

Master Thesis

Factors of Attraction

Renan Oliveira Moreira

2019

Eötvös Loránd University

Faculty of Education and Psychology

Master of Science in Computational and Cognitive Neuroscience

Factors of Attractions

Author Supervisor

Renan Oliveira Moreira Dr. Christophe Heintz

Student Head of the Department of Cognitive Science at CEU

2019

Declaration of Originality

I declare herewith, that this thesis presented here is my own original work.

Furthermore, I confirm that:

− this work has been composed by me without assistance;

− I have clearly referenced in accordance with departmental requirements, in both the text and the bibliography or references, all sources (either from a printed source, internet or any other source) used in the work;

− all data and findings in the work have not been falsified or embellished;

− this work has not been previously, or concurrently, used either for other courses or within other exam processes as an exam work;

− this work has not been published.

I appreciate that any false claim in respect of this work will result in disciplinary action in accordance with the university or departmental regulations.

I confirm that I understand that my work may be electronically checked for plagiarism by the use of plagiarism detection software and stored on a third party’s server for eventual future comparison.

Renan Oliveira Moreira February 04th, 2019

Proof of consultation, supervisor’s statement

page should contain a confirmation form which contains the supervisor's consent for thesis submission

ACKNOWLEDGEMENTS

ABSTRACT

KEYWORDS

Table of Contents

[ABSTRACT I](#_Toc2092322)

[KEYWORDS II](#_Toc2092323)

[PART I: BACKGROUND 1](#_Toc2092324)

[1. INTRODUCTION 1](#_Toc2092325)

[1.1 MOTIVATION OF THE RESEARCH 1](#_Toc2092326)

[1.2 RESEARCH AIM AND OBJECTIVES 1](#_Toc2092327)

[1.3 RESEARCH METHODS 1](#_Toc2092328)

[2. THEORETICAL FOUNDATIONS 1](#_Toc2092329)

[2.1 CULTURE TRANSMISSION 1](#_Toc2092330)

[2.2 CULTURAL ATTRACTOR THEORY 1](#_Toc2092331)

[PART II: EXPERIMENT / EMPIRICAL PART 2](#_Toc2092332)

[3. DESIGN 2](#_Toc2092333)

[3.1 ARCHITECTURE 2](#_Toc2092334)

[3.1.1 ANGULAR FRAMEWORK 3](#_Toc2092335)

[3.1.2 FIREBASE HOSTING AND DATABASE STRUCTURE 3](#_Toc2092336)

[3.2 SCENARIOS FOR TESTING 6](#_Toc2092337)

[3.2.1 CALIBRATION 7](#_Toc2092338)

[3.2.2 FACE 8](#_Toc2092339)

[3.2.3 SPIRAL 9](#_Toc2092340)

[3.2.4 BUTTON 9](#_Toc2092341)

[4. COLLECTING DATA PHASES 10](#_Toc2092342)

[4.1 CALIBRATION PHASE 10](#_Toc2092343)

[4.2 TESTING PHASE 10](#_Toc2092344)

[4.3 ATTRACTOR CONDITION PHASES 10](#_Toc2092345)

[5. ANALYSIS OF DATA 10](#_Toc2092346)

[5.1 ALGORITHMS 10](#_Toc2092347)

[PART III: CONCLUSION 10](#_Toc2092348)

[6. DISCUSSION AND FUTURE WORK 10](#_Toc2092349)

[6.1 RESEARCH OBJECTIVES: SUMMARY OF FINDINGS 10](#_Toc2092350)

[6.2 LIMITATIONS 10](#_Toc2092351)

[6.3 FUTURE RESEARCH 10](#_Toc2092352)

The thesis should contain the table of contents as well as a list of the figures and tables. The page numbering is continuous. The list of tables and figures complement the table of contents.

