, we will perform Hypothesis Tests it in two ways:

**1) Two-Sample T-test with Unequal Variance, where:**

- a) H0: mean of original page views = mean of variant page views
- b) H1: mean of original pageviews != mean of variant pageviews

**2) Two-Sample T-test with Unequal Variance and Directional Hypothesis, where:**

- a) H0: mean of original pageviews <= mean of variant pageviews
- b) H1: mean of original pageviews > mean of variant pageviews

The results of the Two-Sample T-test with Unequal Variance prove that the performance of the two version of the landing page are significantly different, as the p-value is close to zero and we reject the null Hypothesis stating that the two distributions have the same means:

```
t.test(original,variant1)
```
Welch Two Sample t-test

data: original and variant1
t = 38.176, df = 64.212, p-value < 2.2e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
3.411264 3.787969
sample estimates:
mean of x mean of y
5.033933 1.434316
```

As we want to understand the direction in which the performance differs, i.e, which variant has better performance in driving pageviews per client, we perform the same Hypothesis but this time stating as an alternative hypothesis that the Original land page has higher average number of pageviews per client compared to the Variant1 landing page:

```
```{r}
t.test(original,variant1,alternative = 'greater')
```
Welch Two Sample t-test

data: original and variant1
t = 38.176, df = 64.212, p-value < 2.2e-16
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
3.442254 Inf
sample estimates:
mean of x mean of y
5.033933 1.434316
```

Since the p-value is close to zero, we reject the null hypothesis stating that the Original landing page has worse or equal performance as Variant1.

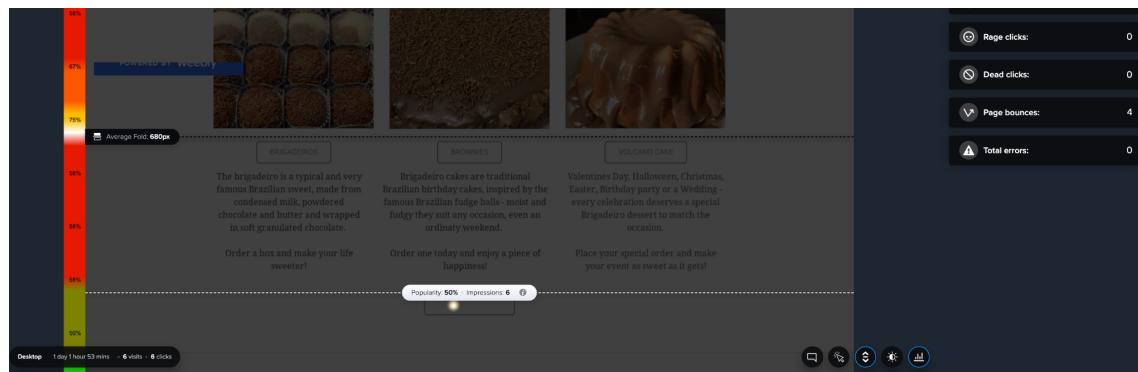
