

DM

Digital Nudging - A Human Component Automation Tool

MASTER DISSERTATION

Fernando Jacob Teixeira Martins

MASTER IN INFORMATICS ENGINEERING



UNIVERSIDADE da MADEIRA

A Nossa Universidade

www.uma.pt

September | 2021

Digital Nudging - A Human Component Automation Tool

MASTER DISSERTATION

Fernando Jacob Teixeira Martins

MASTER IN INFORMATICS ENGINEERING

ORIENTATION

Pedro Filipe Pereira Campos

Dedicatory

I would like to thank everyone who helped and supported me along this path, which now ends with this master's thesis.

To my advisor, Professor Doctor Pedro Filipe Pereira Campos, for his availability, guidance, patience and review of all my work.

To my partner Sara for all her support, help, attention and patience throughout the development of this dissertation, being always available to support me in the bad moments and that always motivated me to finish this journey.

To Carlos, Diogo and Luis, my colleagues at the university, for all their support during the writing of the document.

To other friends from high school, university and work, and also my family, for their support throughout the completion of this dissertation.

Abstract

Technological advances make people increasingly use computer systems to perform various actions such as shopping, watching the news, making payments, etc. Through digital nudges, which are the change of the user interface to choose a certain previously determined option, it is possible to implement human component automation tools that facilitate the integration of nudges in different sites. The implementation of nudges on websites is not simple and requires technical knowledge to change the interfaces previously chosen so that users can make choices predetermined by the site managers. Currently, there are no defined methods or tools that help site managers to implement nudges for their users, thus it is intended to take an initial step towards the creation of a tool that allows this first step to be taken and facilitates the implementation of nudges on the various websites without the need of specialized staff to provide nudges. Through the nudging tool we implemented, it is intended to automate the human component so that site managers can add nudges to their websites through a plugin. The addition of a nudge will be done in a simple way and require little technical intervention by the site managers. A plugin was developed in WordPress, through which three nudges were created. To validate the tool that was developed two similar sites (one without nudges and another with nudges) were made available to a set of users and the interaction of users with both sites was collected through Google Analytics. The results show that applying digital nudging through the variation of the default slider and the size variation of the content has changed users' behavior. On the website with nudges, 75% of the actions performed by users were the intended ones. The website with nudges equally gathered a higher percentage of clicks (more 32.35% in comparison to the no nudges website). The very positive results encourage the continuous use of nudges in digital environments and shed some light to future works.

Keywords: Nudges, Digital Nudges, Human Behavior, Human Automation

Resumo

O avanço tecnológico faz com que as pessoas cada vez mais utilizem os sistemas informáticos para realizar diversas ações tais como compras, ver notícias, efetuar pagamentos, etc. Através dos *nudges* digitais, que são a alteração da interface do utilizador para a escolha de uma determinada opção previamente determinada, possibilita-se a implementação de ferramentas de automação da componente humana que facilitam a integração de *nudges* nos diversos *websites*. A implementação de *nudges* em *websites* não é algo simples e requer algum conhecimento técnico para que se consiga alterar as interfaces previamente escolhidas para que os utilizadores efetuem escolhas predeterminadas pelos gestores dos *websites*. Atualmente, ainda não existem métodos definidos nem ferramentas que ajudem os gestores de *websites* a implementar *nudges* perante os seus utilizadores, deste modo, pretende-se dar um passo inicial para a criação de uma ferramenta que permita dar este primeiro passo e facilite a implementação de *nudges* nos diversos *websites* sem que seja necessário pessoal especializado na disponibilização dos *nudges*. Através da ferramenta de *nudging* que se implementou, pretendeu-se automatizar a componente humana de modo que um gestor de *websites* consiga adicionar um *nudge* ao seu *website* através de um *plugin*. A adição de um *nudge* será efetuada de forma simples e irá requerer pouco intervenção de forma técnica por parte dos gestores do *website*. Foi desenvolvido um *plugin* no WordPress, através deste foram criados três *nudges*. Para validar a ferramenta que se desenvolveu foram disponibilizados dois sites semelhantes (um sem *nudges* e outro com *nudges*) a um conjunto de utilizadores, onde através do Google Analytics se recolheu a interação dos utilizadores perante ambos os *websites*. Os resultados mostram que a aplicação de *nudges* digitais através da variação da posição inicial do *scroll* e da variação do tamanho do conteúdo, alterou o comportamento dos utilizadores. No *website* com *nudges*, 75 % das ações realizadas pelos utilizadores foram as esperadas. O *website* com *nudges* também obteve uma maior percentagem de cliques (mais 32,35 % em comparação com o site sem *nudges*). Os resultados são muito positivos e incentivam o uso contínuo de *nudges* em ambientes digitais, proporcionando um avanço para trabalhos futuros.

Palavras-chave: *Nudges*, *Nudges* digitais, Comportamento humano, Automação humana

Contents

List of Figures	xi
List of Tables	xiii
List of Acronyms	xv
1 Introduction	1
1.1 Context	2
1.2 Motivation	2
1.3 Goals	3
1.4 Structure of the document	4
2 State of the Art	5
2.1 Dual process theories	5
2.2 Nudge	6
2.2.1 Contextualizing nudges	7
2.2.1.1 Mistaken nudges	8
2.2.1.2 Fuzzy nudges	8
2.2.2 Ethics and policy	9
2.2.3 Nudging mechanisms	10
2.2.3.1 Facilitate	10
2.2.3.1.1 Default option	11
2.2.3.1.2 Opt-out policies	11
2.2.3.1.3 Position	11
2.2.3.1.4 Hiding	11
2.2.3.1.5 Suggesting alternatives	11
2.2.3.2 Confront	12
2.2.3.2.1 Throttling mindless activity	12
2.2.3.2.2 Alerting consequences	12
2.2.3.2.3 Friction	12
2.2.3.3 Delude	12
2.2.3.3.1 Displaying poor choices	13
2.2.3.3.2 Induce with past memory experiences	13
2.2.3.3.3 Illusive visualization	13
2.2.3.4 Social pressure	13
2.2.3.4.1 Invoking reciprocity	13
2.2.3.4.2 Exploit public commitment	13
2.2.3.4.3 Show user's actions	14
2.3 Digital nudging	14
2.3.1 Non digital nudges vs digital nudges	15
2.3.2 Examples of digital nudges	16

2.3.3	Process of designing digital nudges	16
2.3.3.1	Defining the goal	17
2.3.3.2	Understand the users	17
2.3.3.3	Design the nudge	17
2.3.3.4	Testing the nudge	18
2.4	Existing solutions	19
3	Development	21
3.1	Implementation tools	21
3.1.1	Squarespace	21
3.1.1.1	Technical analysis	22
3.1.2	WordPress	22
3.1.2.1	Technical analysis	23
3.1.3	Decision	24
3.2	Interface design and description	25
3.2.1	Implementation description	26
3.2.1.1	Choice of type of nudges	27
3.2.1.2	How nudging tool works (explain how it will work and its intended purpose)	27
3.2.1.3	Implementation barriers	28
4	Tests and Results	31
4.1	Experimental procedure	31
4.1.1	Methodology	32
4.1.2	Validation	33
4.1.3	Metrics	33
4.2	Results and discussion	34
4.3	Limitations	38
5	Conclusions and Future Work	41
5.1	Conclusions	41
5.2	Future Work	42
5.2.1	Alert system with Google Analytics	42
5.2.2	Application of artificial intelligence	43
	Bibliography	45
A	Orientações para testes	49

List of Figures

1	Four nudges categories related with modes of thinking	6
2	Designing digital nudges follows a cycle.	19
3	Squarespace vs. WordPress: a comparison	24
4	Designed prototype depicting the structure for creating nudges.	25
5	Designed prototype depicting the nudge applied to the website interface.	26
6	Percentage of pages viewed by users in the no nudges' website.	35
7	Percentage of pages viewed by users in the nudges' website.	35
8	Section of informative content in the website page without nudges.	36
9	Section of informative content section page with nudges	36
10	Log of user click event across the nudge and no nudge websites.	38
11	Percentage of actions of content with and without nudging, in the nudge website.	39

List of Tables

1	Steps for choosing a digital nudge	18
2	Number of website users per country.	34
3	Interaction of users across the nudge and no nudge websites.	37

List of Acronyms

API Application Programming Interface.

GA Google Analytics.

JSON JavaScript Object Notation.

PHP Hypertext Preprocessor.

UI User Interface.

UK United Kingdom.

Chapter 1

Introduction

In recent years, the use of technology has increased. The recent generations increasingly adhere to computer equipment for work, leisure and other operations. Mobile phones have inclusively been considered the 21st-century icon [1].

This increase led to the search for new solutions more adapted to the end user in the digital context. More and more, users are requiring to take certain actions according to situations that benefit them: choosing item x instead of item y, donating to an important cause, etc. Nudges are applied for this purpose. Nudges are slight changes to the way options are displayed or the information is organized so that could have an impact on behavior [2]. For example, the United Kingdom improves public services through strategies of human behavior, by delivering social norms messaging and induced payments of fines with personalized text message of the delinquent they significantly increase on-time tax payments [3]. Another example is the use of an assumed policy of consenting to organ donation, when looking at the countries with this policy applied, it is possible to see that the rate of organ donation was higher than countries that by default had a policy of asking for consent for organ donation [4]. Nudges, that were already used in non-digital environments, now gain relevance to be used in digital environments. Nudges in a digital environment are named digital nudging.

Digital nudging is defined as the change of design elements of the user interface so that people's behavior change [5]. Starting in digital environments, we already have an architecture that is presented to the user and the user is the one who visits this architecture and makes a set of choices about it. Thus, taking into account the good example and the previously tested operation of nudges in non-digital environments, their implementation in digital environments will impact choices that benefit users of digital environments. For instance, An example of a digital nudge is the implementation of a social network detox so that people become less addicted. For this you can apply a nudge to hide sections and notifications, by hiding sections such as display bars or advertising on sites, if users want to see the content they will have the option to show it once or show it always. The default option of nudge hides all the multimedia content of the sites, and you will have to be the user to select the content you want to see. This leads users to see that they are wasting time and stop using social media so much [3].

Nowadays, the use of nudges is becoming widespread around the web. From traveling [6] to food consumption [7, 8] and e-commerce [9] companies, nudges are everywhere. Nudges have been even used to encourage COVID-19 vaccination [10].

After realizing how digital nudges are already in use in several websites on the internet, this thesis intends to respond to the lack of nudging tools on the market in order to create a human optimization component to create nudges on the various websites.

1.1 Context

These days, more and more people are influenced, through tenuous processes. Choosing how options are presented to people can be considered a nudge.

A nudge is defined as any aspect of choosing architecture, that alters behavior in a perishable way, whether choosing something without setting aside either option, or significantly altering economic incentives. A small and apparently insignificant detail can have major impacts on people behavior. Normally, nudges are applied over non-digital environments. These environments are where the user has a physical presence over the space. The most common example of a nudge is promoting healthier eating behavior to people over shops by replacing cakes and chocolates by fruit next to the cash register. In a non-digital environment, nudges can be easily applied, as they were designed taking in account the user proximity and direct contact.

In the digital space, we can also find some nudges, which are usually associated with the scarcity of products presented to users or by alerting the presence of other users seeing the same products. There are more nudges that can be applied to the digital context, however these last two are the most commonly used. There are, already, some use of digital space nudging mechanisms, but it is important to remember that nudge design rules and methods were designed to be used in physical environments. With some adaptation and alternation of existing examples, it is possible to apply these nudges to the digital space.

There are already some tools that aim to apply nudges into the digital environment, but these normally require human intervention and are not easily accessible to any type of user. The same tools, still require market, product and user studies, to understand which and how nudges will be applied. The creation of a tool capable of enabling the simple manager of a web platform to use nudges without external interventions is a big step towards increasing the volume of users on the platform to fulfill what the manager originally intended.

Currently, there is no tool that allows the website managers to choose the elements they want to associate with a nudge. There is also no mechanism that facilitates the implementation of different architectures on the elements (nudges), so that users eventually make the desired choice.

At the moment, the use of nudges is difficult due to the process of creation of the web interface, before implementations of all interfaces, details and presentation messages. This is a problem, since adapting the interface to integrate nudges will apply changes that have monetary and time costs, and is usually made by specialized people.

The complexity of digitally deploying nudges makes it impractical for use directly, as it requires the presence of third parties to implement changes. Ideally, the web platform manager should be able to select the various products/elements and associate it to the various nudges available to use, and then get the expected results from clients/users.

1.2 Motivation

Nowadays, people in different countries spend a lot of time in front of a device with internet access, either doing some kind of work or taking some leisure time. The presence of people in the online world is definitely a small door for nudges in the digital world. Adopting minor

changes to how people view content of a website, advertisements, videos, etc., may lead them to take a decision that was not their choice first.

In the previous topic, we read that there is a weak adoption of nudges on digital platforms. The lack of free and simple tools for the adoption of nudges influences their use on digital platforms.

There is already an extensive experience of the influence of non-digital spaces that has formed over the course of years. Although, there are always some restrictions and changes to make when moving from an offline environment to an online environment. There are already a good basis of testing that shows that this technique really works. Taking something that is already known to be successful and innovating is challenging and also brings motivation for stepping up to the next level. In the creative process, we came up with some ideas on how to make the difference in the digital world. We started with a creation of Application Programming Interface (API), use of artificial intelligence, creation of a proper website to generate nudges and even a tool as a plugin. From these ideas, we chose to select a tool as a plugin, as it aims to integrate this functionality with existing services, such as WordPress, and provide a new presentation opportunity for those who have less room to maneuver with their own web platforms.

The idea of creating a tool that facilitates the implementation of nudges in the digital space, particularly on websites, came when it was found that there is little offer of basic nudge implementation tools. Most tools are paid or have a large maintenance service that web platform managers normally cannot afford.

After the first research on nudges, we found it exceptional how a simple change of a presentation aspect could influence the choices made by people. This theme aroused our curiosity to see what existed at the digital level, given that in a digital environment we also have the possibility of making changes in the various interfaces of the content available in the virtual world.

The theme of nudges in a virtual world is still not very explored, so it was decided to find out how nudges would work and what results they would bring in a digital world and what serious response from people regarding the use of nudges in a virtual world.

Another aspect that led us to think about creating a nudging tool was the possibility of understanding how human behavior is and how it varies according to the situations they face in a digital environment. In the non-digital environment, we already know that nudges have a great impact in terms of changing behavior and selecting different options, given a set of alternatives [11].

For the first tool, we intend to develop a plugin that will support the web platform manager. The plugin is a simple tool, which should already contain a set of rules or parameters that will be applied automatically by the plugin, taking into account the content selected by the web platform manager and the type of influence he intends to transmit to platform users.

1.3 Goals

In this section, we will review what where our goals are during the development of this dissertation. Our first objective was to create a tool that facilitates the implementation of

digital nudges in a website by their managers without the need to make code-level changes and without having specialized staff to make code-level changes. Our goal was that a website manager could apply a nudge without any specialized training and could arrive at an administration dashboard and be able to apply a nudge to a certain interface with an action that was intended by him.

When creating this tool, we also wanted to apply an optimization of the human component in order to facilitate the implementation of nudges in the digital environment.

It was still intended to reduce the time to implement a nudge in a virtual environment. Usually the implementation of changes to digital interfaces requires time for more thoughtful changes at the code-level, however the intention was to reduce this implementation time through a tool that knows how to generate this code that will transform our interface so that users finally make the choice that was initially intended by the site managers.

Finally, our ultimate goal is to understand how human behavior changes in the digital environment through changing digital interfaces. We wanted to understand if, when we change the interface, if the users' behavior would be the same or if they would have different actions and attitudes from the initial ones.

1.4 Structure of the document

After the first introductory chapter, the dissertation is composed of four more chapters. Throughout Chapter 2 we describe what nudges are, how they came about and how we can apply nudges in a digital context in order to change the behavior of a set of people in order to make a previously defined choice.

According to the State of the Art in Chapter 2, in the next Chapter 3 we will describe the approach followed in order to create the intended system, a plugin for the creation of digital nudges. We start by describing the tools and technologies used to implement our tool, the prototyping model and our system architecture.

In Chapter 4 we present the experimental procedure that was followed to validate the work developed. This chapter also analyzed the results collected and discussed these data and what was expected.

Finally, in Chapter 5 the conclusions and future work were presented, here we draw conclusions about the work developed, about the nudges at a digital level, and we also present two features that change the plugin created in order to make it even simpler to use.

Chapter 2

State of the Art

2.1 Dual process theories

In psychology, there is a theory called dual-process that classifies thinking in two basic modes, the reflective and the automatic mode. This theory is one important contribution to understand human behavior and decision-making [12].

The automatic mode is the principal mode of thinking. It is responsible for repeated and skilled actions, and dominates in contexts that demand quick decisions with minimal effort. It is instinctive, emotional and operates unconsciously. People rely on this mode when they have to act quickly, have lack of information, aren't receiving the correct feedback, and when they find themselves in unanticipated feelings or moods [13].

The reflective mode of thinking is essentially the make of decisions based on a rational process. This process is conscious, slow, effortful and goal-oriented [12].

The reflective and automatic mode cooperate with each other. As we have a propensity to reduce effort, our reflective mode is only used when the automatic system cannot handle the situations (Figure 1). Most of our daily decisions are not reflected: they are activated by a situational stimulus and managed by the automatic mind.

When the automatic mind is taking care of our decision/action, we apply heuristics that enable the substitution of unavailable or hard to access information by a piece of accessible information, that will generate accurate judgments. When we are dubious about how to act in a certain situation, we may observe what others do and copy their actions. This is known as herd instinct [12].

Heuristics support the making of easy and fast decisions, in demanding situations, however they open a little breach into cognitive biases turning us susceptible to systematic deviations from rational judgment [13].

For instance, the *status quo bias* reflects the tendency to resist change and accept the path with the least resistance. Therefore, we regularly opt to choose the default option instead of taking some time to consider the possible alternatives, even if the default option is again our interests. The research in the field of behavioral economics provides a repertoire of cognitive biases, which propels in the design of interactive technology that support decision-making and behavior change [12, 14].

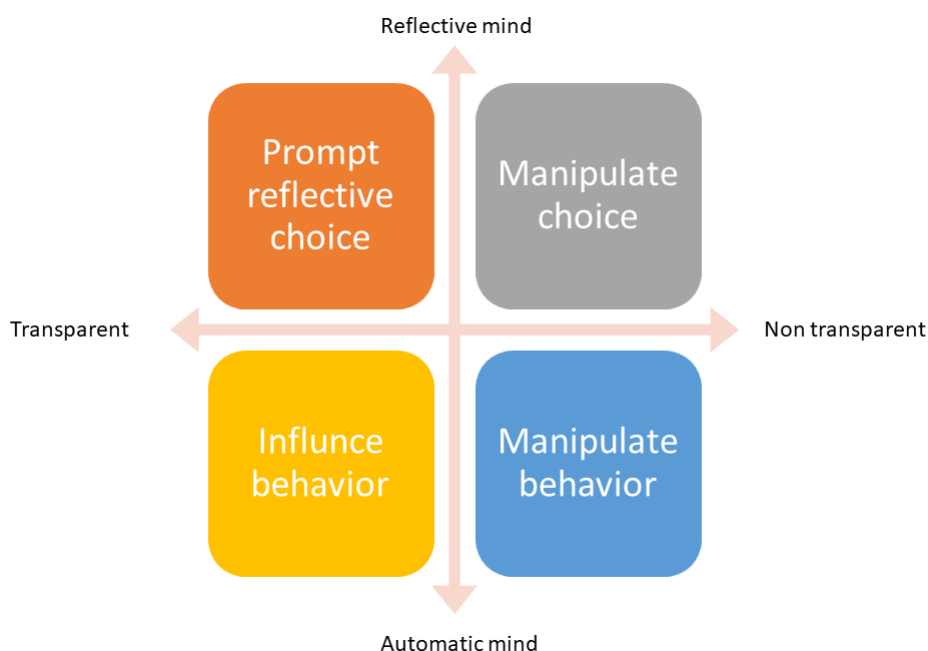


Figure 1: Four nudges categories (prompt reflective choice, manipulate choice, influence behavior, and manipulate behavior) related with modes of thinking. Figure adapted from Caraban [12].

2.2 Nudge

In the previous section, we approached the concept of dual-process theory of decision-making describing an introductory form. Also, a reference was made about how the decision-choices works. The dual-process theory is divided into a process of automatic decision-making (where the process of thinking is quick in decisions with minimal effort) and into a process of reflective decision-making (where a decision is made based on a rational process).

The essential idea to keep from the last section is that, although both modes of thinking work together, the automatic mode is the most often used way of thinking. Although the automatic mode of thinking is the most used, it is important to remember that this is susceptible to cognitive biases [15].

Still in the same subject, the advances in the behavioral sciences revealed that human behavior and decision-making is boundedly rational, systematically biased, and strongly habitual owing to the interplay of psychological forces with what ought to be, from the perspective of rationality, irrelevant features of complex decision-making contexts.

Finding a way to explore the susceptible to cognitive biases in the automatic thinking to reduce negative impacts is a worthy goal. Thaler and Sunstein introduced the idea of nudging where a choice architect, who is responsible for designing, would consider what biases are likely to hold sway [13].

Thaler and Sunstein defined nudging as 'any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any option or significantly changing their economic incentives' [16]. In this perspective, the authors also agree that nudges may avoid some challenges and pitfalls of traditional regulation, like costly and ineffective campaigns and invasive choice regulations like bans [15].

According to Hansen, the way how Thaler and Sustein define a nudge easily conflates what is a descriptive behavioral concept with that of the separate political doctrine of libertarian paternalism. Hanse defined a “nudge as a function of (condition l) any attempt at influencing people’s judgment, choice or behavior in a predictable way (condition a) that is motivated because of cognitive boundaries, biases, routines, and habits in individual and social decision-making posing barriers for people to perform rationally in their own self-declared interests, and which (condition b) works by making use of those boundaries, biases, routines, and habits as integral parts of such attempts” [15].

Nudges are changes in the decision-making context that work with cognitive biases and helps prompt us, in subtle ways that often function below the level of our awareness, to make decisions that leave us and usually our society better off [13].

2.2.1 Contextualizing nudges

The most discussed example in the contextualization of nudges is the changing from an opt-in to an opt-out policy that bring a positive impact. An example of the policy change is to choose an opt-out organ donation. Societal welfare will have a positive impact, without forbidding individuals options or significantly changing their economic incentives. The idea of this example is that with a simple change that requires a new action from user will make him opt for minimal effort, letting the change as it is [17].

Another example of a nudge is to change the place of healthy food in a prominent position, so people have an healthier behavior. A concrete example is the replacement of cake with fruit in the impulse basket next to the cash register. The change was found to lead people into buying more fruit and less cake, when both choices were still available [17].

Now that some examples of nudging were presented, let’s compare the difference between a nudge and a non nudge approach, for instance in cafeterias. Consider two cafeterias that want to help people consume less junk food. One cafeteria decides to attack the problem by placing a higher price (“tax”) on junk foods or by banning the sale of junk foods. The other cafeteria decides to change the food display so that junk foods will be less chosen. Junk foods will be placed on higher, harder-to-reach shelves, while healthy foods will be placed at eye level and within arm’s reach.

Both cafeterias are trying to influence the behavior of people, but they are using two entirely different methods. The first cafeteria is influencing behavior by either financially incentive people to choose healthier options or restricting their options and, thus, their freedom of choice. The second cafeteria uses a nudging strategy. By changing the placement of the food, the cafeteria is influencing people to have a more healthy choice without forbidding any options or significantly changing their economic consequences [16].

Nudges can be quite influential in modifying people’s behavior in ways they are not aware of. To ensure that influence is not exploitable, Thaler and Sunstein insist that choice architects design nudges that are inexpensive to use, easy to opt-out of, function without changing financial incentives, transparent, and only get designed to help people live according to their best interests [13].

2.2.1.1 Mistaken nudges

Even though the idea of nudge appears straightforward, the design and application of nudges can be confusing in practice. The British Behavioral Insight Team created a program that uses nudges by giving citizens free anti-smoking kits containing nicotine replacement patches and voucher checkbooks with discounts on gym memberships, swimming sessions, and other healthy activities. While these examples may be a clever way to change people's behavior, it isn't a nudge. The British program changes costs associated with quitting to smoke and healthy activities. The program relies on people responding rationally to changes in financial incentives. Nudges alter the choice architecture in ways that expect people to continue to respond according to biases. Changes in incentives are not nudges, as they do not work with biases. They expect people to respond rationally to changes in incentives [18].

Another example of a mistaken nudge is a suggestion made by Jean King, the Cancer Research United Kingdom (UK) Director of Tobacco Control. She claimed that cigarettes should be less alluring for children to smoke, and suggests that this can be done by disallowing "brightly lit" displays to appear next to "sweets and crisps" [13].

Despite Jean's suggestion is established on top of psychological insights, it is still a prohibition. Jean's suggestion doesn't nudge tobacco companies to stop targeting children, neither nudge children to feel less drawn to smoking. Prohibitions, policies, and programs that focus on psychology and behavioral economics are not nudges if they limit people's choices. Strategies to modify people's behavior that use psychology and behavioral economics are not necessarily nudges. Nudges use the results of these social sciences, but they do so in ways that work with biases and preserve choice and incentives [13].

2.2.1.2 Fuzzy nudges

Occasionally, it isn't clear if an intervention qualifies as a nudge or not. For example, Daniel Hausman and Brynn Welch argue that Thaler and Sunstein mistakenly use cases of "giving advice", "rational persuasion", and rendering "information salient" as nudges. Daniel and Brynn use the example of the ambient orb, a technology that provides feedback on energy consumption. The orb changes the color of the bulb between red and green, informing users that they are using lots of energy or using much less energy, respectively. Thaler and Sunstein agree that the ambient orb is persuasive that "in a period of weeks, users of the orb reduced their use of energy, in peak periods, by 40 percent" [13].

Hausman and Welch claimed the ambient orb is not a nudge because it makes users aware of information to remind them to think carefully about energy use. The ambient orb is not any different from educational campaigns, warning labels on cigarettes, requirements that firms notify employees of hazards, and signs reminding people to drink more water on a hot day.

A nudge does not try to inform the automatic system, it works with the influence biases. Perhaps, the ambient orb could be a nudge because it changes the atmosphere of the choice architecture to work with people's orienting moods (automatic thinking) in ways that reduce the energy use. Its effect on mood would be similar to how teachers' grading in red ink may negatively affect their students' confidence. Maybe the ambient orb's effect

on people is of this sort. It is not informational, but creates a mood conducive to energy conservation.

Nudges are assumed to be effective means for choice architects to help us satisfy ends we select for ourselves, but routinely fail to meet due to the inevitable biases described earlier. Nudges are always choice preserving. Fines and penalties are not nudges because they change people's incentives and add costs to situations that were not there before [13].

2.2.2 Ethics and policy

The objective of nudging is to influence people to change their behavior predictably. The various supporters of nudging idealize this tool as something to be used correctly, without bringing any consequences or problems for people.

Although most of the time the nudge is used as it was ideally thought, there are always some speculations and suspicions about the threat of science being used by potentially biased legislators to manipulate citizens, however, nudging is not characterized by psychological manipulating. Some nudges are based on non-transparent measures that transfer responsibility to citizens in ways that can be considered as manipulative and illegal strategies in public democratic systems. However, this last idea of manipulation falls apart because nudges leave all the options available.

Another concern relies on the fact that the incentive is used to reverse traditional regulatory efforts. In many cases, the behavioral changes produced by the nudge do not produce the expected political result. This happens frequently, when the expected result involves multiple consecutive decisions, which are produced in different contexts in which the nudge is implemented. An example where you can assess the effects of nudges on politics is in the choices related to food. Governments across the planet are concerned with the levels of obesity that continue to rise and the implications that these levels will have on people's health [19].

Some nudges are designed to encourage healthier eating, in the most diverse scenarios. Previously, we have already given the example of the cafeteria which fits this scenario. Still, it is currently hard to see whether people will continue to have healthy eating habits, even when they are not being influenced by a nudge. Defenders of nudges do not guarantee that nudges are the definitive formulation for behavioral change, there is an associated danger of producing negative effects, which can produce different results from those experienced. For example, a study shows that the consumption of low-calorie products in food can increase the number of calories ingested as consumers feel less guilty eating [19]. Nudges can achieve better political results when the intended objective involves only one reason for making the decision. For example, organ donation. In this case and in similar cases, the nudge is oriented towards the extraction of a specific choice in a specific context that will also produce the intended objective.

If the expected result of a nudge depends on a set of decisions, politicians must take into account that the change in behavior can be limited to a certain context, or it can also produce negative repercussions, negating some or all of the positive changes of the impact behavior change.

So, nudges are completely compatible with political measures. Nudging should be expected to change the way it receives political measures, given the introduction of scientific requirements based on evidence.

The ethics of nudges politics aren't very clear. The moral justifications for nudges are based on the paternalistic assumption or designed in such a way as to improve the situation of those who choose, as nudges judge for themselves [20].

In the real world, although nudges appear to be designed to maximize the collective benefit, in many situations individual and collective interests are altered to produce a common benefit that requires individual nudges to have upfront costs.

Policy makers must create rules to use nudges that are not paternalistic, if the individual nudge aims to produce shared benefits at the collective level. For example, one of the most well-known examples is organ donation, in which there is already an agreed consent. This prospect requires participants to opt-out rather than an opt-in policy. Individuals to be targeted for nudge do not benefit at all by perishing the organ donation list, however, these individuals share a collective benefit, which is the number of organs available for donation, which may need someday.

Nudges that require a price to be paid by individuals without any benefit sharing are morally doubtful. One example was the UK defending an opt-out model policy to apply donations to charity. The implicit acceptance of making donations is morally defensible because it deprives the well-being of one group of individuals by flawing the well-being of another group of individuals.

The nudges that produce a collective good, instead of an individual good, do not fit well in the concept of paternalism. This type of nudges can be morally defensive if the individual is affected from the nudge suffers from collective benefits, otherwise it creates ethical problems [15].

2.2.3 Nudging mechanisms

In the previous section, we approached nudges in relation to their conceptualization at a political and ethical level. These two areas are a little complicated to maneuver, since nudges always want the individual good, and sometimes you can fall into fallacies, where you see the general good as superior to the individual. Nudges should only harm the singular individual in the first instance when, even if he is harmed, he will have a greater good in the future than he was harmed. In this section we will discuss the structuring of the different types of nudge into an overall of four categories: facilitate, confront, delude and social pressure.

2.2.3.1 Facilitate

In this category, nudges facilitate the decision by reducing the effort of a person who have to make the decision. The design encourages people to choose a predefined set of actions, that brings the people's best interests and goals. The more intuitive and simple the nudge is, the better results will be. The facilitating nudges explored the difficulty that people have in changing and following the least resistant path. Although the effects of simplification

are underestimated, the truth is that people have a predisposition to choose what is already chosen because the search for an alternative is a slow, uncertain and costly process [14].

2.2.3.1.1 Default option

The default option is already widely-known option. A default option is chosen at the first step that will have a great impact on an individual level. An example is an auto-enrollment retirement plan, by default people enter the plan and start saving money for the retirement. This influences the saving outcomes at every stage of the saving life cycles. From the article "The Importance of Default Options for Retirement Saving" [21], we can read and understand the importance of offering people a good default option as it brings benefits for individuals suffering from nudge. Another example is the option for printers to be "print on both sides" by default. Many times users want to dispatch print jobs, that they don't even check how the printer is set. So if it is already configured to save paper, users will probably not even take the action to change this type of printing [12].

2.2.3.1.2 Opt-out policies

In a very similar way to the default options, the opt-out policies assume individual consent for the procedure, which generates automatic enrollment in that same procedure. The best known example in exit policy is the organs' donation, where individuals have to perform an action to change the previous made assumption. Another case related to this policy is the change in vaccination schedules. Instead of asking patients if they want to get a vaccine, it is assumed that they want it, and the time is selected for them to get vaccinated. If the participants do not want to, they will have to choose not to take it and opt-out. In addition, the probability that all individuals will be vaccinated can increase [12].

2.2.3.1.3 Position

In the positioning, the arrangement of things in order is altered with the aim of capturing the person *status quo bias*. Re-ordering the position of the security option on wireless networks and associating color codes with network security, influences the rate of choice of a secure network by participants in the order of 60%. Combining the way in which the various items are presented influences how these items are chosen. Another situation that can be found is that individuals can use the first item on a list to compare it with the other items on the list, even if the first is not the best possible choice [16].

2.2.3.1.4 Hiding

The hiding technique consists in making undesired options harder to reach. For example, placing healthier food on the first pages of a website and junk food at the end will make that most of the users choose healthier food [22].

2.2.3.1.5 Suggesting alternatives

Another method of encouraging choice is to suggest a possible alternative that will divert attention to options that may not have been considered. An example is a website designed by Forwood, where when adding food to the cart, healthier and less caloric alternatives are presented so that the user thinks about replacing them with the ones presented [12].

2.2.3.2 Confront

Confrontation is a category of nudge that aims to stop an unwanted action by creating doubts in people. Using the regret aversion bias, people tend to be more careful on decision-making when they perceive some certain level of risk. People attempt to make a reflexive choice instead, a mindless behavior [12].

2.2.3.2.1 Throttling mindless activity

When taking into account the mindless activity, a small pause in time to reverse the action can be effective. For example, the e-mail 10 seconds wait, before it be sent. People tend to re-think if they want to send it or not. People normally use that time to read the e-mail and re-think in the content write and if it makes sense [22].

2.2.3.2.2 Alerting consequences

People tend to predict the frequency of an event in their minds to judge the occurrence of an event based on how easily it can be remembered. From this, we see that we can generate the probability of events when they are available for cognitive analysis. When we can be exceedingly optimistic, these situations are far from happening. In this category, people think about the consequences of their actions.

For example, by changing permissions information on the Google Play Store to add messages that give information about the potential risk from the permissions, users would think twice before accepting it. A message for the user would be selecting a bunch of images from the smartphone and then alert the user that the app can do anything their creator wanted with the selected photos, from deleting them to publishing online [12].

2.2.3.2.3 Friction

Friction nudges aim to decrease intrusion while keeping the ability for people to change their behavior. People think that friction is always a bad thing, but in some cases friction can be good. There are times when people should be thoughtful, like when we impose a cooling-off time, so we can sleep over the final decision [23]. In order to understand this nudge mechanism, we will use an example. Key-moment is a wall locksmith that nudges people to change their behavior by dropping the bike key on the ground when the person grabs the car key. The person will have to grab the bike key from the floor and put it on the wall locksmith again. By this way, the key-moment pretend that the person changes his choice [12]. Another example is provided by Dilip Soman: as we move into a digital payments, it's becoming easier to pay and spend more and more money. What would happen if every time we tap on the phone for making a payment, there was a 30 seconds time pause that displayed a message saying how much the person spent that month with a confirmation to make the purchase. This would create friction, but in this case would be for a good reason, for people spending with intelligence and deliberation [23].

2.2.3.3 Delude

In this category, deception is used as a nudging mechanism to modify how the options are received by the users, or to change the way of actions are experienced with the target to encourage specific outcomes.

2.2.3.3.1 Displaying poor choices

When we present people with inferior choices, they fall into a trap and end up selecting the choice that seems less bad, which, however, could have been previously selected. This effect can be called decoy effect. An example of this type of nudge is the promotion of healthy food on snack ordering websites. To increase the choice of an apple over a cookie, a big shiny apple picture was put aside of a small apple. The shininess of the first apple become more dominant in relation to the other options on the list [22].

2.2.3.3.2 Induce with past memory experiences

The rule of the peak-end indicates that our memory of the past is based on two different moments, the most intense and the last experience. The peak-end rule can have major impact on people choices, as we can change how people remember the events, by changing the endings. An example of exploiting this rule is by manipulation the speed of a loading bar and reordering hard tasks first and the simpler at the end, so that people have the perception of fast progress and keep in mind good memories [22].

2.2.3.3.3 Illusive visualization

The salience bias says that people focus more likely on information that is more important and take less care than with the less important. We can apply illusive visualization that use the salience bias to change people perceptions and judgements. For instance, we can serve food on a smaller plate to influence individuals of the amount of food they already have eaten [16].

2.2.3.4 Social pressure

Social pressure or social influence focus on people desire to become followed and fulfill with what others think or expected of them [16, 22].

2.2.3.4.1 Invoking reciprocity

Approach by which we intend people to activate the feeling of responsibility for others, in which we focus on people's tendency to choose options similar to the actions they receive from other people [24].

An example of this reciprocity effect is *Pinteresce*, an interface for Pinterest that aims to reduce social isolation among the elderly, which leads users to leave a comment in other people's photo galleries. Due to the reproducing effect, users return the action received by others, increasing social interaction [25].

2.2.3.4.2 Exploit public commitment

Public commitment tends to be true even if the commitment previously made does not pay off. As we have already committed ourselves in a public way, we assume that this commitment is true for us [26].

For instance, having people verbally repeat an appointment with a doctor makes people accept the appointment made [27].

2.2.3.4.3 Show user's actions

In this approach focuses on a person in the spotlight, the natural tendency of people is to overestimate the way in which actions and decisions are noticed by other people, thus being able to promote behaviors that must be socially approved and avoiding behaviors and actions that are rejected by the society [28].

We have the example of electronic boards that present speed in real time in public, nudge users changing their speed and complying with standards [27].

Another example at the digital level is a trash can that captures what is produced in a home using a mobile phone, whenever the accelerometer detects movement it captures a photo on Facebook with the trash, users see the trash in recent ones and can compare with the other people [29].

2.3 Digital nudging

In the previous section, we referenced the nudging mechanisms and how they are used to changing people behavior. These mechanisms are divided in multiple categories. Each category has a purpose and has a set of options that define the type of nudge that is used.

Nudges are normally associated to offline context as they have been designed for that context. From the examples presented in section 2.1 we observe that largely imperceptible nudges are effective in various offline contexts. As in offline environments, online environments also can offer a neutral way to present choices. Any user interface, in any organizational website or mobile app, can be defined as a digital choice environment. A digital choice nudges people by rearranging the presenting choices or organizing workflows, making the digital nudging. Choosing the most effective nudge is difficult because the consequences of implementing certain nudges are not always clear, in a digital work-space. The existing guides for implementing nudges have been developed considering offline environments.

Digital nudging only received attention recently. However, guidelines that work offline may not directly work online; for example, online users are more willing to disclose information, but at the same time, they are more cautious about accepting default options [30].

Digital nudging can be defined as the use of interface design elements to guide people behavior applying choices in digital environments. Digital choices appear in user interfaces like web forms, on web pages applications screens. Normally, these type of pages require that people make a choice or a decision before their full commitment; this can be compared to offline environments where people must apply decisions. For example, the typical health food choice between an apple and a cake.

Every single change on the interface can modify the final choice that people will make. So changing a single thing in the environment can influence people choice and nudge them into an expected behavior. There is no neutral way for presenting choices.

In online environment, several choices are made. Nowadays, many services offer the possibility to make decisions online. The design of digital environments influences the human choices. Understanding the effect of digital nudges in online environments will help designers to lead users to the most desirable choice. For example, the application for payments nudges people into offering tips by setting the default tipping option to something. To avoid the

give of tipping, users must deselect the active option “tipping”. If they do not take any action, a tip will be given. Using this nudge, the amount of tips was raised, specially where little or no tipping was common [30].

Nowadays, technologies make part of our lives: everyone has a piece of equipment that use frequently like a smartphone, a tablet, or a computer. Digital technologies are presented on large areas of our private and professional lives, so people usually make important decisions within digital environments. Most of online interactions require people to make choices, from governments application to electronic commerce interactions. People always need to make some kind of choice no matter which application or iteration they are using.

User interfaces like website and mobile apps include digital choice environments. Interfaces of organizational information are also digital choice environments that influence decisions by how the system organizes workflows.

A digital choice environment design can influence people choice to lead to unexpected consequences. The designers of digital interfaces must understand the effects of their designs on user’s navigability and selections so that they can implement a design that nudges users deliberately or one that reduces the effect of the design to increase user’s will.

2.3.1 Non digital nudges vs digital nudges

From section 2.2 we have checked how the nudging works on offline environment and how Theiler and Sustain defined them: “A nudge is defined as any aspect that alters of the choice of the architecture that changes people behavior in a predicted way without setting economic incentives” [31].

Nudging is a behavior concept that defines how changes can influence people decision-making by changing how choices are presented on an environment. The objective of nudges is to improve people long-run welfare, judged by themselves [32].

Non digital nudging requires a previous observation and a study of the environment we pretend to alter user choice. The nudge must be prepared before a person access the environment that we want to make nudging available. When nudging is extended to online environments, it is defined as “digital nudging”. As we referred in section 2.3, digital nudging can described as “the use of user interface elements that are designed to guide people behavior in digital choices environment” [30].

Digital nudges make use of online technologies and communication channels such as e-mail, phone message, push notification, social media, etc., to make to change people choices.

Digital nudges bring some advantages in relation to non-digital nudges, such as they being relatively inexpensive and have the ability of a fast spread. By being on the virtual world, designers can make multiple tests of the changes they will make on the environment in order to change people’s choices. Digital nudges facilitate the production of data and allow an easier, measurably [32].

Shlomo Benartzi says “that digital nudges are two-fold”, on the first point digital environment allow a faster research that in an offline environment it would not be possible. So as the tests are made on multiple designs, we can check which one is more effective, normally getting the results in days or weeks. On an offline environment, the waiting would

take years to check if intervention is effective. The second aspect is that online environment offers large scale dimension. Changing a single website or application with a specific design, we can potentially help people to make better financial decisions all around the world [32].

From this analysis, we can understand that digital nudges have their benefits in the online world and can be used to improve people choices, and we checked. We cannot say that digital nudges is better than offline nudges or vice-versa as each type has its own environment and different type of use, but we can say that digital nudges is more advantageous. So, we can explore the digital nudges to improve people choices in some way, like developing an application that allow marketers to add their own nudges to their own websites or web applications.

2.3.2 Examples of digital nudges

In the previous section, we covered the principal differences between the digital nudges and the non digital nudges. These last ones were the first type of architecture choices that were presented by Thaler and Sunstein. Non digital nudges require a physic environment that people will have gone to visit that space. Digital nudges can be deployed on any application, web page or any digital product that people use. One of the biggest advantages of using digital nudges over non digital nudges is the time for making tests on the multiple choices of architecture. Digital nudges can take days or weeks, while non digital nudges take more time and more efforts to check and capture the results.

Here we will check some examples of Digital Nudges that have been used for some companies and some projects. An example of a digital nudge is the mobile payment app that makes people give tips by setting the default option “tipping” enabled, so that customers must choose “no tipping” option if they choose not to give a tip. Using this simple nudge, the amount off tips were raised in multiple ways, specially where no tip has been common [33]. Another example is that multiple websites use opt-in or opt-out policies in order to nudge people into signing in to a newsletter. Still on the same page, low-cost air carriers provide users frames with decisions about purchasing extra optional services like travel insurance in ways that increase clients cognitive loads and nudges them to choose these tip of options.

In the digital world there is no neural way to present choices to the users, any interface can influence user choices by nudging one kind or another, even that there was no intention on nudging people into something. In digital environments, designers should understand the effects of choice of architectures, so they can deliberately increase or reduce the effects of free will. In offline environments, researchers have proposed some guidelines to choose, implement and test the effects of nudges. From these examples, we can understand that many types of non digital nudges can be transformed into digital methods of nudging.

2.3.3 Process of designing digital nudges

In the previous section, we checked how nudges from offline contexts can be implemented in digital environments. We have seen that default option, opt policies and another type of nudges can be adapted to digital environments. In this section, we will talk over the process of designing digital nudges. This process is inspired by the resource to guidelines of offline contexts [6]. The process of the development follows the next steps define the goal, understand the users, design the nudge and test it [34].

2.3.3.1 Defining the goal

Designers first of all must understand the goal of the organization and take them in account when designing a particular choice, since the goal will influence next choices [6]. For instance, classifying platforms, the goal is users to share realistic ratings over experiences, as these are the main functionality (e.g., TripAdvisor, Booking). The type of goals determinate how choices must be designed, specially in the type of choice to be made by the user. Another example is a binary choice of yes or no choosing subscription to a newsletter, this makes a discrete choice and donating monetary amounts that is a continuous choice can be displayed as a discrete choice. The type of choice determinate the mechanism to be used in nudging [34]. When nudging users, the designers should consider the ethical aspects to ensure that any loss is made.

2.3.3.2 Understand the users

The decisions making of people is susceptible to heuristics and biases, taking into account the digital environment in both positive or negative ways. Heuristics can lead to systematic errors, or biases that are negative. In order to nudge people, the designers must understand the group they want to nudge, the user process and the user goal and which and what heuristics and biases influence the people. For example, rating products, can make that users choose other users ratings as a base and adjust their rating based on the previous user's base [6].

2.3.3.3 Design the nudge

After doing the study of the two previous points, the definition of the goals and the understanding of users, we are in a situation where we are able to implement and select a certain nudge mechanism to guide the user's decision from the desired perspective. As we already talked about in the chapter 2.3.1 in digital environments implementing nudges can be done at a lower cost, as designer can easily modify the user interface, unlike offline environments that take more time to understand results and make changes on the choice of architecture presented [34]. Digital nudges allow tracking of the user's decisions or even nudge based on known or gather on user characteristics. When the designer have the set of goals defined and understand their target group and their heuristics and biases, the proper nudging techniques can be chosen for the influence of the user's choice. Selecting a proper nudge and the way to implement it over available design elements, or user-interface patterns, is determined by the type of decision to be made, like binary, discrete or continuous [34]. In our application, we desire to provide the designers a tool that facilitates the implementation of the nudging mechanism that leads the designer throw a group of steps in order to select the proper nudges taking into account the goals and the user's group. Schneider, Weinmann, and Brocke on a digital nudging guiding, have designed a three-step technique for the selection of the appropriate nudging method. On the table 1 we can check the steps presented. With the steps presented on the table we can take multiple ideas for multiple interfaces for a plugin or a web application that is capable of providing a tool for design nudges for multiple web pages, always focusing on the nudge of the web page users.

Digital Nudging Design Cycle		
Step 1	Step 2	Step 3
Type of choice (what we want to change)	Heuristic/Bias	Design elements and user-interface patterns
Binary	Status quo bias (defaults)	Radio buttons (with default option)
Discrete choice (such as two products)	Status quo bias (defaults)	Use of defaults: <ul style="list-style-type: none"> • Radio buttons • Check boxes • Drop-down menus
	Decoy effect	Selected decoy option(s): <ul style="list-style-type: none"> • Radio buttons • Check boxes • Drop-down menus
	Primacy and recency effect:	Positioning of desired option(s): <ul style="list-style-type: none"> • Earlier (primacy) • Later (recency)
	Middle-option bias	Higher—lower – price alternatives around preferred option Ordering of alternatives Modification of the option scale
Continuous	Anchoring and adjustment	Variation of slider endpoints Use of default slider position Predefined values for quantities
	Status quo bias (defaults)	Use of default slider position
Another type of choice	Norms	Display of popularity (social norms) Display of honesty codes (moral norms)
	Scarcity effect (loss aversion)	Use of default slider position

Table 1: Steps for choosing a digital nudge. Adapted from Schneider [34].

2.3.3.4 Testing the nudge

One last step to complete the design of a digital nudge is to make tests and experiments, as a nudge may work on a context, but it not work on another context. As we refereed before, a small change on the design can change the user choice, so a little change of the context can also change the efficiency of the nudge.

In contradiction to offline environments, nudging in digital environments allow the access to effectiveness of the nudge in the real time, which allows real time web website owners to fine option to the current using nudges. It is very important to make tests on possible design nudges in order to find the nudge that works for a given context and user. The most used way of testing the design of users interfaces is A/B testing (or split testing), these can be used to realize random experiments that test the efficiency of the nudge [6]. The nudge depend on both context and the goal of choice environment and the target users. If a nudge don't bring the expected effect, the first step is to evaluate the presentation, as the nudge can be much obvious or not obvious enough, however, sometimes it may be necessary to redesign the context and the objectives or rethink the decision-making process [33].

After the analysis of the previous steps on the process of design digital nudges we can achieve some conclusions, designers of digital nudges have to pay attention to the effects of the users choices. Designing a nudge on a digital environment requires a special attention to the definition of the user's goals, as it is the bottom line of a design of a nudge. After

the selection of the goals, the designers should understand the users, design the nudges and then test those nudges [6].



Figure 2: Designing digital nudges follows a cycle. Figure adapted from Schneider [34].

With the analyses of the process of designing a digital nudge, we can retain some very important information. To implement a nudge, we always have to do a previous analysis of the objective to be fulfilled. To design something that works well for all situations will be complicated, however we can prepare a tool that helps the manager of a website to decide the type of nudge to apply based on the information it indicates. After knowing the objectives and the users, we can use the table 1 provided by Schneider, Weinmann, and Brocke as a basis for selecting the type of nudge that can be used with the type of choice that the user is supposed to make.

2.4 Existing solutions

In the previous section we reviewed the process of designing a digital nudge, following the design cycle that was provided by Schneider, Weinmann, and Brocke. In the process of designing a digital nudge, we verified that there are several steps that architects must follow

in order to fulfill their objectives and enable users to make the choices they want. We also, checked some advice in order to choose the best type of nudge in relation to the type of choice to be applied. In this section, we pretend to check the existing solution on platforms that allow the appliance of digital nudges on digital context. After some research, we found some softwares for nudging in the digital environment. We found the Crobox, Granify and OptKit.

Crobox is an electronic commerce personalization software that mixes consumer physiology with artificial intelligence to offer an optimized online buyer journey and actionable customer intelligence [35]. This software is a persuasion framework that gives triable vision into the consumers' subconscious attitudes through products messaging. This technology appeals to artificial intelligence to use a specific persuasive design and message that pretend to influence the user to user choice. Crobox works based on the combination of the user with the product and the contextual data, from there it makes an informed decision on which page section or website User Interface (UI) with should use and the type of messages to make [36].

Similar to Crobox, Granify takes advantage of artificial intelligence, behavioral messages and the exclusion of analytical data to optimize electronic commerce and conversion and revenue rates. In order to optimize the commerce to the user, it is deployed on the website some nudges to help interactivity with the platform in an eye-catching and a pleasant way.

OptKit is a software that is specialized in call-to-action that help to turn website visitors into buyers. OptKit is a small tool that has valuable features and helps to boost the bottom line. With this tool it is possible to install banners on any website and monitor and track the visitor's behavior and personalize the user experience. With this tool, it is possible to create unique experiences for the website visitor that will nudge them to leave their contact information or buy some products in the website [37].

From these existing solutions, the software that most relates to our implementation intent is OptKit. This tool uses small elements on the page that allow the user to be led to carry out actions that were previously intended through design elements that translate into forms of nudging.

Chapter 3

Development

In the previous chapter, we discussed nudges both in digital and non-digital environments. According to Thaler and Sunstein, a nudge is any aspect of the choice of architecture that alters people's behavior without prohibiting choices or altering economic incentives [31]. Nudges are usually applied in non-digital environments, and there are numerous nudge mechanisms that explain how to apply them in non-digital environments in different situations.

Like non-digital environments, digital environments can also offer forms of neutral choice. As nudges are an aspect of the choice of architecture, they can be applied in digital environments.

To adjust nudges to the digital environment, Schneider, Weinmann, and Brocke proposed a guide to digital nudging [30]. In the present study, we covered the most important and relevant topics to take into account, while developing our solution. In this chapter, we talk about the solution that we intend to implement as well as the tools that we intend to use and how we proceeded to choose them.

3.1 Implementation tools

In this section present about the development tools used/seen and explain why we selected the tools given their options and features for the development of the intended system. Not all the tools we are going to address were used for the development of the application, however they were part of the research so that we had several reliable sources of information and were able to choose the tools that suit our needs.

3.1.1 Squarespace

In this section we will cover Squarespace, a platform for websites, and analyze what it allows to do.

Squarespace is a powerful and flexible platform for building websites. This platform has a user-friendly system that allows small business and individual people to keep their presence online. Squarespace allows flexibility and range control throw all web pages. A user, without coding knowledge and experience, can create a well-designed website using this platform and their built-in tools [38]. This is a key point for the system that we want.

This platform can serve as a base for users to create their own website. After they created their own website, or it's almost ready, they can use our tools to apply digital nudges following a certain number of steps. Based on this, our system detaches itself from the creation of a web page completely and focuses on the creation of a mechanism to nudge the various users who intend to use the web page.

3.1.1.1 Technical analysis

In this section, we will review some aspect of Squarespace related to the development of the tool and the available options for the use and availability of the tool. Although Squarespace offers a very easy platform for the design of new web pages by web page managers and a set of tools for software developers, these tools are more focused on the option of developing customized interfaces already parameterized where the people that manage the pages must select this type of templates and use them. The new objective in the development of this project will make it possible for website managers to choose and verify what options they have available and what options they could use as nudges in order to influence website users through changes to the website interface.

The Squarespace administration page, where the website manager makes changes to its various pages, is already in a closed environment, that is, it is not possible to create any mechanism or interface that changes this place where the website manager makes changes to the website. In order to create a nudge, we would have to create a template in the Squarespace, where later the website manager would have to re-create/fill the web page based on this template.

Although this option of creating a template to create nudges is feasible, in my opinion it is not the best solution in the website manager's optics. This stems from the fact that every time the website manager wants to put a nudge to use, he would have to create a new page and upload it again. So he would have to recreate the content from the page we wanted to apply a nudge, so he can display the content with a change of the page design.

Squarespace has a great administration page for easy creation and editing of web pages, but its lack of maneuver in creating new options in the administration page so that the user can easily adjust the nudges on the different pages, bringing a functional problem.

Given the aforementioned, we realized that Squarespace was not the best solution for the tool that we intended to develop, given the lack of availability to perform more complex integration's. Furthermore, the platform is too closed to changes in terms of adding features and the administration page, which is an extremely negative point [39].

3.1.2 WordPress

In this section, we will review WordPress, a tool for building websites, and how this tool can help users building their own website.

WordPress is an open-source website creation tool. On a more advanced level, it's a content management system. WordPress is an excellent platform for making a variety of websites, such as blogging, e-commerce, and portfolios websites. This platform was designed with the focus on usability and flexibility, so it becomes a great solution for large and small

websites. The main advantage of using WordPress is the availability of large number of plugins released by many independent developers [40].

Indeed, every section of the website concerning creation, organization, and search engine optimization can be organized using plugins. In fact, these plugins are add-ons that improve the user interface and functionality. With a large variety of plugins available, WordPress became more popular in the public, as people with less knowledge could ask the community for advice and for help to use WordPress content management system [40].

Similar to Squarespace, WordPress also allows users for creating a website, through an administration page where users can customize every page to their needs. With the use of the right plugin, the user can adjust the website according to its needs. Using WordPress, it is possible to create a plugin that offers the possibility of adding nudges to the website through a tool. In the administration page, the user can create the nudge through a set of steps and then apply it to a page. Using WordPress, our nudging tool can become a package (plugin) uncoupled from the rest of the WordPress platform, where users can install it and use it in a simple and quick way on the various pages of the website.

3.1.2.1 Technical analysis

In this section, we are going to approach and check some resources made available by WordPress to develop a tool for website managers, so that they can use it in the design of their pages. Through the WordPress administration page (also known as the dashboard), the website manager can organize the website. This interface has several menus that allow website managers to perform different actions, from creating new pages, installing new themes, new plugins, etc. [41].

Given that WordPress uses plugins to extend its functionality and has a vast set of functions that allow website managers to customize the system from A to Z, we can say that WordPress is a system open to changes, improvements and new features. Through the WordPress plugins, in our opinion, we were able to create a tool that allows website managers to integrate nudges on the pages chosen by the website manager [42].

For that, we must create an interface in the administration dashboard, in which it is possible to make the choice of the nudge that we intend to implement in the selected page. With the flexibility of WordPress, we can create menus in the administration dashboard as we intend, so it is possible to design a menu that is capable of displaying a new interface where a set of nudges can be defined and/or listed. We can use this option of creating menus combined with the possibility of the creation of posts¹ and shortcodes² to create a nudge that can be displayed on any page that the website manager wants [43, 44].

In our opinion, using WordPress with a custom plugin is a great idea for solving the problem of creating a tool for the website managers to integrate nudges on their websites, as they can integrate the plugin within a previous designed website without that much effort. So, if they already have a built, they can add a nudge simply by creating the type of nudge and then apply it to the desired page with the shortcode provided.

¹Content of the blog (the writings, compositions, or discussions).

²Macros that are used to perform dynamic interactions. i.e., rendering a video.

3.1.3 Decision

In the previous subsections, we validated two tools for the implementation of our system, namely a tool that extends a content/page management system and allows adding a nudge to a page, through an administration interface.

The analyzed tools were Squarespace and WordPress, a powerful and flexible platform to build websites and a tool to create websites, respectively. After reading, consulting documentation of both tools, and comparing them in several aspects (Figure 3) we were able to reach the conclusion that the tool to be used in the development of our extension should be WordPress.



Figure 3: Squarespace vs. WordPress: a comparison. Figure adapted from Miller [45].

First, although both tools have a rich administration page, the WordPress tool has more flexibility compared to Squarespace, as it has a greater availability to make changes, tweaks and add specificities to what is intended as a final product through plugins. In Squarespace, we also have the possibility to develop specific software, however this development is more closed and is more directed towards the presentation of the page instead of allowing the addition of new features in the administration dashboard. This means that to apply the desired extension settings, it would be necessary to create a specific template where you would then create the page with the nudges or have an administration completely apart from Squarespace [39].

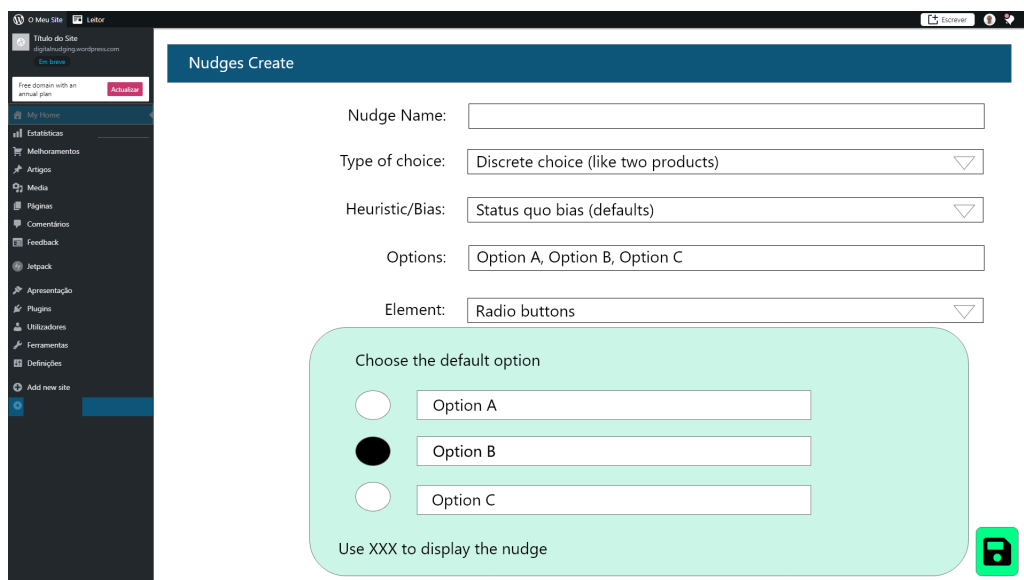
On WordPress, since there is the possibility of extending any part of the application through a plugin, we can create an administration menu where we can configure our extension and create nudge definitions that should be applied to the website users. Since for our extension we can have everything aggregated on the administration page, it is a great advantage to create a plugin to create nudges and so the website manager will only have to do configurations in one place [42].

Another point in favor of WordPress is that it allows the execution of code on the pages that the website managers want, without having any kind of more advanced technique, through shortcodes. Shortcodes allow special content (i.e., forms, content generators) that the website manager can attach to any page by adding the corresponding shortcode to the text of the page. This functionality offered by WordPress is very attractive as it allows for extensive customization by the website manager. An example of using the serious extension is to have the shortcode for the presentation of the intended nudge [44].

Finally, the creation, availability, and installation of plugins on WordPress is much simpler than in Squarespace. On WordPress, a developer can make their plugins available either in the WordPress plugins directory or in any other hosting, website managers can install the plugin. In terms of development, there is more documentation and availability of functions that interact with the WordPress core, on WordPress, than Squarespace [42]. In Squarespace, extensions work externally to the system and require these extensions to be hosted elsewhere and to communicate with the system. Extensions are created and managed by third party services, that connect to the website. The use of these extensions requires some more knowledge on the part of website managers, and they become unusable from website to website, as they have to be configured depending on the website, hosting, and characteristics [46].

3.2 Interface design and description

In the previous section, we evaluated two frameworks to implement the intended tool in order to make it easier for website managers to publish nudges on the various pages of their website. After analyzing the two tools for creating websites, Squarespace and WordPress, it was concluded that WordPress would be the best option in our context to develop a tool that cuts across different types of websites, given that WordPress offers a wide range of methods to interact with the core system and also, it's an ease option for plugin development.



The image shows a screenshot of a WordPress dashboard with a dark sidebar on the left. The main content area is titled "Nudges Create" and contains a form with the following fields:

- Nudge Name:
- Type of choice:
- Heuristic/Bias:
- Options:
- Element:

Below these fields is a light green rounded rectangle titled "Choose the default option" containing three radio buttons:

- Option A
- Option B
- Option C

At the bottom of the form, there is a note: "Use XXX to display the nudge" and a green save icon.

Figure 4: Designed prototype depicting the structure for creating nudges.

In this section, we explore the design process for adding nudges on websites. First, we started by designing an interface in an administration dashboard that allowed us to see which nudges were already created and what kind of nudge was being used. A menu was designed where it would be possible to later access this interface.

After designing the interface with the thought of listing the nudges already registered in the system, we moved on to the part of defining the nudge. When defining/creating the nudge(s), the website manager is faced with a set of options that vary according to their choices, as we can check at figure 4.

The options vary in ladder, with the manager starting by selecting the type of choice, followed by the type of heuristic/bias, then selecting the type of element and finally choosing the desired options or values that website users must be led to choose. Selecting a type of choice will influence the type of heuristic/bias and so on.

Then, with the selection process finished, the website manager will receive a code associated with the nudge that he just created. After pasting this code on the desired page of the website, an interface will be automatically generated taking into account the options that were previously selected by the website manager. This said, the code is something simple, which identifies the interface that should be presented on the selected page. Any user accessing the page will see a set of data that will have its interface dynamically changed through the applied nudge. On figure 5 we can check the interface with the nudge applied.

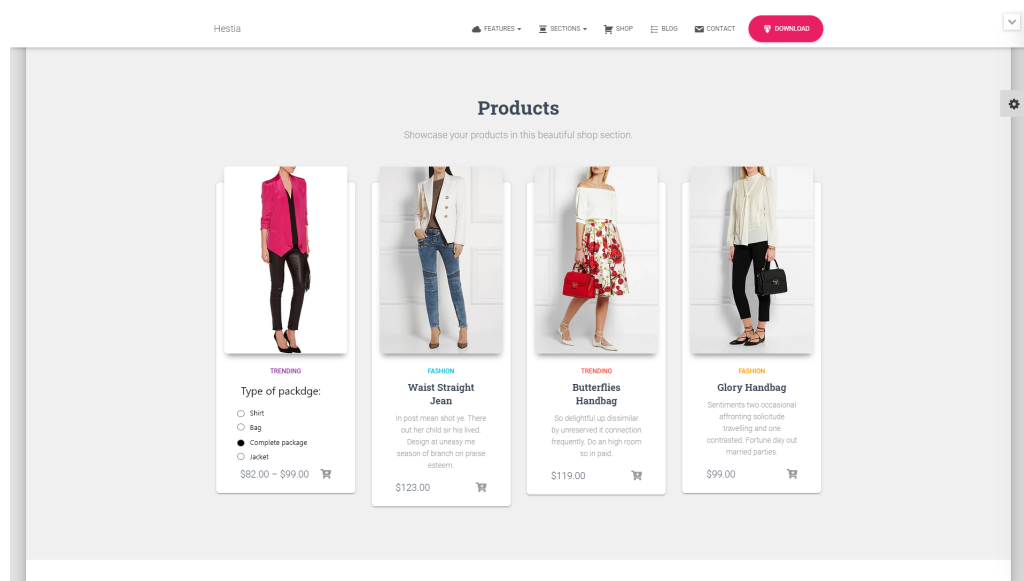


Figure 5: Designed prototype depicting the nudge applied to the website interface.

3.2.1 Implementation description

In the previous section, we talked about the design of the nudge creation interface and its presentation on the various pages of the website, a brief description of how our tool is intended to work. Briefly, to create a nudge we have an interface in the administration dashboard that returns a code that must then be used in the various pages of the website, so that the interface is built based on the nudge.

In this section, we are going to present how we developed our tool to create nudges, with the aim of a human optimization component in nudges creation on the various pages of the website. In a first step, we had to see which nudges best fit our optimization component. For that, we started with the choice of the types of nudges that would be available.

3.2.1.1 Choice of type of nudges

To choose the types of nudges to implement in our library, we use the table 1 to understand which types of nudges are most used in digital nudge design. After a quick analysis we were able to conclude that the various types of choice could be implemented in an interface, however, there were several types that have a higher complexity of implementation and operation, because they require greater treatment of page data and interconnection with the existing website.

One of the first heuristics and bias to be proposed for implementation were the “status quo bias” and “decoy effect” in the binary choice type (status quo bias) and in the discrete choice type (status quo bias and decoy effect). These two types of heuristics/bias use simple design elements (radio buttons, check boxes, drop-down menus) that are easy to integrate into a component that is automatically built for the end user.

The heuristic/bias that was later decided to be integrated in the tool was the anchoring, the status quo bias and the scarcity effect, in the continuous nudge types (anchoring, status quo bias) and in the non characterized types (scarcity effect). In this type of heuristic/bias the elements are also simple to be implemented and in these cases the elements to be used are the slider and its initial position. For this, it is easily possible to insert an anchor in the interface that refers to the correct position of the slider.

3.2.1.2 How nudging tool works (explain how it will work and its intended purpose)

Our tool for creating nudges aims to optimize the human component of implementing changes to the interface of web pages, through a page builder based on pre-defined settings by a website manager.

First, in order to use our library, it is necessary to install a WordPress plugin in an instance that already has a hosted website or is still developing a new website. To integrate our tool into WordPress, it was necessary to carry out an investigation to understand how to create a plugin. After reading some documents, we set out to create the first management interface on the WordPress dashboard.

WordPress works based on posts, so to create a new plugin to save the data chosen by the website managers we had to create a new type of post, where information about the chosen nudge and its chosen sub-options were stored. When choosing the type of nudge, the subsequent options are adjusted according to the choices made, until reaching the element that will be built on the website user’s mobile page. Upon reaching the element to be presented, you must choose the option you want the user to be led to choose.

After choosing the type of nudge to be used and completing the choice of the type of element to be used, when recording the nudge a shortcode will be generated which, when inserted into a web page, will activate the nudge chosen and build the appropriate user interface. This shortcode can be inserted in any page, however, to optimize a page’s

construction properly it will only work on mobile devices. Depending on the chosen nudge, the website manager may have to adapt the position of the chosen nudge to what you want on your page.

3.2.1.3 Implementation barriers

To implement our plugin as described above, we used WordPress as the base software to support our plugin. WordPress, although it is a very malleable tool and with a lot of documentation, has an initial stage of learning that takes some time to get used to the available tools.

The first big difficulty encountered was creating a plugin by ourselves. We'll explain it better. Creating a plugin is really simple: just create a folder with a Hypertext Preprocessor (PHP) file that contains the plugin data as well as its creators. The first barrier starts after the creation of this folder and file, WordPress from scratch only provides the mandatory header in the file, after that all the code and structure, communication with the WordPress API's and the interaction with the various hooks have to be studied and understood in order to realize how they work.

The perception of these components is not linear since they do not follow a PHP base structure and in some functions they use custom parameters that have and must be correctly inserted for everything to work correctly [47].

In the initial phase of creating the nudging plugin, even before starting to create code for to create nudges, it was necessary to create code to activate and deactivate the plugin and also to correctly call the initialization of our plugin. This phase took some time to complete, although there are some good practices in the development documentation. In my opinion and from my practical experience they are still not very reliable as there is still no file structure and programming oriented 100% defined objects.

In a second phase of development, another problem that arose and required learning was the creation of a WordPress menu in the administration dashboard to provide a section where system administrators could select the nudges to use.

WordPress always works with hooks to present the data from the menus on the screen. Therefore, it was necessary to learn how these menus worked and which parameters should be sent so that the same menu would appear in the user interface. To learn how the menus were created, we took several WordPress plugins and studied how the different developers used to present the menus in the dashboard interface.

One last problem faced was figuring out how WordPress saves the data associated with a post. Firstly, we started by seeing examples of recording auxiliary data in the form of categories, however, after some developments and new researches, we came across a barrier that this method of recording data did not serve as it was associated with the category of posts, even if there were data in the category, in the future it would be more complicated to present the nudge data to users. So after this epic glitch we went back to doing a new research on how to save data that are part of WordPress posts, and it was found that auxiliary data to posts must be saved in post metadata that are in a separate table that is directly related to the posts. After verifying this new detail, a way to collect additional data was started, since the nudge parameters must be entered by the user and are not standard. For the collection of nudges data, additional fields were created in the nudge

creation dashboard. After the insertion of data by the website manager, it is saved in the nudges' metadata table in JavaScript Object Notation (JSON) format and associated with a key-value so that it is possible to later translate the data into different types of visual interface that will work as nudges.

Chapter 4

Tests and Results

In the previous chapter, we covered the development of the tool to create nudges. Initially, we started by finding out which would be the best platform to create the tool. WordPress and Squarespace emerged, two tools that allow the management of websites' content.

After an analysis and comparison of both tools, it was concluded that for our reality and aims the best platform as a basis for serious development was WordPress as it allows greater flexibility and transition from website to website without having to do a complete restructuring of the website's interface and alteration of its structure. The use of Squarespace would imply a pre-planning of nudge based on what was intended to be done in relation to the user's choice.

After the first choice of the base development platform, we chose a set of types of nudges that we intended to implement. After this selection we started to implement an interface for the website manager, which is a back-office where the website manager can select the type of nudge that wants to use and still select the various options so that the end-user interface changes (so that the user makes the choice previously planned by the website manager).

After the implementation of the back-office interface, it was necessary to implement the functionality so that nudge changes the interface for the end user. Finally, we came up with a tool packaged on top of a WordPress plugin that can be installed on any WordPress-based website.

In this chapter, we address the tests and results obtained to validate the nudging plugin. An experimental procedure was created, the tests run, the results collected, and their analysis carried out.

4.1 Experimental procedure

In this work, we intend to provide an experimental procedure on a web page related to the ocean and its problems. Ocean pollution is being recognized over the years as a serious concern. Marine litter, in particular, has been gaining prominence. It is predicted that by 2050 the ocean will have more plastic (by weight) than fish [48]. Therefore, marine litter's definition, impacts, and preventive measures were chosen as the main sections of the created website. It was planned to make a website available to a group of people in order to collect a set of data about the use of the site. This dataset was intended to understand how users interact with the website, which clicks they made and which pages they visited.

In a second phase, users were asked to access the website again to collect a new dataset containing information about user interaction, clicks, and pages visited, but this time with the use of nudges. The nudges were used so that users choose the website contents that we consider most important for users to see.

In order to present and influence the most important sections to the user, nudges can be used to change the interface, so that it provides the choices and/or actions that users want to perform. The main objective was to understand if the use of nudges on the page related to the ocean cloud change the type of choice/action performed by the users.

Our first tool was a website that talks about saving the ocean and the problem of marine litter. This website was composed of two large areas, both clickable. The first area was the subscription area, where users were intended to subscribe to newsletters and recommendations on how to save the ocean. In the second area, we had several clickable buttons that take the user to informative pages on how to save the ocean and what steps should take to start changing the world.

Our second tool was the use of the nudge tool previously developed by us. With this tool, we intended to change the look and structure of the interface so that users are led to perform a certain action and thus get to know better new ways to help save the ocean.

Finally, the last tool used was Google Analytics (GA) to assess the behavior of users towards the website without nudges and towards the website with nudges. Through this tool and the association of clicks to actions, we could understand how users of both websites interacted with the page and with the nudges.

4.1.1 Methodology

First, before starting to collect data and evaluate if the changes made through the nudge tool really had an impact on the website's users, it was necessary to collect data on the current website.

To collect that data, we used GA associated with a code that is linked with the website. On the website on all pages, clickable buttons, and options with clickable buttons, we had a tag associated with the action. Thus, whenever a user performed an action, it was saved in GA.

This first data collection, contributed to understand how the website works without any kind of nudge; that is, how people interact with the architecture of the website initially presented. Since we already had the website flow and interaction without nudges, we can then analyze the same website, but this time with the application of nudges.

The selected nudges were intended for people to do different iterations and go according to something that makes them gain some knowledge about the ocean and how to make it clean and enjoyable for everyone.

For the collection of user interaction data, we used GA with a code corresponding to this website with nudges. Again, the actions to be evaluated were coded to create events in GA.

To make the choice of users who were going to carry out the validation tests, the snowball sampling method was used, as this is one of the best known methods [49]. A set

of indications (appendix A) was sent to a number of people, and they were asked to share it with other people successively. Data were collected for two weeks during August 2021.

After completing the tests on both websites, with and without nudges, we took the data collected in GA to make the comparison between the websites and see if the nudge tool used made a change in the user's iteration.

For this, we compared the various events that were previously configured to understand whether there really were changes to the choice before the user.

4.1.2 Validation

To validate the developed nudging tool, a comparison was made between users' clicks before and after accessing the website without and with nudges. Upon first access to the website, users were expected to interact with the website at random based on their personal interests and beliefs about the website's main theme, the ocean.

In the second access to the website, users were expected to be influenced in their choices, as there was a change in the interface that was initially presented to users. On the second access to the website, several options were adjusted. The main objective was that users made certain clicks, access some important information and subscribe to the page to help save the ocean.

As both versions of the website contained websites for collecting different statistics, we can easily compare the data collected and be able to see if users were influenced in the expected way.

4.1.3 Metrics

As validation metrics, we used user clicks in different sections of the pages. Although the pages were similar, one of them contained nudges that were intended to make users take different actions.

On the ocean with no nudges' website, we captured all the clicks of users in the various sections and their choices. On the ocean website with nudges, we also captured all user clicks, but this time we considered the sections where nudges have been added.

One of the first metrics was being the subscription event, where users enter their emails and then subscribe to the page whereas on the website without nudges the subscription was out of the user's view, on the website with nudges subscription was the first thing to be shown by a variation of the default position of the page slider.

Another metric to be used was the subscription event with a donation previously defined as yes, on the website without nudges. This subscription could be done by the user, however, there were no options selected for donation. On the website with nudges, it was resorted to the default option for the user to subscribe and donate. By pressing subscription, was saved in GA.

The third metric was the click and access to a page. The website with nudges changed the way the content was presented so that it gets bigger and has some highlight, trying to make the user press the selected content.

With those metrics, we intended to collect data on the use of websites by users and understand how these nudges influenced their choice.

4.2 Results and discussion

In this section, the main results are presented and discussed. By looking at the data collected during tests, we see that most of the access were in Portugal, followed by the United States, Switzerland, Netherlands, and Spain. When looking at the summary table 2 we come across different number of users on the website without nudges and on the website with nudges. This number can be derived from withdrawals in the middle of the testing process, however we do not invalidate these users as this process was done anonymously, and we do not contain any connection between users and access to the websites. Furthermore, as it just happened two times, we thought it was best to leave the data as it was and make a general balance between all users of both applications to determine the type of actions that were taken and evaluate the functioning of the nudges that were applied.

Country	No nudges website users	Nudges website users
Portugal	27	26
United States	3	4
Switzerland	2	2
Netherlands	1	1
Spain	1	1
	34	34

Table 2: Number of website users per country.

After taking a small look at the origins of participants, we checked which pages were the most visited by users on both websites (with and without nudges).

On the website without nudges, the page with the higher percentage of views was the homepage. That page is the page that receives all users of the website, as it is the entrance page for the other pages. Similarly to the website without nudges, the percentage of views of the website with nudges takes up half of the percentage of views, since it was also the entry point into the website with nudges.

Although these landing pages had a similar logic, being the entry point of both websites, we can see that the percentage of views of the website without nudges compared to the website with nudges is higher (Figure 6 and 7). This leads us to realize that there has been some change in behavior towards the websites. Users of the website with nudges started to see other pages, which lead to a decrease in the percentage of views on the homepage.

On the website without nudges, the most visited pages after the homepage were marine litter (12%), impacts (8%), preventive measures (8%), the subscription page (5%) and the about page (4%).

This shows that users who access the website had some interest in visiting the various pages that were available. Of these pages, the three most visited were in a section with informative content, as we can see in figure 7. Users of the website selected the pages according to their interest and order: people visited the pages in the order suggested by the arrangement of the content on the page (Figure 8).

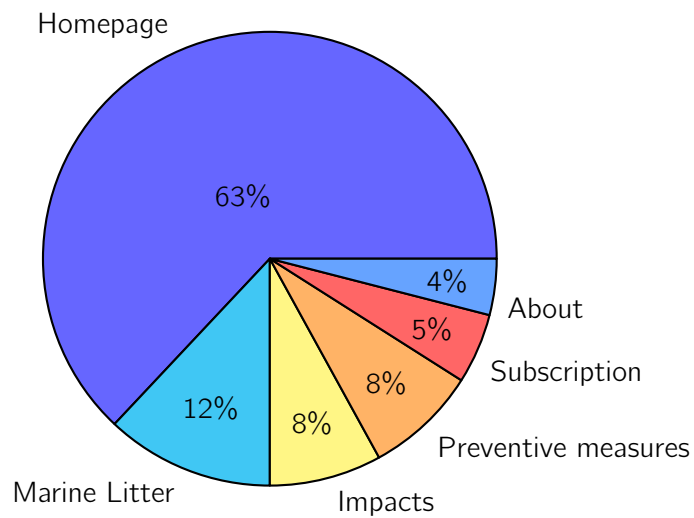


Figure 6: Percentage of pages viewed by users in the no nudges' website.

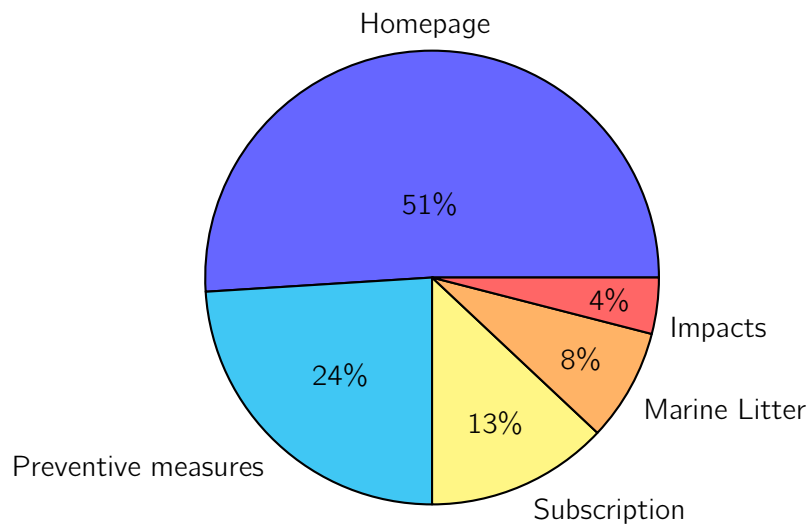


Figure 7: Percentage of pages viewed by users in the nudges' website.

The “subscription” and “about” had the lowest percentage of views by users: the “subscriptions” for being only displayed after a successful subscription and the page “about” the website for having less interest from users.

On the website with nudges, the most visited pages after the homepage were preventive measures (24%), subscription page (13%), marine litter (8%) and impacts (4%).

By looking at these results and comparing them with the website without nudges, we can see that there has been a change in the behavior of users on the website with nudges. There was an increase in the percentage of views of the “preventive measures” and the “subscription” pages.

Again, the “preventive measures” page was in a section with informative content. However, the form of presentation of the access link to the page was under nudging effect, as we can see in figure 9, causing users of the page to press content and access the preventive measures page. Although the order of the contents was maintained as on the website

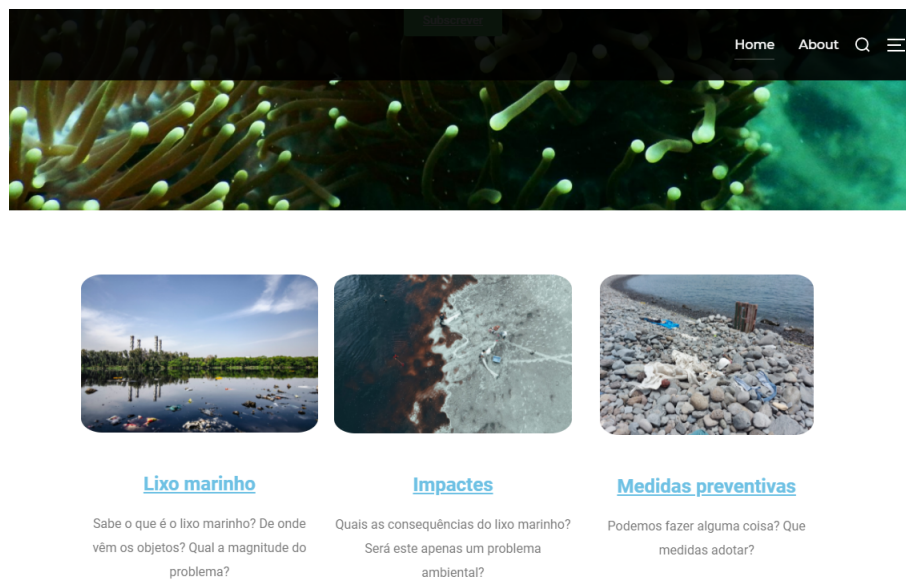


Figure 8: Section of informative content in the website page without nudges.

without nudges (Figure 8), the application of an increase in the scale of the image (Figure 9) made users access the desired page more times.

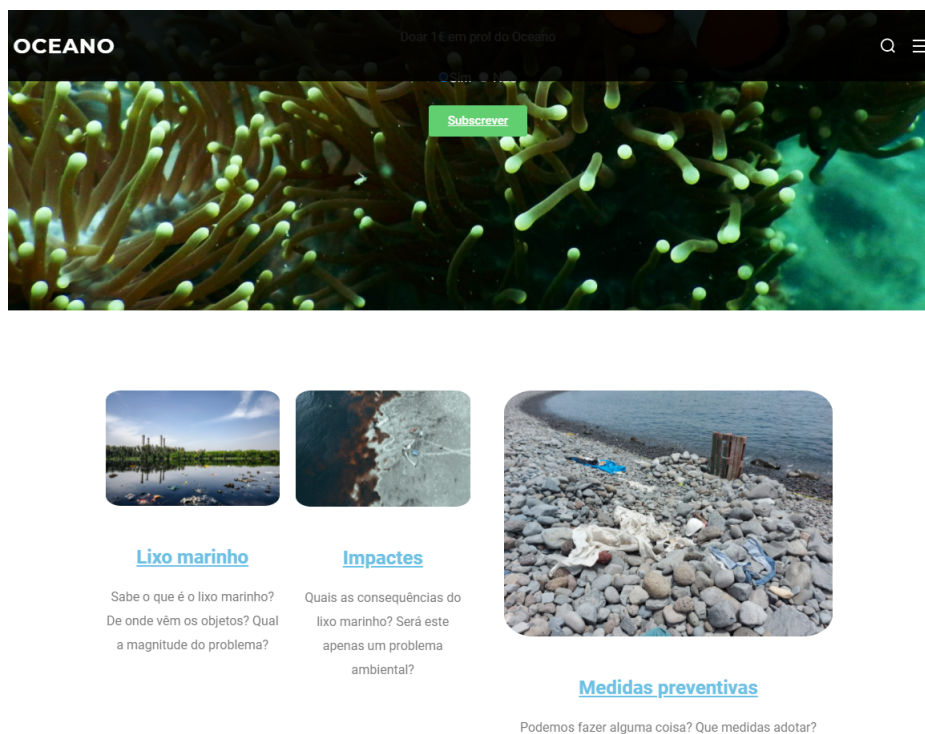


Figure 9: Section of informative content on the website with nudges¹.

¹The purpose of this figure and figure 8 is to have a way to show the reader how the related content was showed initially without any nudge applied (Figure 8) and after display, in order to the reader see the change that the interface underwent after applied the nudge on the section on "preventive measures".

	scroll			click			page view		
	nudge	no nudge	difference	nudge	no nudge	difference	nudge	no nudge	difference
event count	83	71	+ 12	55	41	+ 14	268	220	+ 48
total users	30	29	+ 1	27	16	+ 11	34	34	0
event count by user	2.77	2.45	+ 0.32	2.03	2.56	- 0.53	7.88	6.47	+ 1.41
users percentage	88.24%	85.29%	+ 2.94%	79.41%	47.06%	+ 32.35%	100%	100%	0

Table 3: Interaction of users across the nudge and no nudge websites.

The other page that registered more accesses was the “subscription” page. It had an increase in view percentage by users, as those on the nudges’ page made more subscriptions and then got redirect to that page. On the website with nudges, there was an initial position of the slider variation that caused users to be taken to the subscription section after the page was loaded. This automatic action made users subscribe to receive newsletter from the website.

Through the analysis of the page visits percentages, we were able to understand that the use of nudges influences users’ choices regarding the website. Changing the choice of architecture can make users choose what was previously intended.

Regarding the interaction of users with both websites (Table 3) we were able to get several conclusions regarding the three types of possible events: scroll, click, and page view.

In the scroll events we could see that on the website with nudges, users scrolled more times (83 times on nudges’ website, 71 times on no nudges’ website). This can be explained by the fact that the website with nudges has a variation in the position of the initial scroll bar. In other words, for users to see the different sections of the website, they had to make more variations of the page’s slider.

In click events, there were more users clicking on the content of the page of the nudged site. The clicks also increased, however, the number of clicks per user decreased in relation to the website with nudges to the website without nudges.

The increase in the number of users clicking on the page can be explained by the use of nudges to select a certain option, in this case, the option to access preventive measures and even to subscribe to the website. The number of users making clicks increased by 32.35% percent comparing the nudges’ website to the no nudges’ website.

Again, the application of nudges brought benefits to the selection of certain options on the website. People initially were less interested on the website, the interest then increased. This can be seen through the percentage of clicks on the website without nudges, 47.06%, which went to 79.41%. Taking into account that both websites were identical in terms of content, we can again assess that the change of the interface encouraged users to behave differently.

Finally, we come to the page view events of the table 3. Looking at the table 3 we see that all users have seen the pages, and this is correct since all users accessed the main page to be part of this result.

When looking at the number of events, we could see that the number of pages viewed on the website with nudges increased in relation to the number of views on the website without nudges. This is in accordance with the data seen above and means that on the website with nudges, users accessed more differentiated content.

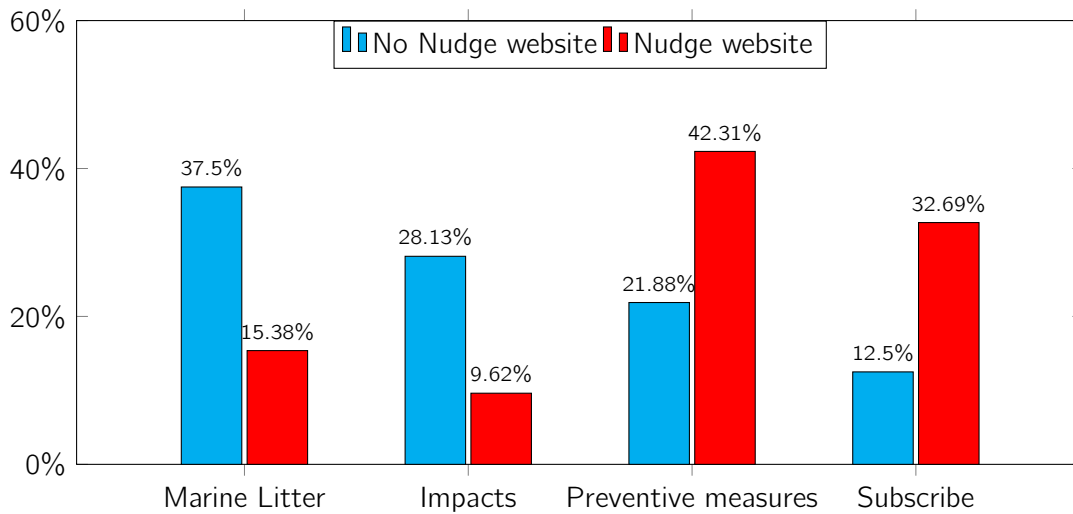


Figure 10: Log of user click event across the nudge and no nudge websites.

Taking a better look at the statistical data collected, we can see that the buttons where nudges were used increased in relation to the buttons where there were no nudges. For example, on the website with nudges, there was an increase in clicks in areas that were previously planned for choice.

By looking at figure 10 we can see that there was a decrease in the action of accessing the marine litter and impacts pages of 22.12% and 18.51%, respectively. There was an increase of 20.43% and 20.19% in access to preventive measures and subscription pages.

From these percentage variations, we were able to see that there really was a better modulation of users behavior, namely an increase in preventive measures and subscription action on the website.

We hypothesize that users who were interested in marine litter and impacts in the first place have changed their action and now selected of preventive measures and subscribing, thanks to the application of nudges on the second website.

Overall, we were able to see that stocks using nudging mechanisms were superior to stocks that did not have nudging actions.

In figure 11 we can see that the nudging actions by the users had a percentage of 75% and the no nudging actions by the users had a percentage of 25%.

We can thus conclude that users performed more actions in those where they were under nudging effects, and even that nudging actions were superior to no nudging actions by 50%. A set of users is more likely to choose an option that contains nudges.

4.3 Limitations

During the experimental period of our application, some limitations emerged that were initially not foreseen.

One of the main limitations of our tests was that we did not have an initial dataset about the use of our website, as two similar websites were created for the execution of the

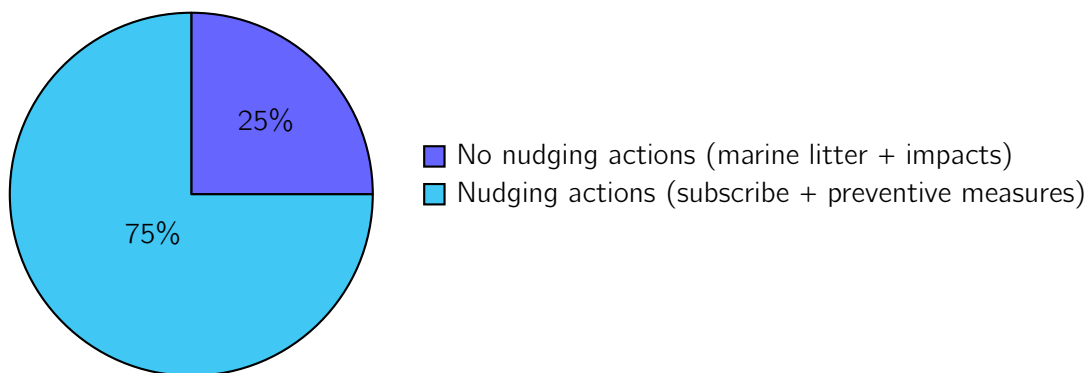


Figure 11: Percentage of actions of content with and without nudging, in the nudge website.

study. There was no previous data on the use of the website and the most common actions performed by users.

The existence of a history of user behavior is important to better study the influence of nudges applied on the website and how they can change the behavior of a user who already knows the website and what he came to see.

Another limitation that we noticed of not having a dataset prior to the use of the websites without nudges was the change in the behavior of users towards the page “about us” on the website. Users who visited the “about us” page on the first visit to the website did not perform the same action in the nudges’ website, looking at the figure 6 and the figure 8 we could see that the page about us stopped loading.

We think that this situation happened thanks to users seeing very similar pages, and whoever had already visited the page “about us” lost any interest in repeating the same action and seeing the same content.

Again, a serious way to have a larger pre-study dataset was the definition of a minimum period of six months, in order to delineate a continuous line of actions and views by users.

During the testing period, we encountered some stability problems with the hosting server. The website was hosted on a free service, however, after starting the tests we found that the service was down for the websites during hours of a few days. We have no idea what inconvenience this failure caused to users, but we think and hope that the share of users has been reduced. Unfortunately, we have no way to carry out this type of measurement.

In our tests, we had yet another nudge that didn’t show up in the results. This nudge was a default option localized on the user click on the subscribe and had the option of donation by default to yes.

Unfortunately, we were unable to use this data from this nudge as the data was not collected every day and every click of the subscription button. When evaluating what happened, we realized that GA had an update of the data measurement platform at the level of custom parameters (options created by us, “yes” and “no”).

The use of these parameters started to require a different configuration. When we realized this change, we had already lost some options taken by users, so we decided not to use this data to validate this nudge applied to the website.

Chapter 5

Conclusions and Future Work

The previous chapter discussed the experimental procedure, addressing the methodology used to test the application of nudges on the website through a plugin previously developed by us. The definition of this procedure addresses several areas that completely define the form of validation of our tool developed for websites managers.

After the description of the experimental procedure, the analysis of the results was carried out, where the collected data was interpreted and discussed.

Briefly, we could easily understand that the use of nudges changed the behavior of users significantly, because their actions in terms of page views and clicks increased, so that they started to make more clicks on components that were nudged.

In this chapter, we address the conclusions of the work presented in this master's dissertation and the future work to be developed.

5.1 Conclusions

The use of digital nudges has already shown results as it has a huge potential to change the behavior of website users. The application of a digital nudge in a web interface can make the user change his initial choice for another one that is previously defined by part of the website manager [50].

In this work, a plugin was created in the form of a tool to implement digital nudges so that the website manager could easily apply nudges to the various pages and lead users to perform certain actions.

To validate the execution of the developed tool and understand the behavior of the website users, three types of digital nudges were created (default option, default slider position and scale modification) in order to understand what would be the actions and responses of users to the change in the website interface.

These datasets were collected over two weeks across multiple users. Users were selected through snowball sampling, where a document was shared with a group of users, and they shared it with other users and so on.

The results showed that several nudges in the digital context can influence website users after changing the interface that these nudges provide. Faced with the use of digital nudges, 75% of users started making the choices that were intended by the website managers. This

indicates that most users had a positive and receptive attitude towards digital nudging in our context.

Although we have had favorable results for digital nudges, it is important to remember that more research should be carried out for websites that already have their daily consumers and that already have a set of data about the users' iteration (this is necessary in order to understand how users behavior differ when using digital nudges and changing the interface they are used to viewing). This dataset would be important to understand the real impact of digital nudges and the plugin developed in an environment with a set of previously existing factors.

Finally, the use of digital nudges brings immense benefits when it comes to the user performing a previously defined action. The future of websites and the planning of user choices involves the use of digital nudges that change the interface and make users perform certain actions unconsciously, which were previously defined by website managers.

5.2 Future Work

For future work, there are two situations that would be very interesting to implement and that would bring advantages for the website managers: the application of alerts on the functioning of the nudges according to a predefined metric and also the application of artificial intelligence on the nudges. In the subsections below, we go on to describe these ideologies better.

5.2.1 Alert system with Google Analytics

Something we came across throughout our tests is that most of the time we could not figure out how the nudges we were using on a page were going or if they were having the intended effects on website users.

In the tool created, there was no mechanism that allowed us to quickly calculate the success rate of applying a nudge on a section or on a page's content. To find out what was the behavior of users towards the contents of the website, we used GA to validate what actions were being taken by users and if the nudges were having the desired effect.

Bringing these ideas together, the possibility arise to create a feature that would be an alert system through the GA conversion rate, for website managers, so that they would know that a nudge that was applied to a different content was not working or would have a small conversion rate.