TABLE OF CONTENTS

ABSTRACT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

PART I: BACKGROUND

1. INTRODUCTION

1.1 MOTIVATION OF THE RESEARCH

1.2 RESEARCH AIM AND OBJECTIVES

1.3 RESEARCH METHODS

2. THEORETICAL FOUNDATIONS

2.1 CULTURE TRANSMISSION

2.2 CULTURAL ATTRACTOR THEORY

PART II: EXPERIMENT / EMPIRICAL PART

3. DESIGN

3.1 ARCHITECTURE

3.1.1 ANGULAR FRAMEWORK

3.1.2 FIREBASE HOSTING AND DATABASE STRUCTURE

3.2 SCENARIOS FOR TESTING

3.2.1 CALIBRATION

3.2.2 FACE

3.2.3 SPIRAL

3.2.4 BUTTON

4. COLLECTING DATA PHASES

4.1 CALIBRATION PHASE

4.2 TESTING PHASES

4.3 ATTRACTOR CONDITION PHASES

5. ANALYSIS OF DATA

5.1 ALGORITHMS

PART III: CONCLUSION

6. DISCUSSION AND FUTURE WORK

4.1 RESEARCH OBJECTIVES: SUMMARY OF FINDINGS

4.2 LIMITATIONS

4.3 FUTURE RESEARCH

REFERENCES

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

Pixels px

PART I: BACKGROUND

# 1. INTRODUCTION

## 1.1 MOTIVATION OF THE RESEARCH

## 1.2 RESEARCH AIM AND OBJECTIVES

## 1.3 RESEARCH METHODS

# 2. THEORETICAL FOUNDATIONS

## 2.1 CULTURE TRANSMISSION

## 2.2 CULTURAL ATTRACTOR THEORY

PART II: EXPERIMENT / EMPIRICAL PART

# 3. DESIGN

The design of this project is a result of a collaborative work and ideas between the supervisor of the project and head of the Cognitive Science department of the Central Eastern University, Dr. Christophe Heintz and myself, student graduating at the Master of Science program of Computational and Cognitive Neuroscience at the Eötvös Loránd University.

Due to the deeper and wider knowledge of C.A.T. and the longer history on the field of Cognitive Science, the conditions tested on this experiment are a result of the Dr. Heintz ideas (with my minimal contributions). And the implementation of the project, meaning: developing, deploying and maintaining the website are result of my expertise on the field of Information Technology, due to my Bachelor in Computer Science and work experience on the aforementioned area.

On the following chapters, it will be detailed the architecture of the website, including the technical aspects of it, and also the conditions tested, the reasoning behind each of them, and how they are related with the theory of factors of attraction. The code of the website won’t be presented nor explained on this paper because it’s not the aim of this project approaching the nuances of computer programming, but rather test the Cultural Attractor Theory using a web platform which enables high availability and collection of data. That said, the code have comments in itself with the goal to facilitate the understanding of anyone interested on it and it’s available on the personal GitHub repository of the author of this Master’s Thesis. That can be accessed at: https://github.com/RenanOm92/factorsAttractionFirebase.

## 3.1 ARCHITECTURE

Talk about the screens (home screen, instructions, start screen, fill-out, feedback screen, results screen)

### 3.1.1 ANGULAR FRAMEWORK

The project was developed using the framework Angular, which provides the possibility of creating applications compatible with cross platforms (web, mobile web, desktop)[insert reference <https://angular.io/>], fulfilling one of the aims of the design of the experiment which was having a website accessible by every type of user, at any moment, from anywhere. Generating this way, a spreader sample of whom would interact with the website, deeply connected with our goal that is to examine culture transmission, meaning that the bigger the reach of the experiment, the more accurate would be the conclusions draw by it.

Angular is also an open source project led by Google and the community, which provides a great and stable environment for development, but at the same time still being updated with new features and being one of the most popular Frameworks for web development [insert reference <https://hackernoon.com/is-the-angular-decline-a-myth-e4cf563b72d6>]. Another important advantage of Angular it’s the two-way data binding feature, which enables the Model and the View being synchronized, allowing them to communicate between each other and any changes on the data would affect the visualization of it, used on the project for the calculation of the random position of the cross visualized in the start of each round.