The results of the above tests bring to **the conclusion that the optimal color of CTA button to drive client pageviews is the Original one, where it is transparent and is the same as all other clickable buttons**. This means that we should not change our page design to Variant 1 land page, where the CTA button is blue, whereas the rest of the button colors remain transparent.

## Further Analysis, Limitations and Next Steps

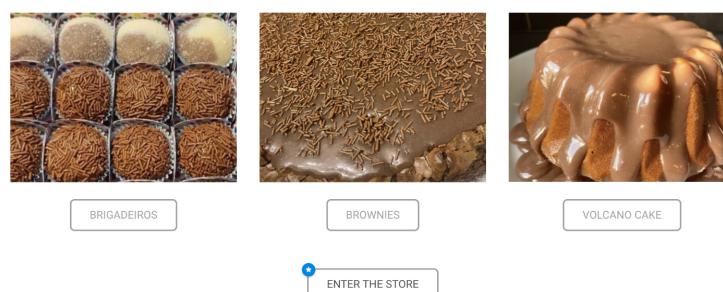
Given that we change a concrete button's color, we would be better off if we choose as a website functionality to optimize the clickthrough rate of the button itself. However, this is not available in the predefined objectives of Google Optimize. An opportunity we looked into and evaluated is the use of Crazy Egg Tag, which we created and used to set up an A/B test in Crazy Egg's website with the Objective to optimize the CTR of the "Enter the store" button.

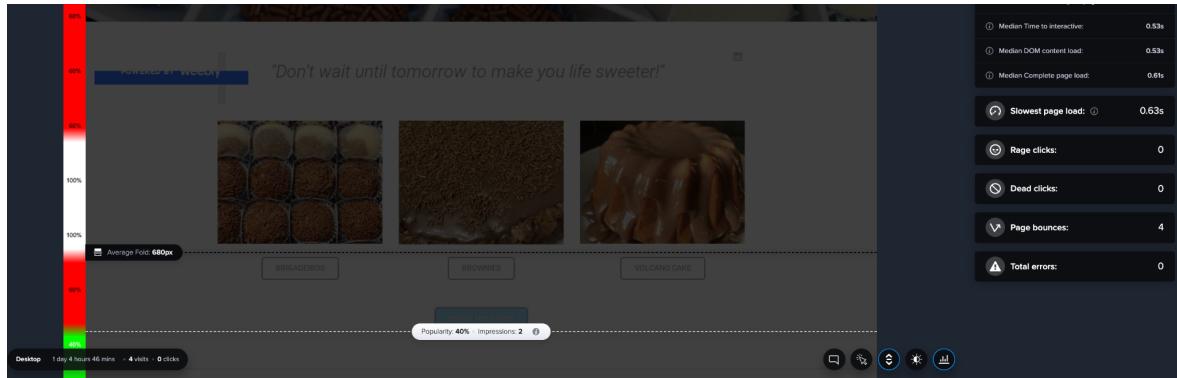
With a conversion rate of 67% of the original landing page vs 158% of the one with changed button color, it states the opposite performance results compared to the Google Optimize A/B test. However, the limitation is that the test was set up too close to the submission deadline, and the number of visitors is not sufficient to make conclusions with certainty, as the sample size is insufficient to do so.

Another opportunity, which we could leverage using Crazy Egg is the heatmap feature, which shows us that the impressions of the landing page are much higher in the center of the page. At the same time our CTA button is below that area:



Hence, we set up an experiment in which we remove part of the content and in this way we have our button in an area where popularity is higher:



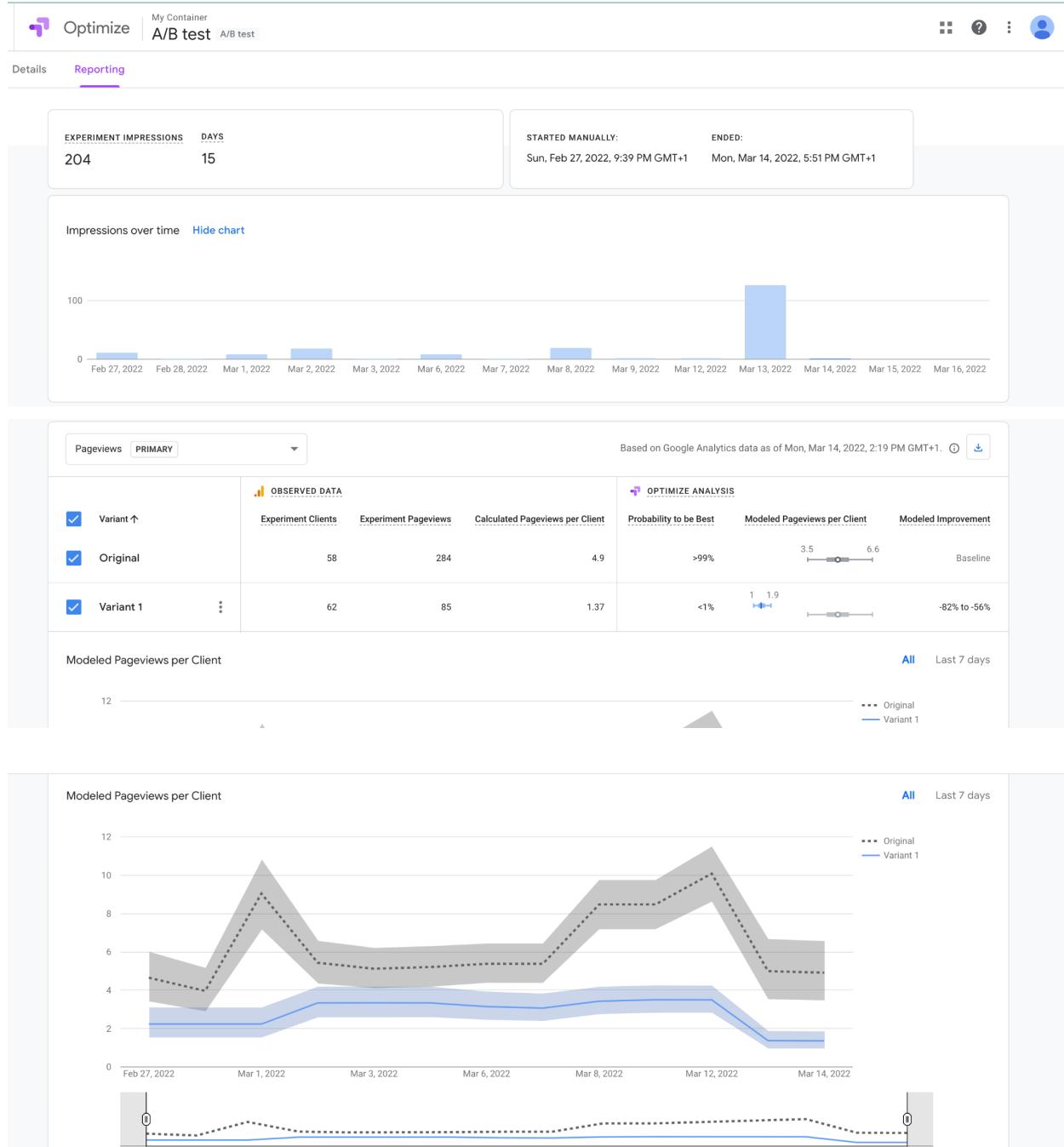