In the tool, there should be a section for the introduction of a conversion rate that should be chosen according to the website's managers, such as the click-through rate or the number of views. After the website manager, selecting this rate GA would know what should be the expected conversion rate.

After that, in the plugin, there should be a tool that accesses the GA API for a defined time and validates if the conversion rate was in accordance with the desired one. In case this does not happen, the rate of conversions appears lower than the indicated by the website manager and an alert should be sent to the website manager, which subsequently should

access this human interaction component and should select a different type of nudge so that it is possible to consequently increase the conversion rate of website users.

5.2.2 Application of artificial intelligence

It will be interesting to transform this human optimization component as an even more optimized tool in order to capture the interests and actions of users towards the websites and automatically adjust the website interface. Adjusting the interface of the websites can lead to choose certain options that the website manager pretend to be selected in order to bring benefits. This behavior would intelligently make it easier for website managers who would no longer have to apply the plugin developed in the various sections of the websites as the plugin would be able to automatically adjust the appropriate pages and sections to the selections desired by the website manager so that the end user would see the ideal option to be selected.

The objective is that through artificial intelligence it is possible to capture the type of user and recognize the type of actions performed by the user, providing a set of nudges that would be suitable for him.

Another important factor in the use of artificial intelligence in optimizing the human component is the possibility of indicating the percentage of success of the application of nudges and also changing the type of nudge to be presented to the user. Coupling digital nudging with artificial intelligence will create a system capable of changing itself automatically, adjusting its interface so that the users' behavior is changed accordingly to the choice of the website managers.

Bibliography

- [1] Richard Shambare, Robert Zhoua, and Takesure Rugimbana. "Are mobile phones the 21st century addiction?" In: *African Journal of Business Management* 6.2 (2012), pp. 573–577. doi: 10.5897/ajbm11.1940.
- [2] Denise de Ridder, Floor Kroese, and Laurens van Gestel. "Nudgeability: Mapping Conditions of Susceptibility to Nudge Influence". In: *Perspectives on Psychological Science* 1-14 (2021), p. 174569162199518. doi: 10.1177/1745691621995183.
- [3] Shirley Gregor and Brian Lee-Archer. "The digital nudge in social security administration". In: (2016), pp. 63–83. doi: 10.1111/issr.12111.
- [4] David Schneider et al. "Nudging users into digital service solutions". In: (2020), pp. 863–881. doi: 10.1007/s12525-019-00373-8.
- [5] Şebnem Özdemir. "Digital nudges and dark patterns: The angels and the archfiends of digital communication". In: *Digital Scholarship in the Humanities* 35.2 (2020), pp. 417–428. doi: 10.1093/LLC/FQZ014.
- [6] Hanna Andersson. "Designing Digital Nudges for Sustainable Travel Decisions". PhD thesis. Umeå University, Faculty of Science and Technology, 2019.
- [7] Michelle Berger, Niclas Nüske, and Chiara Müller. "Digital nudging in online grocery stores - Towards ecologically sustainable nutrition". In: *International Conference on Information Systems, ICIS 2020 - Making Digital Inclusive: Blending the Local and the Global*. 2020, p. 1. isbn: 9781733632553.
- [8] Steef Steggerda. "Nudging Shoppers Towards Healthier Food Choices." PhD thesis. Wageningen University & Research - WUR, 2017.
- [9] Djordje Djurica and Kathrin Figl. "The effect of digital nudging techniques on customers' product choice and attitudes towards e-commerce sites". In: *AMCIS 2017 - America's Conference on Information Systems: A Tradition of Innovation*. Vol. 2017-Augus. 2017. isbn: 9780996683142.
- [10] Mitesh S. Patel. "Text-message nudges encourage COVID vaccination". In: *Nature* (2021). doi: 10.1038/d41586-021-02043-2.
- [11] Linda Thunström, Ben Gilbert, and Chian Jones Ritten. "Nudges that hurt those already hurting – distributional and unintended effects of salience nudges". In: *Journal of Economic Behavior and Organization* 153 (2018), pp. 267–282. doi: 10.1016/j.jebo.2018.07.005.
- [12] Ana Caraban, Evangelos Karapanos, and Pedro Campos. "23 Ways to Nudge: A review of technology-mediated nudging in human-computer interaction". In: *Conference on Human Factors in Computing Systems - Proceedings* (2019). doi: 10.1145/3290605.3300733.
- [13] Evan Selinger and Kyle Whyte. "Is There a Right Way to Nudge? The Practice and Ethics of Choice Architecture". In: *Sociology Compass* 5.10 (2011), pp. 923–935. doi: 10.1111/j.1751-9020.2011.00413.x.
- [14] Matthias Laschke et al. "Overcoming procrastination with ReMind". In: *Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces, DPPI 2013* (2013), pp. 77–85. doi: 10.1145/2513506.2513515.

- [15] Pelle Guldborg Hansen. *what is nudging?* | Behavioral Science & Policy Association. 2014. url: <https://behavioralpolicy.org/what-is-nudging/> (visited on 10/30/2019).
- [16] Kim Ly et al. "A Practitioner's Guide to Nudging". In: *SSRN Electronic Journal* (2015). doi: 10.2139/ssrn.2609347.
- [17] T. M. Wilkinson. "Nudging and manipulation". In: *Political Studies* 61.2 (2013), pp. 341–355. doi: 10.1111/j.1467-9248.2012.00974.x.
- [18] Robert Sugden. "On nudging: A review of nudge: Improving decisions about health, wealth and happiness by Richard H. Thaler and Cass R. Sunstein". In: *International Journal of the Economics of Business* 16.3 (2009), pp. 365–373. doi: 10.1080/13571510903227064.
- [19] Nichola J. Raihani. "Nudge politics: Efficacy and ethics". In: *Frontiers in Psychology* 4.DEC (2013), p. 972. doi: 10.3389/fpsyg.2013.00972.
- [20] Richard H. Thaler and Cass R. Sunstein. "Libertarian Paternalism". In: *American Economic Review* 93.2 (2003), pp. 175–179. doi: 10.1257/000282803321947001.
- [21] John Beshears et al. *The Importance of Default Options for Retirement Saving Outcomes: Evidence from the United States*. Tech. rep. 2007.
- [22] Cass R. Sunstein. "Nudging: a very short guide". In: *Business Economics* 54.2 (2019), pp. 127–129. doi: 10.1057/s11369-018-00104-5.
- [23] Dilip Soman. *Nudge and Sludge: A Conversation with Dilip Soman*. 2019. url: <https://www.csc.gov.sg/articles/nudge-and-sludge-a-conversation-with-dilip-soman> (visited on 10/28/2020).
- [24] Matthias Laschke et al. "Keypoint: Initiating behavior change through friendly friction". In: *Proceedings of the NordiCHI 2014: The 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational* (2014), pp. 853–858. doi: 10.1145/2639189.2670179.
- [25] Robin N. Brewer and Jasmine Jones. "Pinterest: Exploring reminiscence for implicit digital reciprocity of older adults". In: *Proceedings of the ACM Conference on Computer Supported Cooperative Work, CSCW* (2015), pp. 243–246. doi: 10.1145/2685553.2699017.
- [26] Amos Tversky and Daniel Kahneman. *Judgment under Uncertainty: Heuristics and Biases*. Vol. 185. 4157. 1974, pp. 1124–1131. isbn: 185-3A4157-3C1.
- [27] Alexander T. Adams et al. "Mindless computing: Designing technologies to subtly influence behavior". In: 2015, pp. 719–730. doi: 10.1145/2750858.2805843.
- [28] Lucas Colusso, Gary Hsieh, and Sean A. Munson. "Designing closeness to increase gamers' performance". In: 2016, pp. 3020–3024. doi: 10.1145/2858036.2858206.
- [29] Anja Thieme et al. "'we've bin watching you" - Designing for reflection and social persuasion to promote sustainable lifestyles". In: 2012, pp. 2337–2346. isbn: 9781450310154. doi: 10.1145/2207676.2208394.
- [30] Markus Weinmann, Christoph Schneider, and Jan vom Brocke. "Digital Nudging". In: *Business & Information Systems Engineering* 58.6 (2016), pp. 433–436. doi: 10.1007/s12599-016-0453-1.
- [31] C. Thaler, R. and Sunstein. *Nudge: Improving Decisions about Health, Wealth, and Happiness*, Richard H. Thaler and Cass R. Sunstein. Yale University Press. New York, NY: Penguin Books., 2009.
- [32] Şebnem Özdemir. "Digital nudges and dark patterns: The angels and the archfiends of digital communication". In: *Digital Scholarship in the Humanities* 35.2 (2020), pp. 417–428. doi: 10.1093/llc/fqz014.

- [33] Markus Weinmann, Christoph Schneider, and Jan vom Brocke. "Digital Nudging". In: *Business & Information Systems Engineering* 58.6 (2015), pp. 433–436. doi: 10.2139/ssrn.2708250.
- [34] Christoph Schneider, Markus Weinmann, and Jan Vom Brocke. "Digital nudging: Guiding online user choices through interface design Designers can create designs that nudge users toward the most desirable option". In: *Communications of the ACM* 61.7 (2018), pp. 67–73. doi: 10.1145/3213765.
- [35] *Retail Product Intelligence | Crobox*. url: <https://crobox.com/> (visited on 02/21/2021).
- [36] *Crobox | Crunchbase*. url: <https://www.crunchbase.com/organization/sagent%7B%5C%7Dsection-twitter> (visited on 05/12/2019).
- [37] *OptKit is lead easy-to-use, affordable lead conversion software*. url: <https://woofresh.com/listing/optkit/> (visited on 02/21/2021).
- [38] Sarah Martin and Sarah Martin. "Introduction to Squarespace". In: *The Definitive Guide to Squarespace*. Apress, 2017, pp. 1–26. doi: 10.1007/978-1-4842-2937-8_1.
- [39] *Template Configuration — Squarespace Developers*. url: <https://developers.squarespace.com/template-configuration> (visited on 04/23/2021).
- [40] Savan K.Patel, V.R. Rathod, and Jigna B. Prajapati. "Performance Analysis of Content Management Systems Joomla, Drupal and WordPress". In: *International Journal of Computer Applications* 21.4 (2011), pp. 39–43. doi: 10.5120/2496-3373.
- [41] Wordpress. *First Steps With WordPress* « *WordPress Codex*. url: <https://wordpress.org/support/article/first-steps-with-wordpress/> http://codex.wordpress.org/First_Steps_With_WordPress (visited on 06/13/2021).
- [42] Wordpress-plugins. *Managing Plugins | WordPress.org*. url: <https://wordpress.org/support/article/managing-plugins/> (visited on 06/13/2021).
- [43] Wp-cli. *WP-CLI Commands | WordPress Developer Resources*. url: <https://developer.wordpress.org/cli/commands/> (visited on 06/13/2021).
- [44] Wordepress-shourtcodes. *WordPress Plugin Developer Handbook*. url: <https://developer.wordpress.org/plugins/shortcodes/>.
- [45] Bryan Miller. *Wix vs. Squarespace vs. Wordpress: What's the difference?* • *Long Beach Web Design & SEO*. 2020. url: <https://brytdesigns.com/wix-squarespace-wordpress-difference/> (visited on 06/14/2021).
- [46] Squarespace. *Extensões do Squarespace – Squarespace*. url: https://support.squarespace.com/hc/pt/articles/360000975547?_ga=2.79035612.953533365.1623703972-472763024.1616864119_gac=1.162619854.1623704274.CjwKCAjw_JuGBhBkEiwA1xmbRZIOVbD7jpN_p3nR5VdqmWwhZmk_EZ56n50afS-E1K81b6L6fjY_rRoC-HsQAvD_BwE (visited on 06/14/2021).
- [47] Wp-plu-bas. *Plugin Basics | Plugin Developer Handbook | WordPress Developer Resources*. url: <https://developer.wordpress.org/plugins/plugin-basics/> (visited on 07/19/2021).
- [48] World Economic Forum. "The new plastics economy: Rethinking the future of plastics". In: *Ellen MacArthur Foundation* (2016), p. 120.
- [49] Sulaiman Abubakar, Ilker Etikan, and Rukayya Alkassim. "Comparision of Snowball Sampling and Sequential Sampling Technique". In: *Biometrics & Biostatistics International Journal* 3.1 (2015), p. 00055. doi: 10.15406/bbij.2016.03.00055.
- [50] Aditya Kumar Purohit, Louis Barclay, and Adrian Holzer. "Designing for digital detox: Making social media less addictive with digital nudges". In: *Conference on Human Factors in Computing Systems - Proceedings*. Association for Computing Machinery, 2020. doi: 10.1145/3334480.3382810.

Appendix A

Orientações para testes

Gostaria de o convidar a participar num teste para comparar dois sites, desenvolvidos no âmbito da dissertação de mestrado em Engenharia Informática de Fernando Martins. O objetivo do estudo é perceber se a aplicação de uma interface sobre um determinado site consegue alterar o comportamento dos utilizadores.

Todos os dados inseridos no site são meramente representativos e para teste. Os dados são recolhidos de forma anónima e tratados coletivamente, pelo que não será possível identificar nenhum participante. Apenas será registada a intenção do utilizador, pelo que pode efetuar qualquer tipo de ação/subscrição sem recolha de dados nem imputação de custos. A sua participação é totalmente voluntária.

Orientações:

Lists are easy to create:

- Aceder ao site: <http://ocean.freecluster.eu/> (nota: os sites de teste podem levar alguns segundos a carregar na primeira ligação).
- Efetuar o scroll (descer) até ao fim da página.
- Se encontrar algo apelativo, poderá selecionar/carregar na opção ou efetuar uma ação.
- Aceder ao site <http://ocean.freecluster.eu/>.
- Se encontrar algo apelativo, poderá selecionar/carregar na opção ou efetuar uma ação.
- Fazer scroll (subir) até ao início da página
- Fazer scroll (descer) até ao fim da página
- Se encontrar algo apelativo, poderá selecionar/carregar na opção ou efetuar uma ação.

Obrigado pela sua ajuda no teste da aplicação.