With all of these qualities listed above, Angular was chosen as the framework used for constructing the website of the experiment. The version utilized was Angular 5, released on November 1st of 2017.

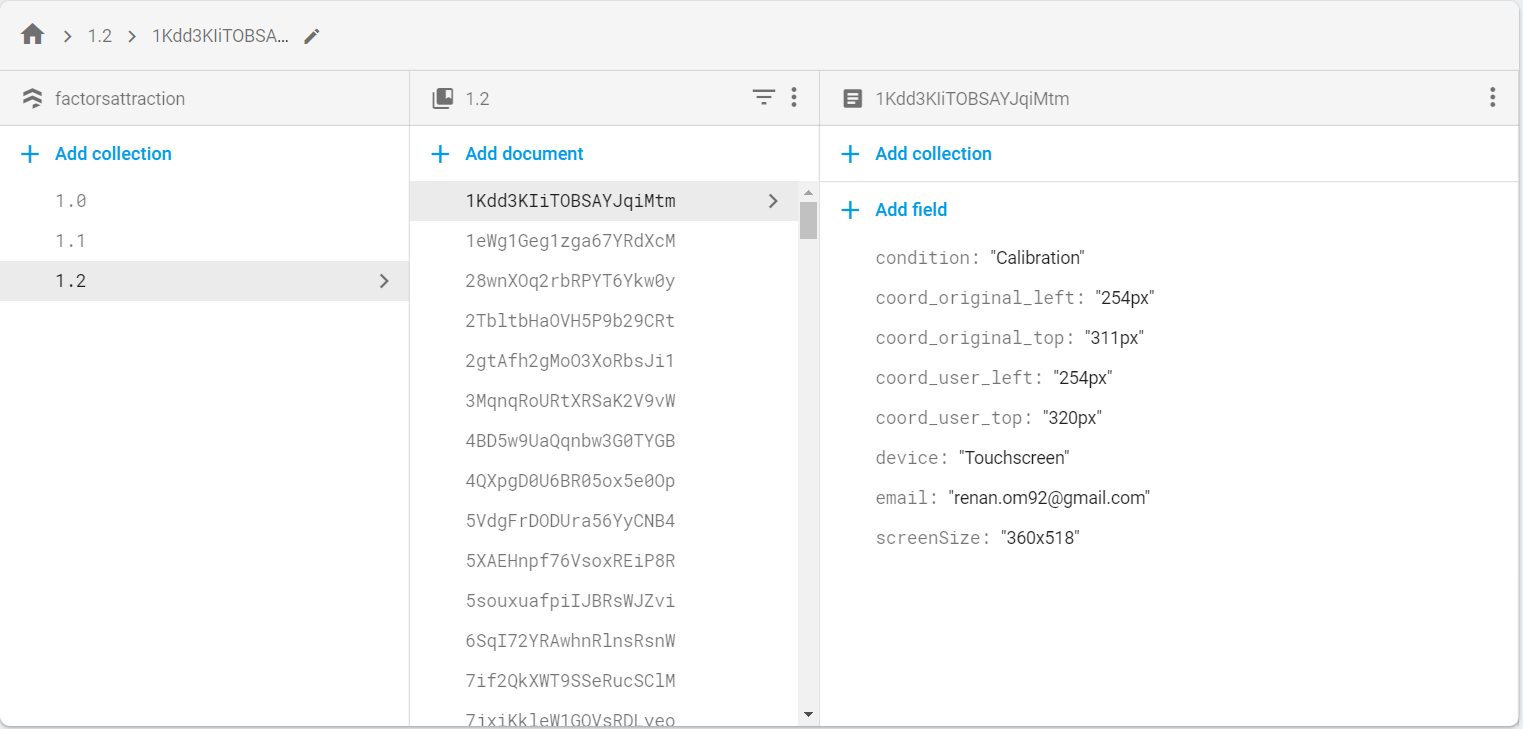
### 3.1.2 FIREBASE HOSTING AND DATABASE STRUCTURE

Firebase is a multifunctionality platform owned by Google which provides a large range of products, including hosting and database integration to web applications which were necessary for the deployment of this experiment. [insert reference <https://firebase.google.com/>] Firebase was the chosen platform because it offers a free plan with the following specifications, which covers all the needs of the project: hosting the web application, 100 simultaneous connections, saving the data on a database with a limit of 1 *Gigabyte* per month, extracting the data from the database and custom domain. For the reasons listed above, the website was then hosted on Firebase with the domain name: factorsattraction.firebaseapp.com. And all the data collected from the experiment was saved on the Cloud Firestore Database accordingly with the data structure supported: Collection, Document, Data as shown on the figure [Figure X]. [insert reference <https://firebase.google.com/docs/firestore/>]

Figure X. https://firebase.google.com/docs/firestore/data-model

The experiment was released in different phases, as it will be explained on the section 3.2 COLLECTING DATA PHASES, and it each phase was saved as Collections using the semantic versioning approach [insert reference <https://blog.codeship.com/best-practices-when-versioning-a-release/>]. Each interaction of the user (also called as one round) it was saved as a Document with ID generated randomly by Firebase, and all the data referent to the round was saved inside the document. Each document on the final phase of the project had the following structure of data: *condition*, *coord\_original\_left*, *coord\_original\_top*, *coord\_user\_left*, *coord\_user\_top*, *device*, *email*, *screenSize*. The database structure can be seen on the figure [Figure X].

Figure X. Made by me on my profile firebase



The meaning of each field value is better explained on the Table X below:

|  |  |  |
| --- | --- | --- |
| Field | Description | Type of data and exemplification |
| Collection | Container of the document. Used for control of version. | Numbers on the format:  1.1  2.0 |
| Document | Unit of storage, represents one interaction of the user playing the experiment. It’s an unique sequence of 20 characters composed of letters or numbers generated randomly by Firebase. | Sequence of 20 letters or digits:  1Kdd3KIiTOBSAYJqiMtm  4BD5w9UaQqnbw3G0TYGB  4QXpgD0U6BR05ox5e0Op |
| Condition | Represents the possible conditions in which the experiment can be played. | One of the following values:  Calibration  Face  Spiral  ClickHereBottomLeft  ClickHereTopRight |
| coord\_original\_left | Represents the horizontal position on pixels which the cross was displayed at the beginning of the experiment. Where the 0 value is the left of the screen. | Number followed by pixel:  746px |
| coord\_original\_top | Represents the vertical position on pixels which the cross was displayed at the beginning of the experiment. Where the 0 value is the top of the screen. | Number followed by pixel:  520px |
| coord\_user\_left | Represents the horizontal position on pixels which the cross was answered by the user. Where the 0 value is the left of the screen. | Number followed by pixel:  777px |
| coord\_user\_top | Represents the vertical position on pixels which the cross was answered by the user.. Where the 0 value is the top of the screen. | Number followed by pixel:  12px |
| device | Contains which type of input device was used by the user. | One of the following values:  Touchscreen  Mouse |
| email | Contains the e-mail of the participant, used with the purposes of controlling the number of total interactions versus total of users. | Any possible value containing the e-mail format:  aaaaaa@aaaa.aaa |
| screenSize | Stores the value of the screen size of the device in which the participant used for starting the experiment. | Number x Number:  1366x626 |

Table X.

## 3.2 SCENARIOS FOR TESTING

## 

When playing the game, the user can experience seven unique and different scenarios, they are: calibration, face, spiral centralized, spiral on the top right, spiral on the top left, “click here” button on the top right and “click here” button on the bottom left of the screen. Those scenarios will be detailed and explained in the following chapters. The scenario on which the user will play the game is randomly generated before the round starts (on the screen containing the instructions of the experiment in case of being the first round or at the end of the experiment for any rounds after that).

Even though the scenarios are randomly assigned, it was created a weighted value of appearance for each of them, with the purpose to have more appearance of a desired scenario. In the tested design, the weights were the selected ones: 33.3% for face scenario, 33.3% for the spiral scenario, 22.2% for the “click here” button and 11.1% for the calibration scenario. The calibration scenario has a lower weight because it was collected calibration data in previous phases, meaning that it wasn’t necessary expose this scenario with the same frequency. And the “click here” button has a slightly lower weight due to the fact that it has only two variances, in contrast with the spiral that have three.

### 3.2.1 CALIBRATION

The calibration scenario was the first stage of the software development and contains the core of the experiment, and it also has the purpose of being a calibration for the following scenarios, meaning that the data collected with this scenario can be used as our control group to further comparisons, this is possible because the calibration scenario don’t have any figure or image that could have a role of being a factor of attraction.

The calibration scenario consists of a white background at the start page and feedback page with a black fill-out screen between them. The start page contains the original position of the cross and it is displayed for one second. Then automatically it is displayed the fill-out screen for half second and then the feedback page can be visualized until the user inputs some value for the cross.

The original position where the cross can be displayed at the beginning of the experiment is generated randomly but it follows some conditions and one parameter. The conditions that it must follows are: not being too close to the edges of the screen, nor being in the center. The cross can not be in the center due to the appearance of the button “play again” on the center of the results page, which could lead the button to cover some results.

The parameter for calculation of the position of the cross is the screen size of the device of the user. Due to the reason that each user can have different devices (mobiles, personal computers, tablets) with different screen resolutions, it is necessary to capture the screen size on which the user is playing and then based on that, generate the original position of the cross.

Based on those informations, the original position of the cross is a random value in pixels between 5% of the screen size until 45% or 55% until 95% (for both height and width independently). So for example, if the screen resolution is 2000 × 1000 pixels (width × height), the possible values for the width would be from 100px until 900px, and from 1.100px until 1.900px and for the height would be from 50px until 450px and from 550px until 950px.

### 3.2.2 FACE

The face scenario has the same features of the calibration but with the addition of a background image in the start page and feedback page, this image (figure X) has the intention of recalling the shape of a face with a missing eye. The purpose of this scenario is to try out the hypothesis that the missing eye could be a factor of attraction. Due to the reason