Current results show that this view has the lowest conversion rate despite placing the button in an area with more impressions. It could be that the reduction of content leads to a decrease of the call to action effect due to lack of sufficient information. However, as this experiment was set up quite late, the sample size is not large enough to make definitive conclusions.

As a next step, we would collect clickstream on the Crazy Egg test, and make the appropriate analysis to conclude which web design leads to more engagement with the button that links most closely with the bottom line of the business. Moreover, we would perform Multivariate tests in Google Optimize to test the change of multiple features in the landing page.

# Appendix

## Google Optimize Report Page



# Google Analytics Report Page

Reports snapshot (✓)

All Users Add comparison +

Custom Feb 26 - Mar 13, 2022 ▾

**Users** 125    **New users** 126    **Average engagement time** 0m 21s    **Total revenue** £0.00

27 Feb 01 Mar 03 05 07 09 11 13 Mar

WHERE DO YOUR NEW USERS COME FROM?

New users by First user default channel grouping ▾

| Channel        | New users |
|----------------|-----------|
| Direct         | 115       |
| Organic Social | 15        |

[View user acquisition →](#)

WHAT ARE YOUR TOP CAMPAIGNS?

Sessions ▾ by Session default channel grouping ▾

| SESSION DEFAULT CHANNEL G... | SESSIONS |
|------------------------------|----------|
| Direct                       | 146      |
| Organic Search               | 18       |
| Organic Social               | 11       |

[View traffic acquisition →](#)

Users ▾ by Country

| COUNTRY        | USERS |
|----------------|-------|
| United States  | 76    |
| Bulgaria       | 25    |
| United Kingdom | 13    |
| Sweden         | 4     |
| El Salvador    | 3     |
| Armenia        | 1     |
| France         | 1     |

[View countries →](#)

HOW ARE ACTIVE USERS TRENDING?

User activity over time

30 DAYS: 129  
7 DAYS: 101  
1 DAY: 93

27 Feb 01 Mar 03 05 07 09 11 13 Mar

HOW WELL DO YOU RETAIN YOUR USERS?

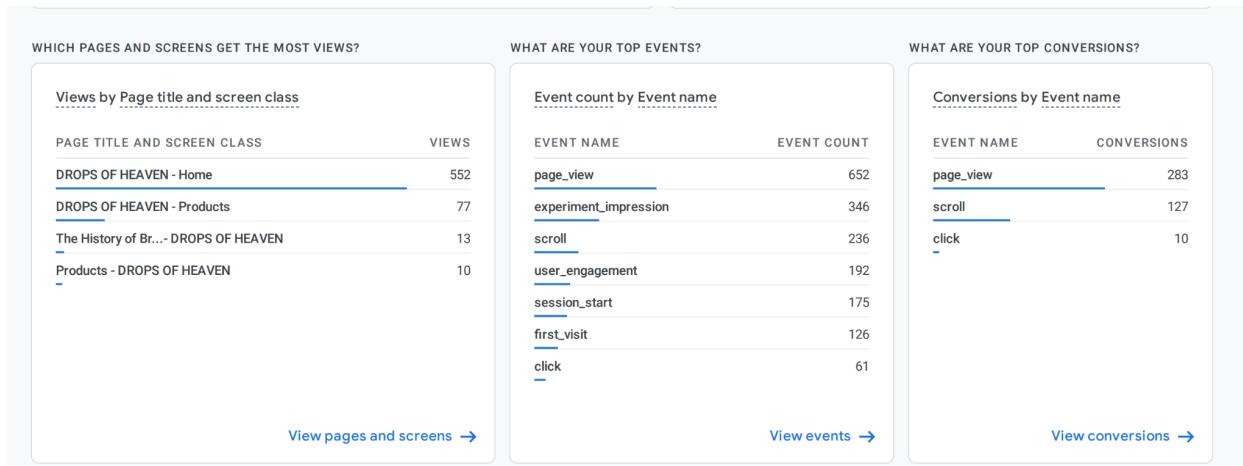