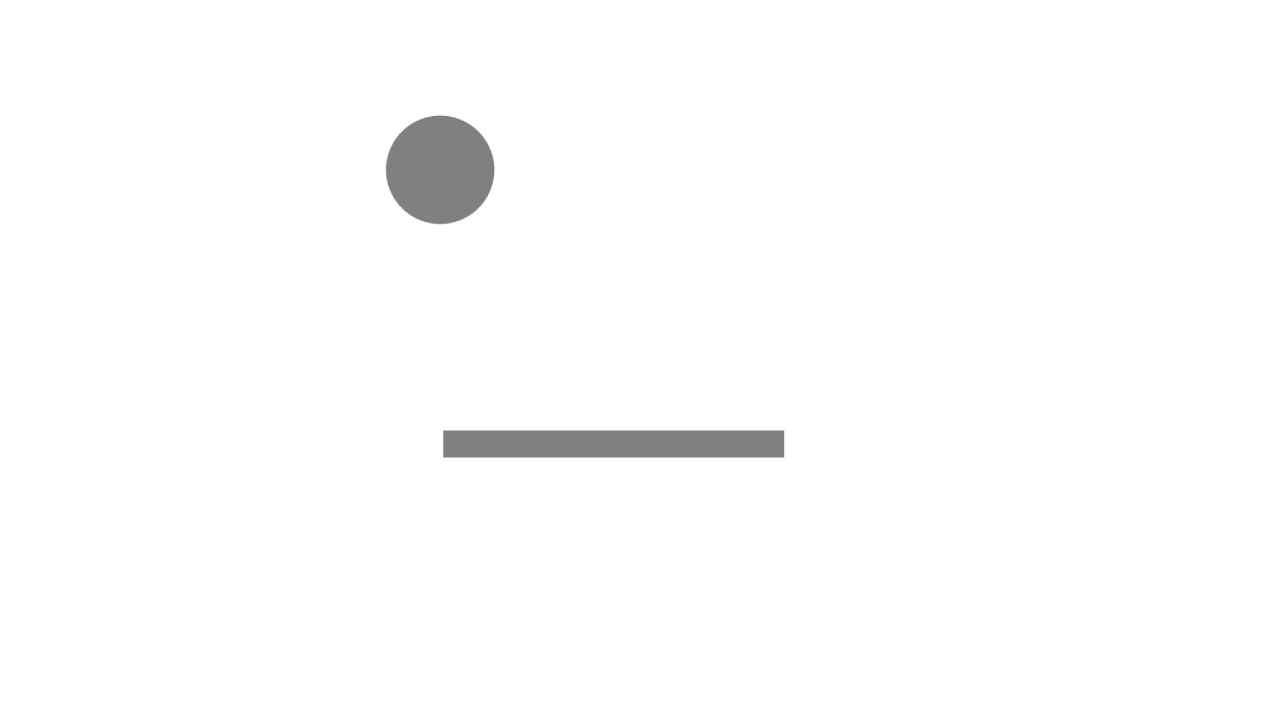


Figure X

The face shaped image is always centralized on the screen, and has the feature of missing the right eye. The size of the image is adjustable and relative to the size of screen, which means that the figure does not have a fixed value in pixels, so our analysis of the feedback of the cross need to be based on percentage of the screen size of each user, so in this way we are able to examine if the feedback of the user is located in an approximate position of the missing eye of the shaped face figure. With that said, the center of the missing eye position figure (a hypothesized factor of attraction) is approximately on the coordinates 55% from the left and 27% from the top screen sizes.

Due to the position of the face and more specifically the missing eye being centered, I guided the generation of the random cross position to be more centered also. While the conditions of the cross position on the calibration scenario is being between 5% and 45% or 55% and 95%, in the scenario of the face, it was defined as between 30% and 49% or 51% and 70%. With these limits, the occurrence of the cross position on the center will be higher than in the calibration phase. At the moment of the design, I believed it was worth generating values between 45% and 49% and 51% to 55%, meaning that the cross position could be further covered by the “Play again” button, affecting the usability and user experience quality but would increase the total of valuable samples for data analysis.

### 3.2.3 SPIRAL

The spiral scenario like the previous one is an extension of the calibration, but it has the addition of showing a spiral on the fill-out screen for 0.5 seconds, this spiral (figure X) has three different variances, based on the location where it can appear (top-left, centralized or top-right) on the screen. This scenario have the purpose of to try out if the center of the spiral could be a factor of attraction. Due to the reason



Figure X

### 3.2.4 BUTTON

The button scenario is also based on the calibration, but it has the addition of a button on the fill-out screen which is necessary to be clicked to proceed with the experiment, this feature is different from all other scenarios, in which the fill-out screen is showed for 0.5 seconds then automatically the feedback screen is shown. The button (figure X) has two different variances, based on the location (bottom-left and top-right) on the screen. The possible factor of attraction tested on this scenario would be the button itself. Due to the reason



Figure X

# 4. COLLECTING DATA PHASES

The website started gathering data on the day XX of December of 2018 and is available until the present day, but at XX of April of 2019 it was taken a snapshot of the database and this specific day will be the last date in which the data will be used for analysis.

## 4.1 CALIBRATION PHASE

## 4.2 TESTING PHASE

## 4.3 ATTRACTOR CONDITION PHASES

# 5. ANALYSIS OF DATA

## 5.1 ALGORITHMS

PART III: CONCLUSION

# 6. DISCUSSION AND FUTURE WORK

## 6.1 RESEARCH OBJECTIVES: SUMMARY OF FINDINGS

## 6.2 LIMITATIONS

## 6.3 FUTURE RESEARCH

ANALYSIS: USER\_LEFT - ORIGINAL % SCREEN SIZE - POSITIVE MEANS: MORE LEFT

NEGATIVE MEAN MORE RIGHT

USER\_TOP - ORIGINAL % SCREEN SIZE - POSITIVE MEANS MORE TO TOP

NEGATIVE MEAN MORE BOTTOM

LOOK SPECIFICALLY EACH QUADRANT