User activity by cohort

Based on device data only

|                 | Week 0 | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 |
|-----------------|--------|--------|--------|--------|--------|--------|
| All Users       | 100.0% | 20.7%  | 25.0%  | 25.0%  | 0.0%   | 0.0%   |
| Jan 30 - Feb 5  | 100%   | 20%    | 25%    | 25%    | 0%     | 0%     |
| Feb 6 - Feb 12  | 100%   | 20%    | 25%    | 25%    | 0%     | 0%     |
| Feb 13 - Feb 19 | 100%   | 20%    | 25%    | 25%    | 0%     | 0%     |
| Feb 20 - Feb 26 | 100%   | 20%    | 25%    | 25%    | 0%     | 0%     |
| Feb 27 - Mar 5  | 100%   | 20%    | 25%    | 25%    | 0%     | 0%     |
| Mar 6 - Mar 12  | 100%   | 20%    | 25%    | 25%    | 0%     | 0%     |

6 weeks ending Mar 12

[View retention →](#)



## Crazy Egg A/B test

Original:

The screenshot shows a dark-themed dashboard from Crazy Egg. On the left, there's a heatmap overlay on a webpage showing user interaction patterns. The main content area displays a promotional message: "Don't wait until tomorrow to make your life sweeter!" Below it are three dessert images: BRIGADEIROS, BROWNIES, and VOLCANO CAKE. To the right, a sidebar lists various performance metrics with their values: Median DOM content load (0.54s), Median Complete page load (0.61s), Slowest page load (0.64s), Rage clicks (0), Dead clicks (0), Page bounces (4), and Total errors (0). At the bottom, there are navigation icons and a summary bar indicating 1 day 1 hour 53 mins, 6 visits, and 6 clicks.

Variant 1:

This screenshot shows the same dark-themed dashboard for Variant 1. The heatmap and main content area are identical to the original. However, the sidebar metrics show significant differences: Rage clicks (3), Dead clicks (5), Page bounces (9), and Total errors (0). The summary bar at the bottom indicates 1 day 6 hours 18 mins, 12 visits, and 19 clicks.

## Variant 2:

