

**FUZZY COGNITIVE MAPS TO EVALUATE THE CONSUMER DECISION  
JOURNEY THROUGHOUT THE EVALUATION AND UNDERSTANDING OF  
THE CONSUMER MOTIVATION SCALE**

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**Degree work to qualify for the title of ADMINISTRATOR ENGINEER**

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## ABSTRACT

Taking into consideration the importance of understanding the consumer decision journey, along with being able to pick out the factors that drive the motivation of a consumer towards deciding to purchase or not a product is essential. It is a fact that by understanding and being able to predict consumer trends it is possible to boost up engagement people have with the products all new/existing businesses can offer. By utilizing an adequate consumer motivation scale to determine what drives the consumers and in that way develop new products, new campaigns, or even implement new services, it is possible to reach the unreachable and to dig into the neurological sides of consumers. By understanding this deeper, subconscious side of the consumer, it is possible to understand how to create a long-lasting effect in them.

Using data and neuromarketing, it is possible to, at a big scale, determine what motivates a consumer to buy. This can then lead to understanding what products to offer and which market to offer it to increase the likelihood of adoption in its exposed market. The reason why new business ideas fail, or current business ideas get outgrown by the market is either due to the lack of product development, the selection of the incorrect targeted market, or the selection of an inadequate value proposition. If all these are not chosen with the consumer's psychology on mind then the consumer believes he or she "needs" rather than "wants", which generates a delay in the purchasing action.

With the above in mind and using data-intense analytic studies, composed of fuzzy cognitive maps and concluding by deep learning models, it was possible to identify the key variables of the consumer motivation scale for all tourism products. In this way, opening the door to a new way of thinking. A neuromarketing-oriented marketing strategy that creates the "Why?" before anything else in product development, market development, or simply a product penetration goal. This strategy then allows businesses to start with the need or purpose they need to solve and the key variables the product needs to cover, to then release something to the market. In that way, the product will be something that the consumer psychologically, is already looking for.

In this way, two different phases of the project were created where two different models were proposed. Then, through different deep learning models, one was selected and brought a consumer motivation scale as the final product.

Keywords: consumer motivation scale, consumer decision journey, deep learning models, fuzzy cognitive maps, neural networks, neuromarketing.

## RESUMEN

Teniendo en cuenta la importancia de comprender el proceso de toma de decisiones del consumidor, además de poder identificar los factores que impulsan la motivación de un consumidor para decidir comprar o no un producto, es un hecho que comprendiendo y prediciendo las tendencias de los consumidores es posible impulsar productos nuevos o existentes. Al utilizar una escala de motivación del consumidor adecuada para determinar qué impulsa a los consumidores y de esa manera desarrollar nuevos productos, nuevas campañas o incluso implementar nuevos servicios, es posible llegar a lo inalcanzable y profundizar en el lado neurológico de los consumidores para comprender cómo crear un efecto duradero.

Utilizando datos y neuromarketing, es posible determinar qué motiva a un consumidor a comprar. Esto puede llevar a comprender qué productos ofrecer y qué mercado ofrecer para aumentar la probabilidad de adopción en su mercado expuesto. La razón por la cual las nuevas ideas de negocios fracasan, o las ideas de negocios actuales son superadas por el mercado es la falta de desarrollo del producto, una selección del mercado objetivo incorrecto o la selección de una propuesta de valor inadecuada que no está psicológicamente ligada a lo que el consumidor considera como necesario. Se debe optar por ofrecer los productos que el consumidor considera que "necesita" en lugar de que "quiere".

Teniendo en cuenta lo anterior y utilizando datos de extensos estudios analíticos, compuestos por mapas cognitivos difusos y concluidos por modelos de aprendizaje profundo, fue posible identificar las variables clave de la escala de motivación del consumidor para productos turísticos.

De esta forma, se abre la puerta a una nueva forma de pensar. Una estrategia de marketing orientada al neuromarketing que crea el "¿Por qué?" antes que nada en el desarrollo de un producto, desarrollo de mercado o simplemente un objetivo de penetración de producto. Luego, esta estrategia permite que las empresas comiencen con la necesidad o el propósito que necesitan resolver y las variables clave que el producto necesita cubrir, para luego lanzar al mercado algo que el mercado, psicológicamente, ya está buscando. Así, crearon dos fases diferentes del proyecto donde se propusieron dos modelos diferentes. Luego, a través de diferentes modelos de "deep learning", se seleccionó uno y se trajo una escala de motivación del consumidor como producto final.

Palabras clave: escala de motivación del consumidor, viaje de decisión del consumidor, modelos de aprendizaje profundo, mapas cognitivos difusos, redes neuronales, neuromarketing.

# INTRODUCTION

Any marketer who has ever wondered which new strategies to create to sell different products, which differentiated channels to explode to create a noticeable awareness difference or which new innovative products to release to create a big turn in the markets, have no started the journey with the why (Sinek, 2009). Grand mistake of all marketers, as there is not a fundamental reason that is igniting the purchase behavior. This is not marketing, marketing is understanding what moves a human and then designing with that why in mind, just like Simon Sinek mentions in his book *Start with the why*; “Very few people or companies can clearly articulate WHY they do WHAT they do. By WHY I mean your purpose, cause, or belief - WHY does your company exist? WHY do you get out of bed every morning? And WHY should anyone care?”

To correctly identify the why, or the reason of human internal motivation, it is essential to understand what drives the internal belief system of a person. This including the fields of economics and psychology that drive the construction of a consumer’s internal motivation (Barbopoulos & Johansson, 2017). By having a deeper clear understanding of the consumer motivation scale, it is possible to perform tailored marketing, consumer segmentation and new products.

Later, when it comes down to understanding and predicting the consumer decision journey, there are many psychological and neurological aspects that need to be studied closely to understand how a consumer behaves, decides, selects, and consumes. Understanding the base motives that move the consumer, before going into the marketing details on how to sell any article to a customer, is essential. Starting by very top and comprehending the three master goals that guide the consciousness consumer at scale is primordial. These master goals are identified as: gain, hedonic and normative. Each of these main goals could be then segregated into subgoals: consisting in Value for Money, Quality and Safety (Gain); Stimulation and Comfort (Hedonic) and ethics and social acceptance (Normative). These are all explained deeper in the following figure

Figure #1. The nine preliminary sub-goals of the gain, hedonic, and normative master goals.

Goal	Sub-goal	Underlying motive
Gain	Value for Money	To get value for money, pay a reasonable price, avoid wasting money <sup>a</sup>
	Quality	To get something of high quality and reliability, that meets one's highest expectations <sup>b</sup>
	Function	To get something useful and practical, that serves many purposes <sup>c</sup>
	Safety	To feel safe, calm and prepared for the unforeseen <sup>d</sup>
Hedonic	Pleasure	To get something that satisfies immediate needs, that makes one feel good and happy <sup>e</sup>
	Stimulation	To get something exciting, stimulating or unique, avoid dullness <sup>f</sup>
	Comfort	To get something pleasant and comfortable, avoid hassle and discomfort <sup>g</sup>
Normative	Ethics	To act in accordance with one's moral principles and obligations, avoid guilt <sup>h</sup>
	Social Acceptance	To make a good impression, identify with peers, live up to expectations <sup>i</sup>

Building into the importance of understanding this main head goals and subgoals, it is essential to look at consumer motivation scale within its past studies like the one performed by Barbopoulos & Johansson in 2017.

For the particular case of the CDJ in the purchase of tourist products and services, several papers show how AI has allowed the interaction of consumers with this type of products and services thanks to immersive experiences, and also like artificial AI can help improve the consumer experience. In this same sense, (S. Puntoni, R. W. Reczek, M. Giesler, 2021) shows how AI can personalize tourism products and services to achieve positive and long-term experiences in consumers as a result of a better characterization of the information available on the network. Finally, (M. D'Arco, L. Lo Presti, V. Marino, 2019) presented in 2019 an article that makes an extensive review of the literature, which clearly illustrates how the Big Data and AI analytics tools can offer effective support to decision-making systems reducing the risk of bad marketing decisions by consumers and organizations

Figure #2. The consumer motivation scale

	Item #	What matters the most to you when you _?
Value for Money	VfM1	<b>Reasonable price:</b> the product should be reasonably priced
	VfM2	<b>Not too expensive:</b> the product should not be too expensive
	VfM3	<b>Economy:</b> the product should be economical
	VfM4	<b>Value for money:</b> I should get a lot for the price I pay
	VfM5	<b>Not wasteful:</b> the product should not be a waste of money
Quality	Quality1	<b>Quality:</b> the product should be of consistent and high quality
	Quality2	<b>First class:</b> the product must be of the highest class
	Quality3	<b>Well made:</b> the product should be well-made or well-performed
	Quality4	<b>Fulfills expectations:</b> the product should fulfill even my highest requirements and expectations
	Quality5	<b>Reliability:</b> the product should be reliable (I should know what I get)
Safety	Safety1	<b>Security:</b> the product should provide a prolonged and persistent feeling of security
	Safety2	<b>Safe and secure:</b> the product should feel safe and secure
	Safety3	<b>Preparation:</b> the product should make me well-prepared in case something unforeseen happens
	Safety4	<b>Calm and safe:</b> the product should make me feel calm and safe
	Safety5	<b>Future needs:</b> Needs that may arise in the future should be taken into consideration
Stimulation	Stimulation1	<b>Exciting:</b> the product should be exciting
	Stimulation2	<b>Stimulating:</b> the product should be stimulating
	Stimulation3	<b>Avoid boredom:</b> It is important that the product is not too boring or routine
	Stimulation4	<b>Unique:</b> the product should be unique (or give many unique experiences)
	Stimulation5	<b>Interesting:</b> the product should be interesting
Comfort	Comfort1	<b>Smoothness:</b> the product should be smooth and comfortable
	Comfort2	<b>Avoid inconvenience:</b> the product should not be too inconvenient
	Comfort3	<b>Avoid hassle:</b> the product should not be too complicated or strenuous
	Comfort4	<b>Pleasure:</b> the product should be pleasant and agreeable
Ethics	Ethics1	<b>Not morally wrong:</b> the product should not be morally wrong
	Ethics2	<b>Principle:</b> the product should not violate my principles
	Ethics3	<b>Obligations:</b> the product should be compatible with my personal and moral obligations
	Ethics4	<b>Ideals and opinions:</b> the product should be compatible with my ideals and opinions
	Ethics5	<b>Good conscience:</b> the product should give me a good conscience
Social Ac.	Social1	<b>Friends' approval:</b> the product should be approved by my friends
	Social2	<b>Popularity:</b> the product should be popular in my circle of friends
	Social3	<b>Friends' expectations:</b> the product should not go against my friends' expectations of me
	Social4	<b>Good impression:</b> the product should make a good impression on people who are important to me
	Social5	<b>Liked:</b> the product should be liked by people who are important to me

Note: The dimension labels and the item # should not be visible when used in a questionnaire, and the items should be presented in randomized order.

Social Ac. = Social Acceptance

The following study will aim in validating the above model, along with analyzing any high correlation between the high influence variables qualified through fuzzy cognitive map. Not only will the past be analyzed, but also new correlations would be drawn to compare the above motivation scale with a new kind of motivation scale.

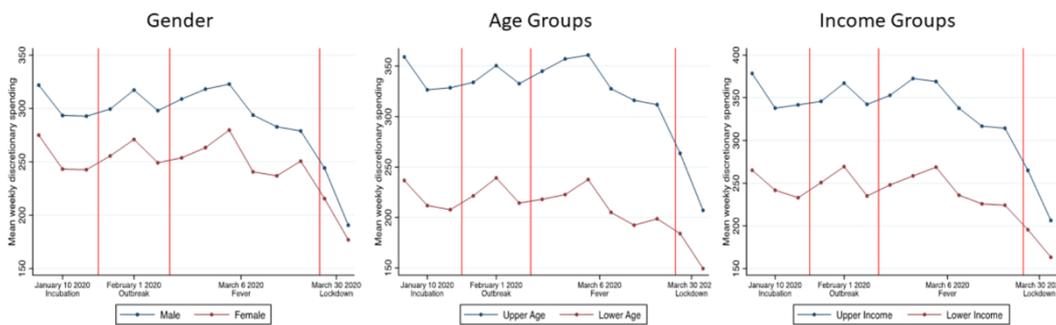
It is essential to understand that consumption is a purpose and goal driven human behavior (Bagozzi, 1993), which means that consumption is driven by an end goal or mean rather than by the actual physical act of acquiring or having one new thing. This, in other words, symbolizes behaviors by goals, which are desired end states ignited by a discrepancy of the current vs. the desired state (Carver & Scheier, 1981). The desired end state then is capable of constantly reconstructing the perceived value of different consumption alternatives that could be conducive, but also detrimental with reaching that end goal (Forster, Liberman & Friedman 2007).

# 1. PRELIMINARY

## 1.1 PROBLEM STATEMENT

Due to the current pandemic, consumerism has been greatly affected. The continuous lockdowns, the shortage of labor offer and overall, the economic decline has affected the world tremendously. The following graphs exemplified consumeristic particular behaviors during the first months of 2020:

Figure #3. Overall discretionary spending in the UK 2020 (Chronopoulos, Lukas, & May, 2021)



Other than that, the rise in attitude for caring and loving the planet more than anything else continues rising. Eco-friendliness, no-animal eating diets, vegan clothing, cruelty free products, recyclable and reusable tendencies are stronger than ever before (Habibun, 2021).

From both factors above, it can be understood that consumerism is heading towards a rapid decline, which does not agree with the rapid increase of small business that is happening across the world. How to deal with both challenging circumstances? How to design and develop products in a non-consumeristic tendency heading just around the corner? It is time to think before launching new products, to design wisely and supported on consumer data understanding what the different products will fix for the customer and why one customer will buy it.

Nowadays, all consumers are also fighting an oversaturation of product exposure as everything has become a contact site of advertisement, even more since the human population is growing more digital. Companies like Facebook are exponentially increasing their revenue with Ads, as suggest by Salvador Rodriguez “The company attributed its massive revenue growth to a 30% increase in the average price per ad, as well as a 12% increase in number of ads shown.” (Rodriguez, 2021). Furthermore, even major players and companies like Google/Alphabet have positions like the one described further: “More than 80% of Alphabet’s revenue comes from Google ads, which generated \$147 billion in revenue last year”. Where is the world heading and how can one small company enter the advertisement world to compete with multi-millionaire private and public firms?

It is to no doubt that digital marketing should be an essential piece to all companies’ business and growth plan and should be included within the budgeting nowadays. However, should digital marketing really be the new source for companies to be spending

20% of their revenue? Should this really become a race of giants to see who can spend more? Not many business owners have stopped and thought this might just be a way for the biggest tech giants to control the digital world, own our data and our privacy.

Then, the real question becomes, how can marketers, entrepreneurs, and traditional businesses fight the war for attention? Is it all depending on the marketing spend and brand awareness techniques that the brand has planned out and has the budget to sustain, or does it depend on the triggering of the adequate feelings to the consumer? In other terms, should psychology start playing a bigger role, and should it become as essential for all marketers as knowing how to handle Google Ads, LinkedIn Ads and Facebook Ads Manager?

Certainly, most business are dedicating between 15-20% of their desired revenue to marketing, and almost 70% of that spend is going straight to digital (Luo, 2008). But is this the correct avenue? This easiness of posting an ad, of creating and freelancing content nowadays is immeasurable, which then gives birth to the real race which is becoming who can pay more the digital world and survive longer than its competitors.

The psychology of the consumer, the feeling expected or experiences when buying a product, the experience of the customer has been long forgotten and overlooked, which this thesis aims to prove is a big mistake. Not by being shown more ads will the consumer be prone to buy more, there are more than enough Ads trying to take as much attention as they can while humans browse, scroll through their personal feeds, watch a movie, listen to a podcast, open their email box. Then what does it depend on?

It is necessary to take a closer look at how humans think when they purchase, the feelings that when triggered will initiate an immediate buying response, even understanding the types of products which give rise to different internal emotions. When understood like this, marketing becomes a channel to link the product to the clients' feelings in the most perfect and unnoticeable way. It gives rise to a whole new era of products that are thought of before they are created, products with a reason and not products to amplify consumerism even to a bigger and wider scale.

In summary, the problem presented here, is that budget should not be the only factor that defines whether a business will or no grow, as this would never let real smart ideas flourish. Hence, the real issue treated is how to get to the desired customer in an easier way, how to approach the customer, which feelings to trigger in the customer to increase the chances of conversion, and hence to increase the revenue of a business which is required to survive in the market.

## **1.2 PROJECT OBJECTIVES**

### **1.2.1 General Objectives**

To understand and evaluate the effect that the seven factors in the consumer motivation scale (CMS) have on the purchase decision through a fuzzy neural model.

### **1.2.2 Specific Objectives**

- 1.2.2.1 Complete a bibliographic review that allows defining the nine main variables affecting the consumer motivation behaviors.
- 1.2.2.2 Characterize numerically the effects that each attribution evaluated in consumers have over the sub-goals
- 1.2.2.3 Develop a fuzzy neural model that allows the estimation of the level of influence and correlation between each of the variables being evaluated.
- 1.2.2.4 Compare the different fuzzy neural models to select a final one to perform a deep learning evaluation and further understand the correlation between the strongest variable

## **1.3 FRAMEWORK**

### **1.3.1 Background Investigation**

#### **1.3.1.1 Theoretical Mark**

The theory of consumer behavior is defined from a marketing point of view as a “a set of activities that people carry out from the moment a need arises, until it is satisfied” (Schiffman, 2011). The present paper then aims to shorten and communicate the gap between how consumers think and behave and how marketers offer and behave. Quite surprisingly, the digital era has given birth to a new form of marketing, the “want” marketing, where things are sold to the eye based on how they look and not based on their function or the human need that they aim to fulfill. Hence, it all becomes about creativity, about finding a way to innovatively show the eye the product to create remembrance and making the customer buy it due to visual cues which are studied and identified by marketers. The above strengthened by Titus Suciú in her saying, “With a creative and data-driven approach, digital marketers can deliver better experiences that offer more long-term brand awareness and loyalty” (Suciú, 2014). Then, it is possible to understand, evaluate, and further predict consumer behavior tendencies as the most important pillar of consumer behavior research.

When understanding consumer behavior, two important dimensions must be considered, the external and the internal conditioning (Schiffman, 2011). The first of them places the consumer in their social and cultural contexts to obtain a detailed panorama of these dimensions that and how these can in the future affect their respective surroundings. The foremost, tests the human being as an individual bearing with a particular way of thinking, and an individual behavior and mind of its own. To emphasize the external conditions, include things from the culture and hereditary subculture to which an individual belongs and all the way up to income, specific role in society, family size etc. Then the internal conditioning refers more to the personality of an individual, his internal motivations, goals, reward systems and fears in life, the conditioning implanted throughout the growth of the individual etc.

There are many ways to go around consumer decision theory. Many social and economic traits can affect the decision of one particular consumer, which can then lead to confusion on how to deal with the way in which consumers think. However, it is essential to understand at least the factors that drive the purchasing decision in the consumers. Humans are social and emotional creatures that look for avenues in which pleasurable feelings can be aroused, hence for purchasing behaviors it is a must to

understand and categorize the different arousal factors a customer looks for in the purchasing journey.

### 1.3.1.1.1 An introduction to consumers and what drives them

Like most behaviors in the human psychology, consumption has proven to be a goal-driven behavior (Bagozzi, 1993), which means that it is done with the purpose of achieving something in particular by the end. It is important to understand then how a goal drive behavior works. The mind starts perceiving a differing state between what is wanted to be achieved and what is currently achieved or held. Then, as the importance of achieving this goal starts building up, it creates tension and need in the human brain to release this tension by driving the adequate resources to close this gap (Carver & Scheier, 1981). The human brain is then capable of assessing all the alternatives that come in hand as either detrimental or conducive to reach that goal (Custers & Aarts, 2005).

### 1.3.1.1.2 The decision journeys

The decision journey of a consumer is also essential to understand as it builds up into what goes through a consumers mind before, while and when they decide to buy a particular product with a specific brand in the market. It is essential to highlight that the selection itself agrees to the factors and the goals which will be discussed later, but the flow of the process can usually be understood psychologically (Court, Elzinga, Mulder, & Vetvik, 2009). Traditionally, customers have taken decisions as per shown in *Figure 4* below, selecting a “set of potential brands and methodically reduce that number to make a purchase”.

In the 20<sup>th</sup> century however, the number of offerings for each product has increased, changing the way in which a consumer decides completely. As per shown in *Figure 5*, the decision journey has become a circular process. This one consists of four phases: active evaluation (researching stage), closure, post purchase and product experience. The funnel still plays an important role, as the purchase of every product requires a research cycle and product preference pre-selection; nevertheless, the post service and product experience is what provides an opening for the brand to be rebought, which indicates the chances the brand has of surviving in the market.

*Figure #4.* The Traditional Consumer Decision Journey

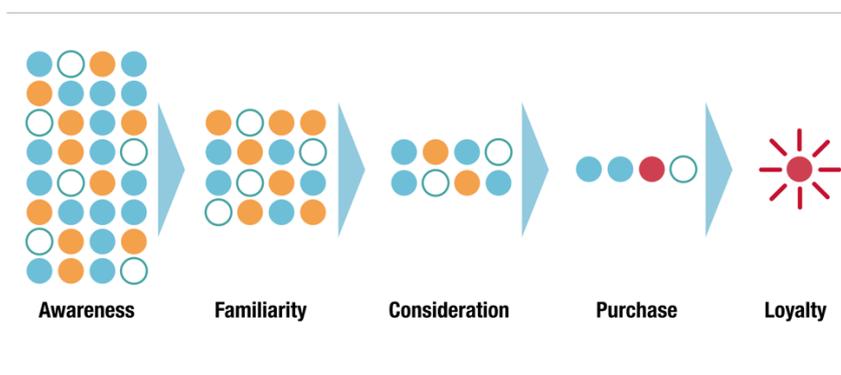
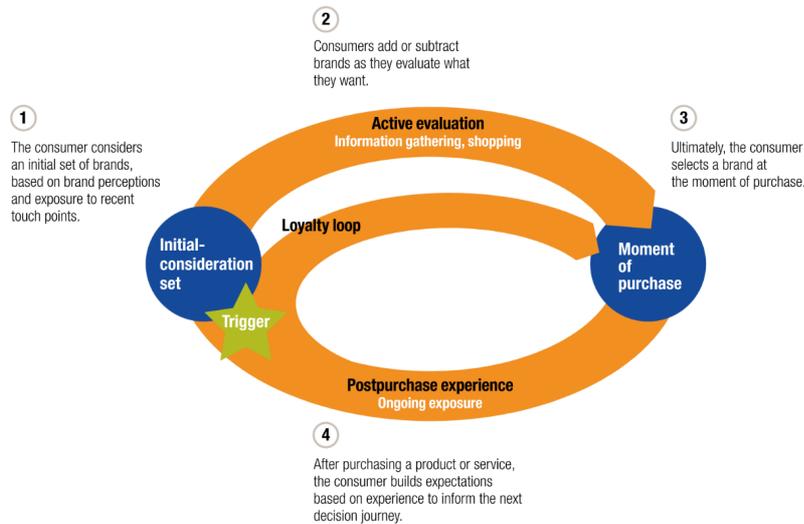


Figure #5. The New Consumer Decision Journey



### 1.3.1.1.3 The Master Goals

Now that the decision journey is well understood, building up the goal driven criterion is essential. The structure is placed with three main goals, followed by nine subgoals and exemplified with the consumer motivation scale (CMS), *Figure 2*, (Isak Barbopoulos & Johansson, 2017). The three head motivational factors, which represent the master goals include: Gain, Hedonic, and Normative. Specifically, the gain goal is with a sensitivity to changes of personal resources (Lindenberg & Steg, 2007), gaining some in exchange of purchasing something else. The hedonic refers to when a consumer is motivated to improve how they feel and are susceptible to changes in pleasure and mood (Lindenberg & Steg, 2007). Lastly, the normative, unlike the hedonic and gain, is not self-interested and refers to how appropriate a purchase is in terms of the perceived moral obligations, and social norms that one falls under.

#### *Gain*

The gain goal usually outlies the hedonic and normative goals when it is active within a purchase, as the cost of an item and its perceived value evolve as fundamental part of purchasing in the modern day. It has probably been the master factor with the biggest research background, as it being a fully rational choice makes it easier to analyze and build reports on. All of it evolves around the exchange in value between that is received and given in return (Zeithaml, 1988). Lastly, it is important to note that the gain goal does not always depend indirectly on the price of a product, as high price also indicates high quality which is another gain subgoal which is of outstanding importance when understanding the gain emotion.

#### *Hedonic*

The hedonic goals are not active as frequent as the gain goals are, but they are certainly the goals that appear when consumers want to improve the way in which they feel, which makes the goal pleasure and mood driven (Lindenberg & Steg, 2007). Hence, the goal is fully shortsighted, uni-dimensional, and relatively unstable as they don't provide a clear strategy to follow to maintain offerings or incentives to attract a client. Similar as with gain, the hedonic goals are not always related with excitement, as there is

also a customer sectors which perceives improvements in a way of being more comfortable and relaxed (contrary of excitement).

### *Normative*

The main aspect to recall of the normative master-goal is to “supervise” the buying behavior of an individual based on different cultural norms or traditions of what is or is not adequate to buy within an ethical and moral society. The goals doesn’t only reward the good behaviors but it also penalizes the incorrect ones across social sanctions, and moralization ques (Tangey & Dearing, 2002). The normative goals are always associated to behaving the way in which the society believes is correct, contributing to a green world, and exceptional environment and showing correct social behavior. Due to the nature of the goals, its importance tends to vary greatly with the different cultures; in the sense in which most conservative culture suffer from a greater normative goal effect, whereas a liberal culture does not as it does not enforce anything on the people that belong to it.

#### **1.3.1.1.4 The sub-goals**

After understanding the master goals, it is possible to build up into the sub-goals.

For the gain master-goal, the below subgoals should be enounced and defined:

Value for Money: to get value for money, pay a reasonable price, avoid wasting money (Isak Barbopoulos & Johansson, 2017)

Quality: to get something of high quality and reliability, that meets one's highest expectations (Isak Barbopoulos & Johansson, 2017)

Function: to get something useful and practical, that serves many purposes (Isak Barbopoulos & Johansson, 2017)

Safety: to feel safe, calm and prepared for the unforeseen (Isak Barbopoulos & Johansson, 2017)

For the hedonic master-goal, the below subgoals should be enounced and defined:

Pleasure: to get something that satisfies immediate needs, that makes one feel good and happy (Isak Barbopoulos & Johansson, 2017)

Stimulation: to get something exciting, stimulating, or unique, avoid dullness. (Isak Barbopoulos & Johansson, 2017)

Comfort: to get something pleasant and comfortable, avoid hassle and discomfort. (Isak Barbopoulos & Johansson, 2017)

For the normative master-goal, the below subgoals should be enounced and defined:

Ethics: to act in accordance with one's moral principles and obligations, avoid guilt. (Isak Barbopoulos & Johansson, 2017)

Social Acceptance: to make a good impression, identify with peers, live up to expectations. (Isak Barbopoulos & Johansson, 2017)

Important however to point out that the above factors are just the potential sub-goals of the master goals, as when exemplified by *Figure 2* in the first page, it can be easily observed that some additional sub-goals and motives for purchase are added at the end of the Consumer Motivation research proposed by Barbopoulos & Johansson.

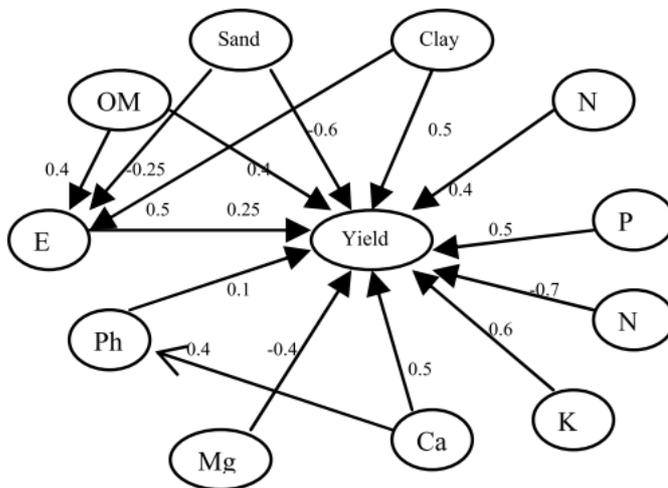
The information presented in this document is the sole responsibility of the authors 17 and does not commit the EIA.

### 1.3.1.1.5 Fuzzy Cognitive Maps

Fuzzy cognitive maps (FCM) are a qualitative and visual tool that allow the expression of quantitative relational data. The main characteristics of FCM's is that they allow modeling the behavior of a system in terms of concepts, where the latter represent characteristics or variables of main system. In this order of ideas, the end results allow the system to be illustrated with the different cause and effect relationships that keep existing between the different concepts. The below figure shows a visual representation of what a fuzzy cognitive map looks like, but for a different application in agriculture.

Figure #6. Representation of a simple fuzzy cognitive map

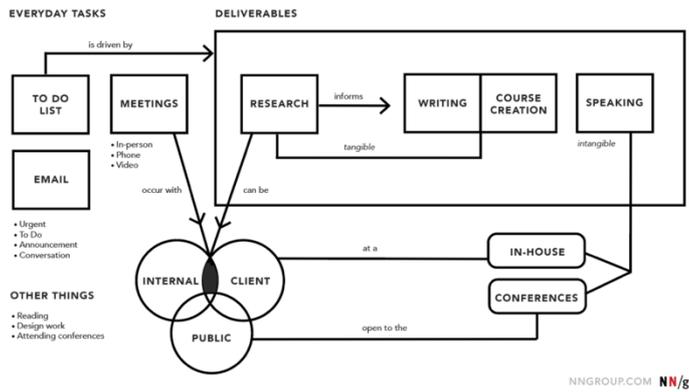
Source: (Markinos, Papageorgiou, Stylios, & Gemtos, 2007)



It is essential to define the following terms for the complete understanding of the fuzzy cognitive maps

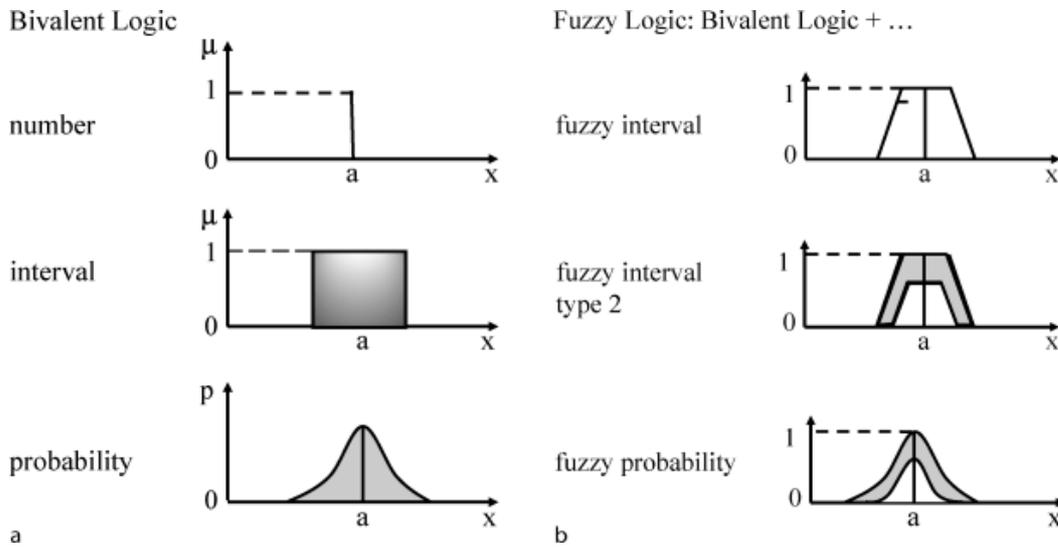
**Cognitive maps:** “Any visual representation of a person's (or a group's) mental model for a given process or concept” (Gibbons, 2019). The above is exemplified in the below *Figure 6*, where an understanding of the fundamental basis of a cognitive map can be seen, even though at the cognitive map extent it is mainly qualitative as it has no numbers but just plain descriptions.

Figure #7. Cognitive mapping

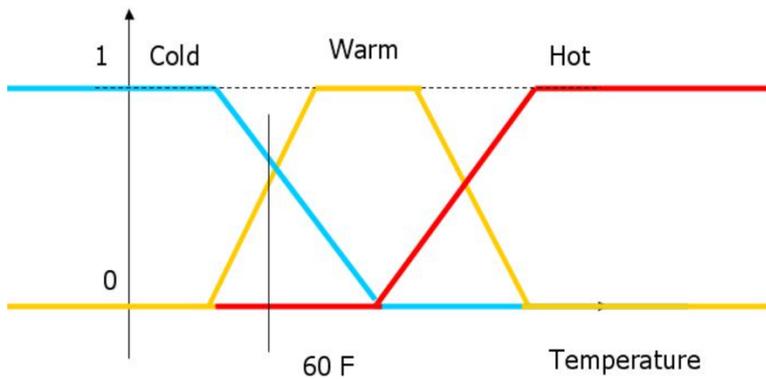


**Fuzzy Logic:** the aim of fuzzy logic is to make possible the modelling of vague information, without kneeling towards the traditional bivalent logic which has led the way in the past years. *Figure 7* below portrays As suggested by the Stanford Encyclopedia of Philosophy, fuzzy logic is “intended to model logical reasoning with vague or imprecise statements” (Cintula, 2016). It no longer needs to be a yes or no description, but systems can now be described as the juncture between a series of interlapping curves as shown in *Figure 8*.

*Figure #8.* Bivalent vs Fuzzy Logic



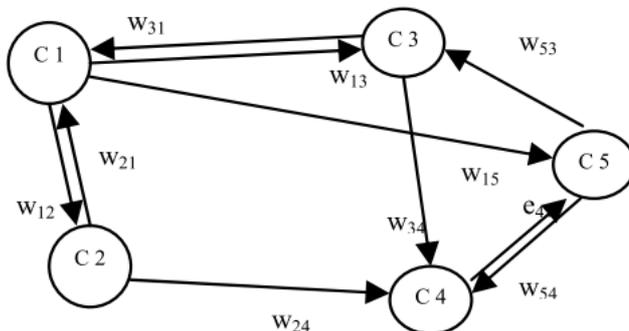
*Figure #9.* Fuzzy Logic Interlapping Graphs



*Nonlinear dynamic systems*: systems whose function of change is nonlinear, independently of its behavior (Van der Built, 2020). Essential in the development of fuzzy maps as these are usually described with interval conditions of non-linear systems.

To understand the symbolism of a fuzzy cognitive map itself, and hence understand how to read the different relationships it portrays, the below figure can be utilized:

Figure #10. Fuzzy Cognitive Map Template



All the relationships are categorized with a value within the interval  $(-1,1)$  which symbolize the so called  $W_{ji}$ , which shows the extent to which the factor  $i$  affects factor  $j$ . Taking the above into consideration, one can later establish three types of causal relationships that allow defining the influence of a concept towards others as follows (Chen & Minai, 2015) :

1.  $W_{ji} > 0$  (positive): an increase in the value of factor  $i$  leads to an increase in the value of  $j$  and, in turn, a decrease in the value of  $i$  culminates in a decrease in  $j$ .
2.  $W_{ji} < 0$  (negative): a decrease in the value of  $i$  leads to an increase in the value of  $j$  and vice versa.
3.  $W_{ji} = 0$ : there is no causality between both factors.

### 1.3.1.1.6 Neural Networks

Coming under machine learning and as the heard of deep learning algorithms (IBM Cloud Education, 2020), neural networks, aka artificial neural networks have revolutionized the way in which algorithms used to learn and think for themselves. Inspired fully by the

human brain, neural networks aim to mimic the way in which the neurons found in the human brain mimic each other to solve problems or find optimized solutions.

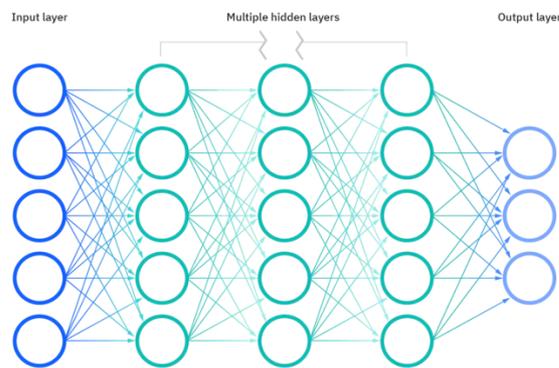
The artificial neural networks are usually made up of three different layers:

1. An input
2. A set of hidden layers
3. An output layers

Each node connects with each other with a particular weight and when a threshold is reached, the data is sent to the next layer until it reaches a set of outputs. Interconnection between each of the different layers is essential for the data to be passed along and the algorithm to reach a final response or responses by the end of the repetitions.

Then, deep learning is a subset of neural networks which refers a multiple set of hidden layers which gather information from the input layer and then communicate information to the output layer. *Figure 10* below exemplifies the way in which a deep learning neural network works.

Figure #11. Deep Neural Networks. Source: (IBM Cloud Education, 2020)



The functioning of neural networks is not as complex as the visuals, or the descriptions make it look. Neural networks are basically a junction of linear model nodes which interact with each other to create an output which is better than its input (as it has been through the extensive process of re-learning its own algorithm to produce something better). As a fact, neural networks can either be initiated with linear functions with a derivative equal to zero, or they can be initiated with exponential functions which tend to return higher correlations between the input variables.

## 2. METHODOLOGY

The proceeding investigation was performed with the main purpose of understanding consumer behavior and psychology to a deeper degree to be capable of proposing a new way of offering products from a seller's point of view to the buyer. Currently, not much reasoning is backing up the why of launching new products or new companies, and it has become more like a fashion to be an entrepreneur and launch a business idea into the market. However, this is leading to many initiatives going bankrupt, due to the lack of fundamentals and preparations when launching new business ideas. In this reasoning, it is then essential to change the orientation of thought and welcome marketers into psychology and consumer behavior. After the different specific objectives are accomplished, the project can indicate a clear message in regard to where marketers need to focus and the characteristics that product innovation should try to aim at.

Hence, the project is opening door for future marketers and entrepreneurs to think smart, to solve the question the customer is looking for unconsciously, instead of following the trend of launching any product into the market and then backing it up with a big marketing spend to push it to be successfully in this way. This approach is not sustainable and is just collaborating towards big tech-companies' pockets which are just in the never-ending rise.

The competitive advantage that this kind of inverse engineering has is that customers feel heard and related since the moment in which they buy a product, which already plays in a company's favor. Fuzzy maps and deep learning neural networks will both play an essential role in exemplifying visually how the different variables interact under certain external conditions.

### **2.1 Complete a bibliographic review that allows defining the nine main variables affecting the consumer motivation behaviors.**

To achieve the first objective, an extensive bibliographic review is carried out, at first glance to understand the different factors that can affect the consumer behavior and motivation scale when purchasing or considering purchasing something. This bibliographical reviewed allows to have a general background on the consumer behavior side, as well as the different variables or factors that drive or affect the purchasing journey of a client.

After being able to recognize the different variables, the specific concepts within the consumer motivation scale can be evaluated on a high level (master goals level). The selection is based on the extensive Consumer Motivation Scale research carried out by I. Barbopoulos, L.-O. Johansson. In the first and second model to be presented below, the same variables were taken into consideration, but the correlation was interchanged between A variable creating a change for the B variable and the B variable creating a change for the A variable.

Hence, deriving from the main three master-goals it was possible to then drill down even further, until nine subgoals were reached. The different sub variables belong to a specific master-goal and portray completely different aspect of the main master-goal.

## 2.2 Characterize numerically the effects that each attribution evaluated in consumers have over the sub-goals

In this stage of the works, a deep analysis was done in each of the different sub-goals and their real, final relationship with the main master goal. This step looks at building a data base which characterizes numerically the behavior a person has while performing different kinds of shopping (Accommodation, Travel, Groceries, Clothes, Entertainment) from all the sub-goal and master-goal points of view. The data-base used was a sample from the research: “The Consumer Motivation Scale: development of a multi-dimensional and context-sensitive measure of consumption goals” carried out by Isak Barbopoulos & Lars-Olof Johansson. The researchers were contacted and kindly offered three different data samples which tested for different areas of the consumer decision journey or motivation scale.

In this way, the database used allows to interpret how the different kinds shopping experiences arise and trigger different emotions, which in turn reflect the different sub-goals selected. By having a sub-goal activity relation it was possible to then link it to the master-goal and understand overall, how the master-goal (Gain, Hedonic or Normative) interfered or conducted the purchase.

This goal allowed to further evaluate the behavior of consumers on a big scale. With 988 participants being part of Sample 1, it was possible to then evaluate what the different consumer contexts generated in terms of the master goals and sub-goals. The master goals were generated as a weighted average of the responses obtained from the different sub-goals. Below the tables which specific how the different subgoals were tested for. It is important to emphasize that the *Gain* master goal breaks down into – Value for Money, Quality, Safety, and Function; the *Hedonic* master goal breaks down into- Pleasure, Stimulation and Comfort ; and the *Normative* master-goal breaks down into Ethics and Social Acceptance.

To test for the different subgoals, the participant was asked different questions which alluded to the specific sub-goal’s presence. Below *Table 1* exemplifies the different questions which the participants were asked across the process.

*Table #1. Sample 1 List of Items and questions. Source: (Isak Barbopoulos & Johansson, 2017)*

Item#	When I _, it is important that what I choose...	Item adapted from:
VfM1	Is reasonably priced	Sweeney and Soutar [29]
VfM2	Offers value for the money	Sweeney and Soutar [29]
VfM3	Is a good choice considering the price	Sweeney and Soutar [29]
VfM4	Is economical	Sweeney and Soutar [29]
VfM5	Provides good return for the money	Sweeney and Soutar [29]
VfM6	Is not too expensive	-
VfM7	Is not a waste of money	-
Quality1	Is of consistent and high quality	Sweeney and Soutar [29]
Quality2	Is well made (or well performed)	Sweeney and Soutar [29]
Quality3	Has an acceptable standard of quality	Sweeney and Soutar [29]
Quality4	Is first class	-
Quality5	Meets even the highest requirements and expectations	-
Quality6	Has a lasting value	-
Function1	Does not have too limited or short use	Sweeney and Soutar [29]
Function2	Is reliable	Sweeney and Soutar [29]
Function3	Is practical	-
Function4	Is useful	-
Function5	Is functional and fit for purpose	-
Function6	Serves many purposes	-
Safety1	Makes me feel calm and safe	-
Safety2	Makes me feel safe for the future	-
Safety3	Takes consideration of needs that may arise in the future	-
Safety4	Is a good choice in the long-term	-
Safety5	Makes me prepared in case something unforeseen would happen	-
Safety6	Improves my safety or security	-
Pleasure1	Makes me feel good	Childers et al. [11]
Pleasure2	Is enjoyable	Childers et al. [11]
Pleasure3	Is pleasant or enjoyable	Batra and Ahtola [5]
Pleasure4	Makes me want to use it	Sweeney and Soutar [29]
Pleasure5	Appeals to me	-
Pleasure6	Makes me happy and satisfied	-
Pleasure7	Satisfies immediate needs	-
Stimulation1	Is exciting	Childers et al. [11]
Stimulation2	Is interesting	Childers et al. [11]
Stimulation3	Offers diversity	Aluja et al. [1]
Stimulation4	Is not too dull or routine	Aluja et al. [1]
Stimulation5	Gives a unique experience	Bello and Etzel [8]
Stimulation6	Is new or exotic	Bello and Etzel [8]
Stimulation7	Is stimulating	-
Comfort1	Is not too uncomfortable	Childers et al. [11]
Comfort2	Gives relaxation	Bello and Etzel [8]
Comfort3	Gives me rest and recovery	Bello and Etzel [8]
Comfort4	Is not too much bustle or stress	Bello and Etzel [8]
Comfort5	Is not too complicated or strenuous	-
Comfort6	Is smooth and comfortable	-
Comfort7	Makes me feel less stressed out	-
Ethics1	Is consistent with my personal and moral obligations	Steg et al. [27]
Ethics2	Does not make me feel guilt	Steg et al. [27]
Ethics3	Makes me feel like a good person in my own eyes	Steg et al. [27]
Ethics4	Does not violate my principles	Bamberg and Schmidt [2]
Ethics5	Gives me a good conscience	Thøgersen [31]
Ethics6	Is not morally wrong	Thøgersen [31]
Ethics7	Is consistent with my ideals and opinions	-
Social1	Is approved by my friends	Bearden, Netemeyer and Teel [6]
Social2	Is liked by people who are important to me	Bearden et al. [6]
Social3	Is what my friends would expect me to choose	Bearden et al. [6]
Social4	Makes a good impression on people who are important to me	Bearden et al. [6]
Social5	Gives me a sense of belonging with people who are like me	Bearden et al. [6]
Social6	Makes me more alike my role models	Bearden et al. [6]
Social7	Is similar to what people who I identify with choose	Bearden et al. [6]
Item#	When I _, it is important that what I choose...	Item adapted from:
Social8	Makes me feel accepted	Sweeney and Soutar [29]
Social9	Improves the way I am perceived by people who are Important to me	Sweeney and Soutar [29]
Social10	Is popular among my friends	-

Each response was given based on a number from 1-5, 5 being the highest and alluding to when the participant feels more related to the statement. Then, considering each individual response for each subgoal, created an average numerical number for each Item # “Vfm1”, “Vfm2” etc. This then allowed for a numerical categorization both in terms of sub-goals, and then finally a weighted average per master-goal.

The 1-5 numerical scale then can define under different consumer contexts which master-goals are essential to touch on and which sub-goals are primordial when a person is considering buying something new. It is important to mention that then, some item numbers were moved around to different master-goals according to the correlation between the sub-goal question and the sub-goal itself (Safety, Social Acceptance, Stimulation, Quality, Ethics, Value for Money and Comfort). Some other Item numbers were removed based on their redundancy/ close relation to other variables. The pleasure and the stimulation categories were rearranged and made part of a seven factor structure (Isak Barbopoulos & Johansson, 2017) according to their strong relationship with the sub-goals mentioned above.

**2.3 Develop a fuzzy neural model that allows the estimation of the level of influence and correlation between each of the variables being evaluated.**

After the variables to be defined underwent a thorough evaluation, it was then important to start analyzing the relation between the variables themselves. This was done to generate a series of linguistic values so the different fuzzy sets could be generated (Nameirakpam & Singh, 2015). Then with the above established, fuzzy system are structured, with a designed process and specific rules. The fuzzy models for Model 1 and Model 2 were both recorded for 20 iterations and for 100 iterations, this to ensure the variable with the biggest slope and change could be analyzed in detail but also to ensure all the 7 variables reached a stable moment (which can sometimes occur at an iteration over 20)

For model 1:

The correlation between each of the sub-goals was taken from the below table (*Table 2*), which was initially recorded in the study by Isak Barbopoulos & Lars-Olof Johansson. Then, the correlation matrix had different input vectors applied which came from five different linguistic variables “Very Low”, “Low”, “Medium”, “High” and “Very High” and the respective belonging that each of the linguistic variables had to the sub-goal. *Table 3* below shows the different activation vectors used, categorized under “Very Low”, “Medium”, “Extremes”, “Expert Knowledge” and “Sign Changing”. Each of this then created a particular fuzzy map representation.

*Table #2. Final Correlation Table Model 1*

	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Value for Money	0	0	0	0	0	0	0
Quality	0.25	0	0	0	0	0	0
Safety	0.41	0.35	0	0	0	0	0
Stimulation	0.06	0.32	0.28	0	0	0	0
Comfort	0.46	0.41	0.45	0.18	0	0	0
Ethical	0.27	0.32	0.39	0.35	0.26	0	0
Social	0.13	0.19	0.33	0.17	0.2	0.18	0

*Table #3. Input Vectors*

Input Vectors - Model 1							
	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Very low	0.770054494	0.775812	0.590106	0.724775	0.459013	0.893063	0.750079
Medium	0.910187003	0.972949	0.963693	0.981487	0.740781	0.597208	0.903939
Very High	0.660250732	0.66704	0.866453	0.727947	0.912164	0.43829	0.69088
Extremes	0.660250732	0.66704	0.590106	0.724775	0.459013	0.43829	0.903939
Expert Knowledge	0.88	0.75	0.8	0.45	0.3	0.25	0.83
Sign Changing	0.5	-0.5	0.5	-0.5	-0.5	-0.5	0.5

For model 2:

The correlation between each of the sub-goals was taken from the R-studio cor function when comparing the different weighted average vectors for each of the seven variables as shown in figure (Figure 12). Then, the final correlation matrix used for model 2 used variable signs to the ones shown in Figure 12. These signs were applied based on common marketing sense, when variable i increases should variable j decrease or increase, if decrease then that dictates the need of a negative sign in front of the numerical value but when increasing it dictates the need of a positive sign. The final correlation matrix used can be seen in Table 4. Then, the correlation matrix had different input vectors applied which came from five different linguistic variables “Very Low”, “Low”, “Medium”, “High” and “Very High” and the respective belonging that each of the linguistic variables had to the sub-goal. Table 4 below shows the different activation vectors used, categorized under “Very Low”, “Medium”, “Extremes”, “Expert Knowledge” and “Sign Changing”. Each of this then created a particular fuzzy map representation. The factors that had the biggest change was then highlighted in red, as seen in Table 4

Figure #12. Correlation table between sub-goals dictated by R Studio

```
> Xk=cbind(XData$CMS_VFM_index, XData$CMS_Quality_index,XData$CMS_Safety_index, XData$CMS_Stimulation_index,
XData$CMS_Comfort_index, XData$CMS_Ethics_index, XData$CMS_Social_index)
> cor(Xk)
      [,1]      [,2]      [,3]      [,4]      [,5]      [,6]      [,7]
[1,] 1.0000000 0.2555902 0.4298609 0.0623363 0.4611868 0.2711669 0.1271416
[2,] 0.2555902 1.0000000 0.3658778 0.3263849 0.4140751 0.3161353 0.1999508
[3,] 0.4298609 0.3658778 1.0000000 0.2781647 0.4521910 0.3933324 0.3317668
[4,] 0.0623363 0.3263849 0.2781647 1.0000000 0.1754085 0.3701893 0.1762959
[5,] 0.4611868 0.4140751 0.4521910 0.1754085 1.0000000 0.2644308 0.1971816
[6,] 0.2711669 0.3161353 0.3933324 0.3701893 0.2644308 1.0000000 0.1901954
[7,] 0.1271416 0.1999508 0.3317668 0.1762959 0.1971816 0.1901954 1.0000000
```

Table #4. Final Correlation Table Model 2

	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Value for Money	1	0.25559	0.429861	0.062336	-0.461187	-0.271167	-0.127142
Quality	0.2555902	1	0.365878	0.326385	0.414075	-0.316135	0.199951
Safety	0.4298609	0.365878	1	0.278165	-0.452191	0.393332	-0.331767
Stimulation	0.0623363	0.326385	0.278165	1	0.175409	0.370189	0.176296
Comfort	0.4611868	0.414075	0.452191	0.175409	1	0.264431	-0.197182
Ethical	-0.2711669	0.316135	0.393332	0.370189	-0.264431	1	0.190195
Social	0.1271416	0.199951	-0.33177	0.176296	0.197182	0.190195	1

Table #5. Input Vectors Model 2

Input Vectors - Model 2							
	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Very low	0.770054494	0.775812	<b>0.590106</b>	<b>0.724775</b>	0.459013	0.893063	0.750079
Medium	<b>0.910187003</b>	0.972949	0.963693	0.981487	0.740781	0.597208	<b>0.903939</b>
Very High	0.660250732	<b>0.66704</b>	0.866453	0.727947	<b>0.912164</b>	<b>0.43829</b>	0.69088
Extremes	0.910187003	0.66704	0.590106	0.724775	0.912164	0.43829	0.903939
Expert Knowledge	0.88	0.75	0.8	0.45	0.3	0.25	0.83
Sign Changing	0.5	-0.5	0.5	-0.5	-0.5	-0.5	0.5

In order to evaluate different contexts or consumer behaviors regarding the purchase of tourist products and destinations, Table 3 defines four fuzzy scenarios (input vectors): “Very Low” (Indifferent consumer), “Medium” (Average consumer), “Extremes” (Extreme consumer), “Expert Knowledge” (Expert consumer), while the Figure 3 shows the evolution of purchasing scenarios for 50 iterations according to cause-effect matrix.

Table # 5.1 Fuzzy Input Vectors

	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Very Low	0.08571	0.09749	0.1127	0.08932	0.06568	0.12209	0.06337
FCM Very Low	0.18700	0.05445	0.21430	0.09962	0.20754	0.27591	0.41463
Medium	0.37783	0.48778	0.35350	0.22669	0.35911	0.34286	0.47461
FCM Medium	0.15389	0.05144	0.23694	0.12773	0.22387	0.35077	0.47562
Extreme	0.87908	0.58570	0.84484	0.91256	0.64635	0.44726	0.97560
FCM Extreme	0.81286	0.94552	0.78573	0.90044	0.79247	0.72428	0.58559
Expert Knowledge	0.82948	0.58142	0.91399	0.52323	0.31263	0.28808	0.55952
FCM Expert Knowledge	0.84739	0.94811	0.78471	0.88446	0.78034	0.68267	0.54920

Figure 5.1 above shows that the factors closest to ethics such as: ethics and social acceptance had a greater relevance for the Indifferent consumer and Average consumer, with less important factors such as Value for money, Quality, Safety and Stimulation of the senses. In general, in these categories are people committed to caring for the environment and looking for tourism products and services close to nature, which are not necessarily associated with Comfort and Safety. It should be noted that the Value for money factor had a significant growth in the first iterations of the model, but then it had a significant decrease because of a significant growth of the ethical factors mentioned above. In the case of Expert consumers and Extreme consumers, the Quality and Safety factors were much more relevant than other factors, followed by Value for money, this mainly promoted by the fact that these types of consumers of tourism products and services are part of people associated with high socioeconomic incomes and that they are willing to pay to achieve comfort, quality, safety and stimulation of the senses more than factors considered as ethical, as evidenced in the scientific literature. It can be observed in the same Figure, that the behaviour of the model for Extreme consumers and Expert consumers had the greatest variations, since the vectors that define the purchasing contexts for these consumers presented values that are high, and that somehow generate problems of stability in the adaption process of the FCM-DL model, however, the model

evolved towards sub-goals that are in accordance with this type of consumers against tourism products and services.

The elaboration of the fuzzy cognitive maps facilitated with the above sets of matrixes and vectors then helped in visualizing a numerical value with a linguistic characteristic, which aided in understanding correctly which were the strongest variables and the ones which showed an underlying strength to change and adjust the most rapidly from the initiating vector.

Having the opportunity to deal both with numerical and linguistic variables is an eye opening, trend-setting option to discover new fluctuations in the market and the reason being for these. Numbers even though exact, sometimes lack in speaking for themselves, especially in the data boom the entire world is in now. Hence, the wonderful interaction and visualization that fuzzy maps offer serves to grow even further in the understanding and analysis of the set of factors treated.

The visual representation allowed by cognitive maps also assisted in outlining the different relations and the prevailing factors across the 12 different scenarios. Then, the visual behavior created by the modeling could be further analyzed and interpreted. In this way, it was possible to estimate the level of influence and correlation between each of the variables and outline the three most recurring ones to later test them with the use of deep learning models.

#### 2.4 Compare the different fuzzy neural models to select a final one to perform a deep learning evaluation and further understand the correlation between the strongest variable

After the twelve (12) different fuzzy neural maps were considered, the three factors that appeared as having a substantially higher value and correction with the different input vectors in place, were selected to be further analyzed through a deep learning model. By using R-studio, along with a linear activation equation, it was possible to enable the data and the algorithm to work together towards a reliable correlation between the three of them. Only linear was tested to the convergence of the different methods under other functions like the exponential ones.

This enabled the scale validation as having a higher correlation could indicate that variables were affected by similar changes in circumstance. A low correlation strengthened the consumer motivation scale proposed by Isak Barbopoulos & Lars-Olof Johansson initially as it marked the factors as independent, but as proposed for the theory point of view highly affecting the consumer motivation degree.

In this order of ideas, by the end of the project everyone reading the below investigation will know what specific factors to reach out continuously under to consumers, as it will become very clear which ones will create a bigger effect or call to action within the consumer.



### 3. DISCUSSION OF RESULTS

#### 3.1 Complete a bibliographic review that allows defining the nine main variables affecting the consumer motivation behaviors.

Initially to complete this objective, it was essential to carry out a bibliographical review that would nurture the consumer motivation investigation and therefore aid in identifying the main and eventually the secondary variable that could affect the purchase behavior of a consumer.

Throwing in different kinds of reviews, data journals, consumer behavior and psychology research; a previous research done by I. Barbopoulos, and L.-O. Johansson was found which was the start of point for the present works. Within the works, 9 sub-goals which were important to the consumer while taking a purchasing decision were explored this being (Isak Barbopoulos & Johansson, 2017):

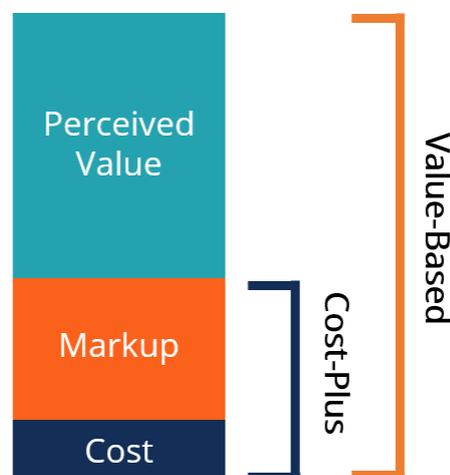
##### 3.1.1 Value for Money

The value you get from service or product against the money you initially invested. This one could be deeper explored in the psychology of the consumer with questions like:

- When I buy \_\_ (product/service), it is important that what I choose is reasonably priced (Stern, 2000)
- When I buy \_\_ (product/service), it is important that what I choose offers value for money (Stern, 2000)

Within many other potential questions, these are the two aspects that evaluate both the product being cheap in the eyes of the consumer, and also the aspect of the product having any price but responding accordingly with a high value of investment. The below figure emphasizes on the different pricing methods based on different value attributions, one purely price competitiveness and the other one named “Value-based” pricing which denotes providing value to the customer independent of the cost involved.

Figure #13. Value-based vs Cost-Up Markup. Source: (Corporate Finance Institute, 2017)



### 3.1.2 Quality

The grade or class of a service or product not always depending on the money you initially invested. This one could be deeper explored in the psychology of the consumer with questions like:

- When I buy \_\_ (product/service), it is important that what I choose has an acceptable standard of quality (Stern, 2000)
- When I buy \_\_ (product/service), it is important that what I choose is first class (Stern, 2000)

Within many other potential questions, these are the two aspects that evaluate both the product having a good, acceptable degree of quality, and also the aspect of the product having an exclusive, superior quality.

### 3.1.3 Function

The purpose or task or use that a product or service a consumer is after has. This one could be deeper explored in the psychology of the consumer with questions like:

- When I buy \_\_ (product/service), it is important that what I choose is functional and fit for purpose (Isak Barbopoulos & Johansson, 2017)
- When I buy \_\_ (product/service), it is important that what I choose serves many purpose (Isak Barbopoulos & Johansson, 2017)

Within many other potential questions, these are the two aspects that evaluate both the product or service having one specific function that performs above standard or having a set of different functionalities or purposes which the product could be used for.

### 3.1.4 Safety

The protection or security that one single product or service offers a consumer after the purchase of a specific product. This goal is not only important for the consumer but also for all the regulatory entities who in the different countries accept or not a product based on how safe a product is

- When I buy \_\_ (product/service), it is important that what I choose improves my safety and security (Isak Barbopoulos & Johansson, 2017)
- When I buy \_\_ (product/service), it is important that what I choose makes me prepared in case something unforeseen happens (Isak Barbopoulos & Johansson, 2017)

Within many other potential questions, these are the two aspects that evaluate both the safety/feeling calm and comfortable with the presence of a project (passive scenario), but also relying on the product or service to provide safety in case something unforeseen could happen (active scenario).

### 3.1.5 Pleasure

The happiness, satisfaction, or joy that a product or service offers a consumer after the purchasing it. This goal can be seen as an emotional driven goal as all that it pursues, and studies is the overall happiness or joy brought by a particular product

- When I buy \_\_ (product/service), it is important that what I choose is pleasant and enjoyable (I. Barbopoulos & Johansson, 2017a)
- When I buy \_\_ (product/service), it is important that what I choose makes me want to use it (Stern, 2000)

Within many other potential questions, these are the two aspects that evaluate both the personally emotional side of simple joy brought by having a particular

product, but also the feeling the product creates itself which can or cannot tempt us to use it.

### **3.1.6 Stimulation**

This one is a complex one to define, especially because stimulation can be taken in many ways and scenarios when utilizing it to fulfill a need. In this way, it can be interpreted as both the excitement that a purchase transmits, as well as the diversity or innovativeness that it brings or the experience it provides to the person that purchases it. Consumer should always have emotions of excitement triggered throughout the purchases as humans are an emotional and social creature.

- When I buy \_\_ (product/service), it is important that what I choose gives a unique experience (Cheung, 1999)
- When I buy \_\_ (product/service), it is important that what I choose is not too dull or routine (Becker, 1973)
- When I buy \_\_ (product/service), it is important that what I choose is exciting (Cheung, 1999)

Within many other potential questions, these three of the aspects which stimulation could point towards, as they explore both the personal excitement felt by a consumer, but also the experience perceived from it.

### **3.1.7 Comfort**

The support, relief, alleviation one can feel when obtaining a new product or service. Also focused on the emotional, hedonic side; this goal is important for the person to feel their purchase was worthy as it added something to their peace of mind which in their interpretation, they required.

- When I buy \_\_ (product/service), it is important that what I choose gives me rest and recovery (Cheung, 1999)
- When I buy \_\_ (product/service), it is important that what I choose is not too complicated or strenuous (Isak Barbopoulos & Johansson, 2017)

Within many other potential questions, these are two of the aspects that highlight both relying on the product to receive the rest and recovery required, but also trusting the product to not provide any additional stress or complications in the how to use aspect.

### **3.1.8 Ethics**

The morals, principles and ideals that conform the consumers personality and judgement of what is wrong and what is right. It is not so much of a personal fulfillment, but a social fulfillment of doing something which is looked up by society. Now focused on the normative, following the rules side; this goal for the society to maintain its identity and agreement of what should and should not be supported by the regarded consumer.

- When I buy \_\_ (product/service), it is important that what I choose is consistent with my personal and moral obligations (Sheth, Newman, & Gross, 1991)
- When I buy \_\_ (product/service), it is important that what I choose makes me feel like a good person in my own eyes (Sheth et al., 1991)

Within many other potential questions, these two which focus both on the society's expectation on an individual, and on the personal standards one's own morals and ethics have set for themselves.

### 3.1.9 Social

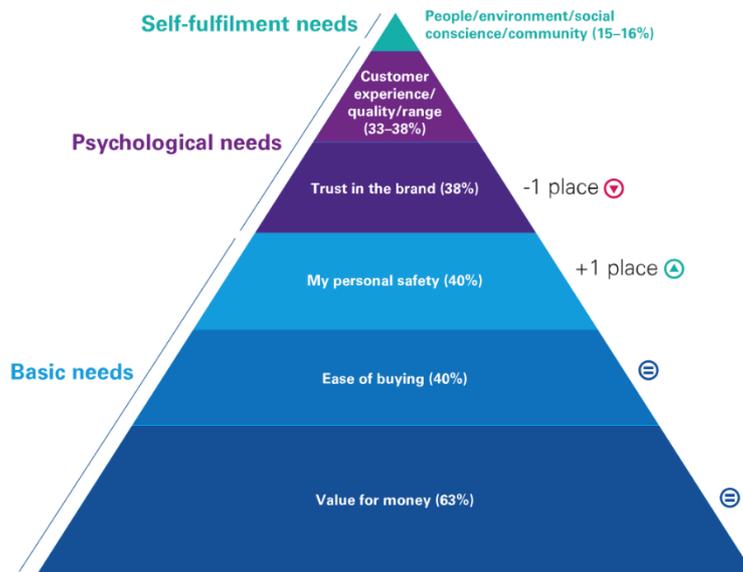
The acceptance in society that a consumer feels based on the alignment of the individual towards its society, in terms of acceptance, being alike or similar to the traditional point of reference, or simply belonging or being liked by the tribe or community who surrounds one individual in particular.

- When I buy \_\_ (product/service), it is important that what choose makes a good impression on people who are important to me (Batra & Ahtola, 1990)
- When I buy \_\_ (product/service), it is important that what I choose is liked by people who are important to me (Batra & Ahtola, 1990)

Within many other potential questions, these two which focus both on purchasing products which have already been accepted by society, but also on purchasing products which create a heightened view or recognition of an individual in its community.

After evaluating the 9 factors described above, the KPMG study performed in 2020 (KPMG, 2020) and represented in *Figure 14* below, dives into the relative importance of different factors in the consumer purchase and decision taking journey. With Value For Money being the base of the pyramid (63% importance), followed up by ease of buying and personal safety, all covering for the basic needs of a consumer, it will be possible to build a comparison between the study of KPMG and the fuzzy maps which will be later discussed.

*Figure #14.* Maslow's pyramid in the modern world. Source: (KPMG, 2020)



### 3.2 Characterize numerically the effects that each attribution evaluated in consumers have over the sub-goals

To complete this work, the study from Isak Barbopoulos & Lars-Olof Johansson was used as a starting point. The database was firstly translated from Swedish and was then cleaned, removing any responses which were missing the answer to a specific attribute to avoid unreliable weighted averages for the nine different sub-goals. Under 5 different purchasing contexts, 988 customers were asked specific questions to determine the involvement of each of the 9 sub-goals with their purchasing journey. In order to understand the reach that the different sub-goals may have over the consumer purchasing journey, the questions were developed to specifically understand the importance of one specific sub-goal. Each of the sub-goals is comprised of different facets or different components which should all be evaluated, as the consumers perspective varies depending on the situation he/she is in, the culture, their economic status and their beliefs or motifs (many times created from the way in which they were raised). The way in which the question was worded was: "When you buy \_\_\_ (items related to either Groceries, Accommodation, Travel, Entertainment, Clothes), it is important that what you choose \_\_\_". Then, the figures below describe the specific question asked to customers which will then generate a numerical value in return to study and analyze the behavior utilizing fuzzy maps and neural maps.

*Figure #15.* Subgoal no.1 - Value for Money related questions

VfM1	Is reasonably priced
VfM2	Offers value for the money
VfM3	Is a good choice considering the price
VfM4	Is economical
VfM5	Provides good return for the money
VfM6	Is not too expensive
VfM7	Is not a waste of money

*Figure #16.* Subgoal no.2 - Quality related questions

Quality1	Is of consistent and high quality
Quality2	Is well made (or well performed)
Quality3	Has an acceptable standard of quality
Quality4	Is first class
Quality5	Meets even the highest requirements and expectations
Quality6	Has a lasting value

*Figure #17.* Subgoal no.3 - Functionality related questions

Function1	Does not have too limited or short use
Function2	Is reliable
Function3	Is practical
Function4	Is useful
Function5	Is functional and fit for purpose
Function6	Serves many purposes

*Figure #18.* Subgoal no.4 - Safety related questions

Safety1	Makes me feel calm and safe
Safety2	Makes me feel safe for the future
Safety3	Takes consideration of needs that may arise in the future
Safety4	Is a good choice in the long-term
Safety5	Makes me prepared in case something unforeseen would happen
Safety6	Improves my safety or security

*Figure #19.* Subgoal no.5 - Pleasure related questions

Pleasure1	Makes me feel good
Pleasure2	Is enjoyable
Pleasure3	Is pleasant or enjoyable
Pleasure4	Makes me want to use it
Pleasure5	Appeals to me
Pleasure6	Makes me happy and satisfied
Pleasure7	Satisfies immediate needs

*Figure #20.* Subgoal no.6 - Stimulation related questions

Stimulation1	Is exciting
Stimulation2	Is interesting
Stimulation3	Offers diversity
Stimulation4	Is not too dull or routine
Stimulation5	Gives a unique experience
Stimulation6	Is new or exotic
Stimulation7	Is stimulating

*Figure #21.* Subgoal no.7 - Stimulation related questions

Comfort1	Is not too uncomfortable
Comfort2	Gives relaxation
Comfort3	Gives me rest and recovery
Comfort4	Is not too much bustle or stress
Comfort5	Is not too complicated or strenuous
Comfort6	Is smooth and comfortable
Comfort7	Makes me feel less stressed out

*Figure #22.* Subgoal no.8 - Ethics related questions

Ethics1	Is consistent with my personal and moral obligations
Ethics2	Does not make me feel guilt
Ethics3	Makes me feel like a good person in my own eyes
Ethics4	Does not violate my principles
Ethics5	Gives me a good conscience
Ethics6	Is not morally wrong
Ethics7	Is consistent with my ideals and opinions

*Figure #23.* Subgoal no.9 - Social related questions

Social1	Is approved by my friends
Social2	Is liked by people who are important to me
Social3	Is what my friends would expect me to choose
Social4	Makes a good impression on people who are important to me
Social5	Gives me a sense of belonging with people who are like me
Social6	Makes me more alike my role models
Social7	Is similar to what people who I identify with choose
Social8	Makes me feel accepted
Social9	Improves the way I am perceived by people who are Important to me
Social10	Is popular among my friends

Once the different questions were answered, the different categories were weighted out to create an index per sub-goal. Hence, each of the 988 individuals ended up with a weighted average per each subgoal. For reporting purposes, in the table below the weighted average for all the participant in the different respective indexes can be visualized. Also, for comparison purposes, some extra columns which display the individual average per each consumer context can also be seen. It is important to make a disclaimer in that two out of the initial nine sub-goals mentioned in the 3.1 factors, two sub-goals were integrated with others (Pleasure and Functionality), as their facets were strongly interconnected with other sub-goals and to keep the independence within the variables this new grouping up was necessary. For this reason, in the tables and graphs to be shown below only seven sub-factors will be displayed.

*Table #6. Sub-goal index based on 988 participants – all consumer contexts included*

	Weighted average (General)	Weighted average (Accommodation)	Weighted average (Clothes)	Weighted average (Entertainment)	Weighted average (Groceries)	Weighted average (Travel)
Value for Money Index	4.085	4.683	4.194	3.661	4.024	3.981
Quality Index	3.774	3.811	3.718	3.927	4.077	4.072
Safety Index	2.765	4.121	2.599	2.100	2.359	2.305
Stimulation Index	3.275	3.205	2.607	3.949	2.707	2.691
Comfort Index	3.765	4.316	4.367	3.280	3.284	3.264
Ethical Index	3.355	3.386	3.040	3.419	3.518	3.485
Social Index	1.425	1.542	1.900	1.452	1.252	1.204

Here, straight comparisons can be done across to identify the behavior of consumers in every purchase, and then across specific purposes. When comparing horizontally, the following can be analyzed:

The highest value for money index can be seen in an accommodation context (around 0.6 higher than the weighted average), while the lowest can be seen in the entertainment field (around 0.4 lower than the weighted average).

The highest quality index can be seen in the groceries and travel context (around 0.3 higher than the weighted average), while the lowest can be seen in the clothes field (around 0.1 lower than the weighted average).

The highest safety index can be seen in the accommodation context (around 1.4 higher than the weighted average), while the lowest can be seen in the entertainment field (around 0.7 lower than the weighted average).

The highest stimulation index can be seen in the entertainment context (around 0.7 higher than the weighted average), while the lowest can be seen in the clothes field (around 0.6 lower than the weighted average).

The highest comfort index can be seen in the clothes context (around 0.6 higher than the weighted average), while the lowest can be seen in the travelling field (around 0.5 lower than the weighted average).

The highest ethical index can be seen in the grocery's context (around 0.2 higher than the weighted average), while the lowest can be seen in the clothes field (around 0.2 lower than the weighted average).

The highest social index can be seen in the clothes context (around 0.5 higher than the weighted average), while the lowest can be seen in the travelling field (around 0.2 lower than the weighted average).

Then, after performing this analysis it is also important to compare the relative weight of the different indexes within each consumer context. The figures below analyze with percentages the relative weights.

Figure #24. . Weighted Average General

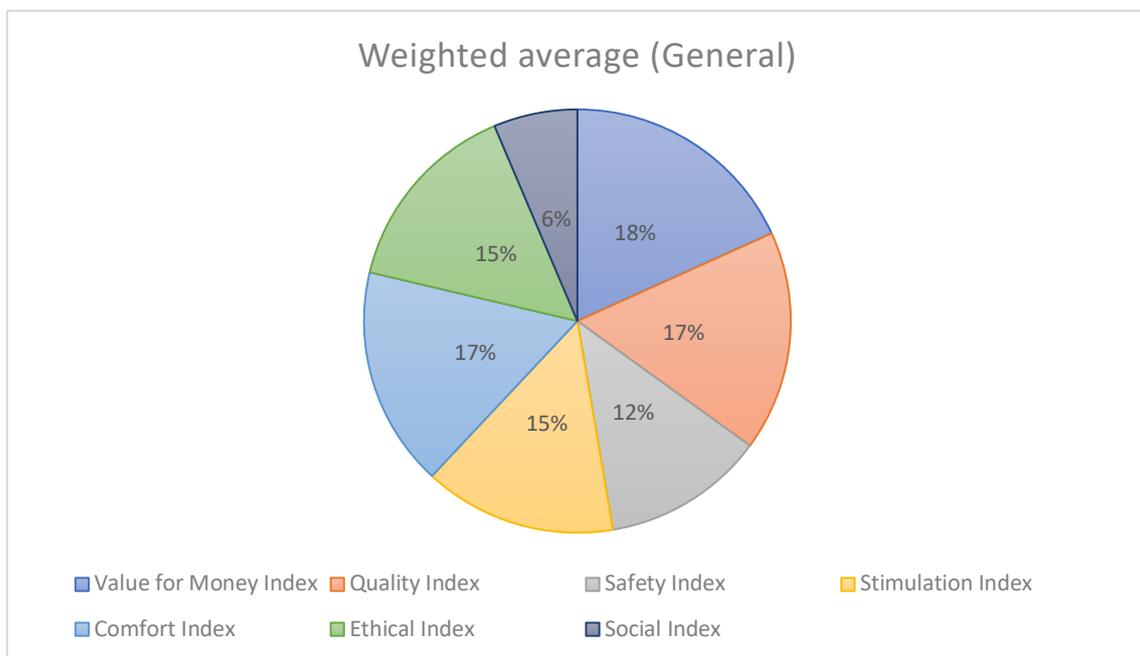
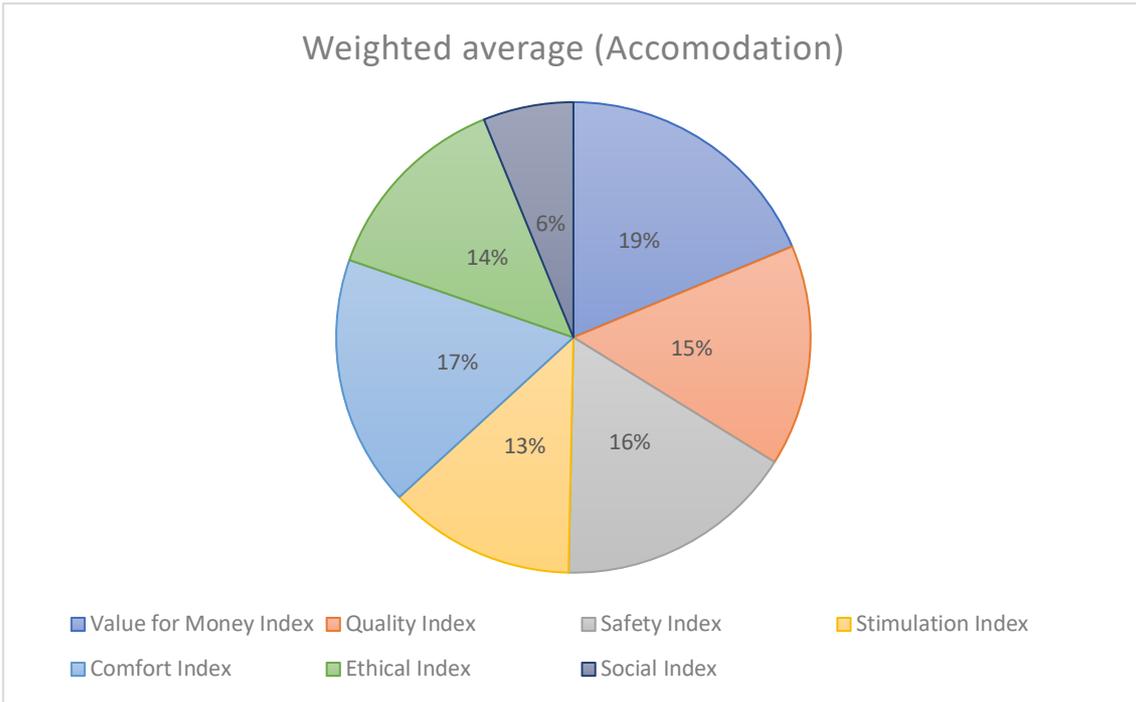
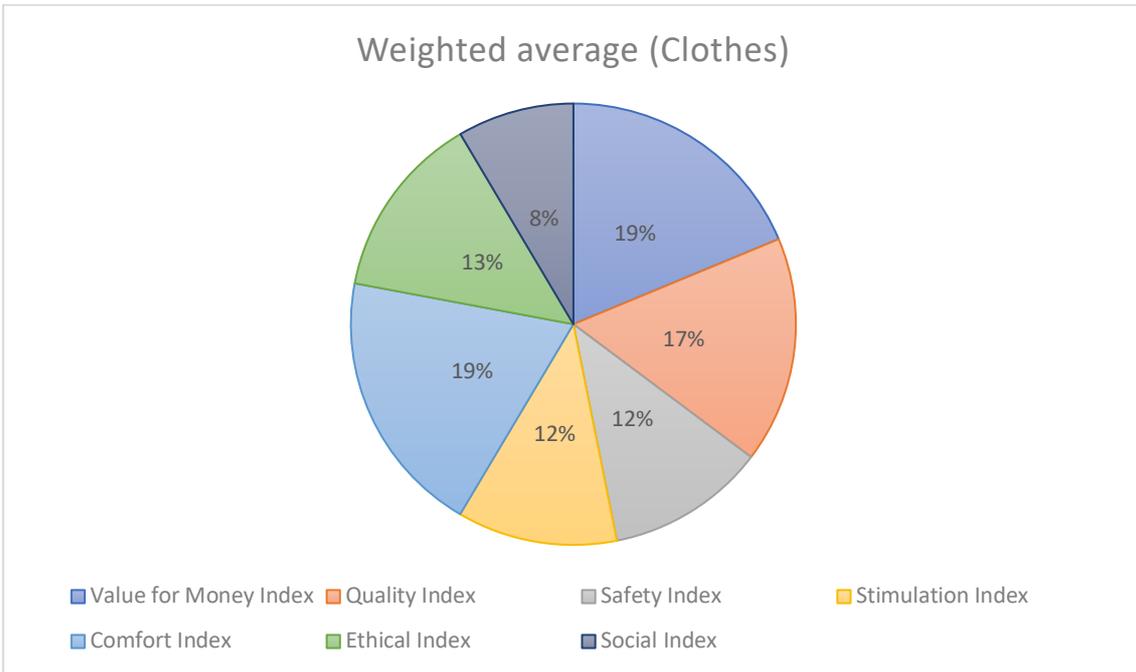


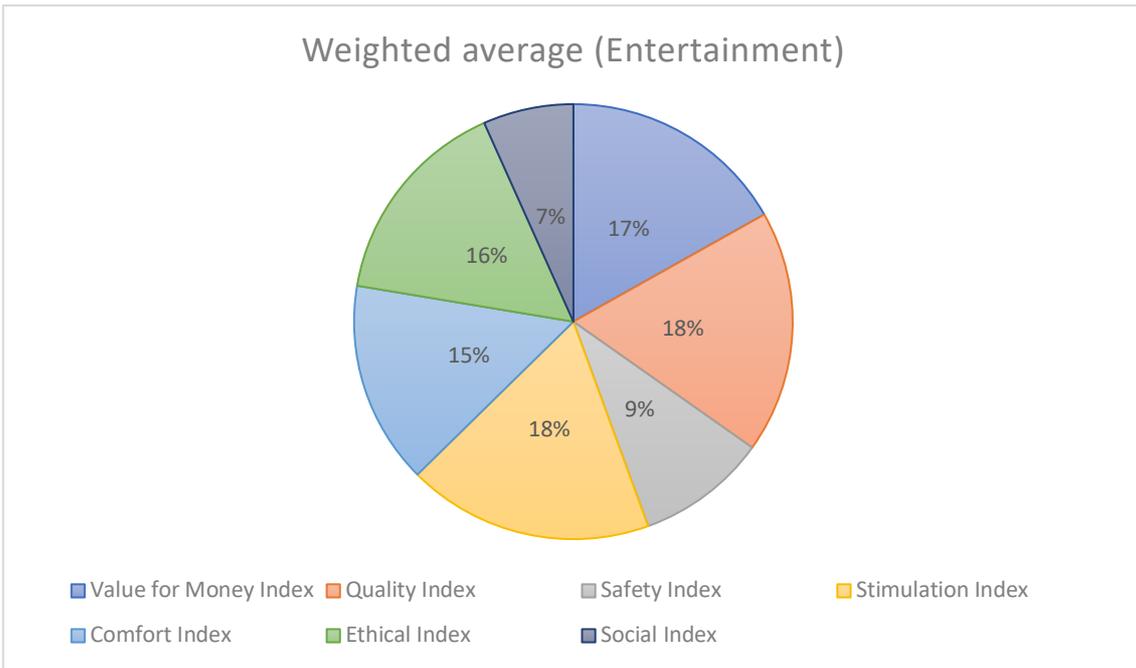
Figure #25. . Weighted Average Accomodation



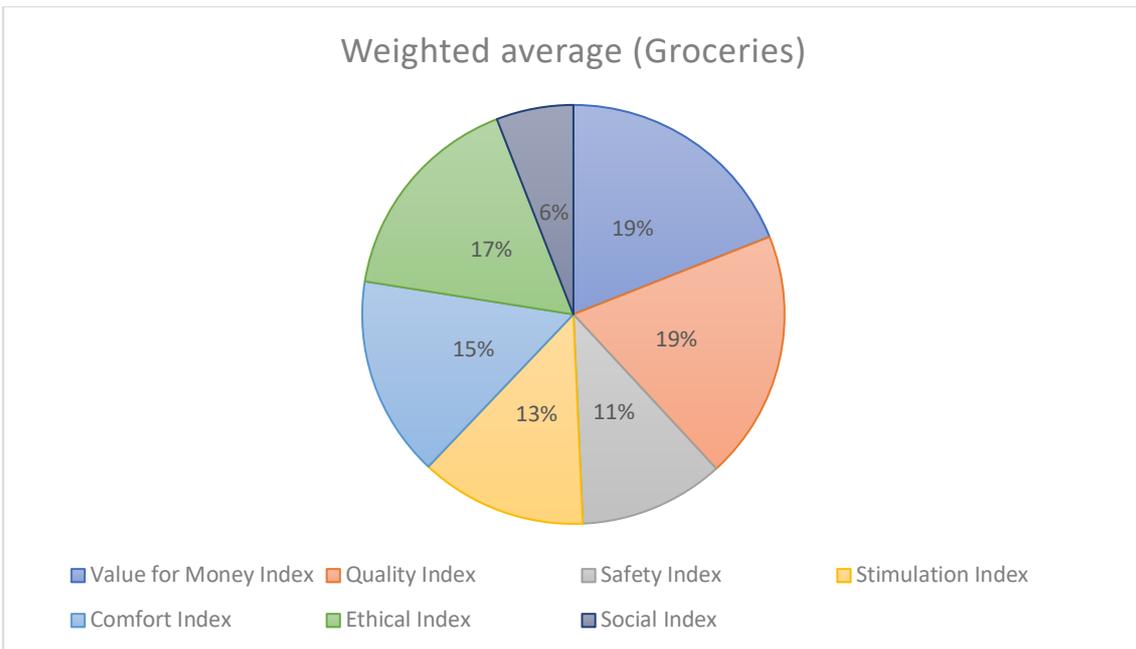
*Figure #26.*      **Weighted Average Clothes**



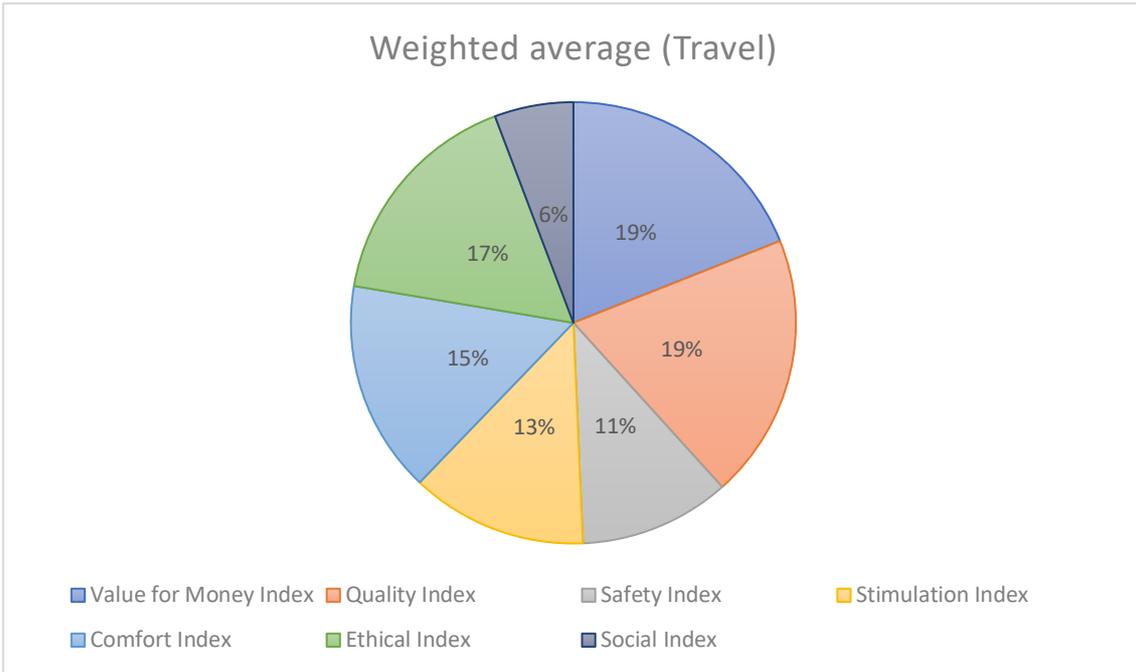
*Figure #27.*      **Weighted Average Entertainment**



*Figure #28.*      **Weighted Average Groceries**



*Figure #29.*      **Weighted Average Travel**



The highest percentual weight for all in the indexes is always attributed to a sub-goal pertaining to the gain master-goal. Value for money turns out to be the one with the highest weight across: general purchases, accommodation, clothes, groceries, and travel. The only category which has a different primary one is entertainment with stimulation and quality both leading the way. Then, the indexes or sub-goals with the lowest effects is always the social one, ranging between 6-8% across all the different sub-goals studied. However, the social goal is a hard one to test by utilizing a survey as not many people are willing to accept how much they rely on society to take decisions. As humans are social creatures the social sub-goals will always represent a key element towards all human decisions, hence the importance of trends and popular items.

### **3.3 Develop a fuzzy neural model that allows the estimation of the level of influence and correlation between each of the variables being evaluated**

To proceed with the evaluation of the level of influence regarding the nine sub-factors evaluated across the above objective conclusions, the decision to build a fuzzy neural model was made. Within the evaluation, only 7/9 the variables will be taken into consideration due to the fact that once that the correlation between some facets of 2/9 sub-goals evaluated in 3.2 could be reorganized and hence placed in the seven subsequent other factors. Hence, the final factors with which the fuzzy maps will be carried are: Value for money, Safety, Quality, Stimulation, Comfort, Ethics and Social.

For research and sample reasons and to ensure enough supportive data was had, the consumer context was disregarded, and the research was analyzed as a whole group. In other words, the options of having groceries, accommodation, travel, clothes or entertainment will not be seen in the fuzzy maps stage as all the data will be carried under a general purchasing category. In accordance with the above, the research will not segregate by gender, age, or any other subcategory as the initial data set will be treated under a general purchase requirement.

The study previously done build and initial correlation matrix which analyses the relation between the different sub-goals. As the subgoals should be completely independent, the initial phase of this research consisted of this pre-established correlation matrix. However, a second phase of the model was performed using a different kind of matrix given by R-studio and based on the different individual indexes from the 988 participants. Both correlation matrixes were exposed in the methodology section *Table 2 – Phase 1 and Table 4 – Phase 2*.

Continuing with the configuration of the model and bearing in mind the different variables explore in objective number one, it was considered pertinent to structure two independent models that could later be compared and analyzed linguistically across the fuzzy map results.

Bearing in mind the above, it is essential to point out the key differences between both phases proposed. Basically, one of the phases will be purely analyzing the results gathered by the research in the data in brief report called “The Consumer Motivation Scale: development of a multi-dimensional and context-sensitive measure of consumption goals” (Isak Barbopoulos & Johansson, 2017). Then, based on the data gathered, cleaned and present in the above-mentioned research, a new correlation table was done. The use of both would ensure that the top three variables to be studies with deep neural networks in objective 4 are the adequate ones.

Taking this into consideration, model number one and two will have seven input variables; accompanied by six different input vectors each, hence twelve fuzzy maps will be explored and shown in graphs of both 20 iterations and 100 iterations. The six different vectors were also exposed in the methodology *Table 3- Phase 1 and Table 5- Phase 2*.

#### **3.3.2 Data Clustering Method and Fuzzy Data Sets**

Once the fuzzy maps are finalized and understood, it will then be possible to continue working with the top 3 variables for the 988 individuals, which with the help of deep neural models will be further analyzed to understand the severity and importance of these.

The below set of figures and table will expose the different values of  $A_i$  explored to go into the concept  $C_i$  to further understand where they may adopt it. On the other hand, for qualitative or linguistic variables, the value type will be associated with the scale established in the objective that refers to the characterization of the concepts.

Important to add that the scales used for the output variables were established according to the results obtained by each separate sub-factor analyzed. Then, the lower limit was always equal to the lowest score presented for that variable, the upper limit equal to the maximum number of the variable (to grade the variables the highest score was equal to six and the lowest score was equal to zero). Based on these limits, a clustering process was initialized with random numbers between the maximum and minimum recorded for the specific sub-goal. Then, the absolute difference between the randomized seed and the individuals answer was calculated. The minimum difference encountered between the five seeds randomized seeds was then recorded as the “minimum” for the individual  $i$ . Then, the seed where the minimum is found is recorded, to later create a cluster matrix where the average of times each seed got elected will be calculated to understand how the data points are spread across the graphic. The results for the cluster matrix can be seen below to exemplify how the analysis of the data point was carried.

Figure #30. Data clustering for 7 subgoals

Value for Money		Quality		Safety		Stimulation	
Cluster	Centroid	Cluster	Centroid	Cluster	Centroid	Cluster	Centroid
1	5.6322619	1	4.483	1	3.080	1	5.632
2	2.9898168	2	1.811	2	0.505	2	2.990
3	1.0602564	3	5.368	3	1.959	3	1.060
4	4.9140845	4	3.085	4	3.805	4	4.914
5	4.2045732	5	3.790	5	4.840	5	4.205

Comfort		Ethical		Social	
Cluster	Centroid	Cluster	Centroid	Cluster	Centroid
1	0.159	1	5.714	1	4.564
2	4.885	2	4.085	2	4.200
3	3.414	3	4.604	3	3.013
4	0.940	4	2.276	4	0.881
5	2.106	5	4.996	5	5.560

Based on the cluster-centroid relation, a matrix was then created to associate the relation between each of the clusters between each other. This assisted in the creation of the diameter for each cluster by adding the absolute difference between the different centroid values and then dividing them by 4 to generate the average and find the diameter for the cluster. To exemplify the step above, the below *Table 7* will disclose the matrix and diameter found for the Value for Money.

Table #7. Cluster Diameter for sub-goal 1 Value for Money Phase 1

Cluster	Centroid	Centroide					Diameter
		1.060	2.990	4.205	4.914	5.632	
1	1.060	0.000	1.930	3.144	3.854	4.572	3.375
2	2.990	1.930	0.000	1.215	1.924	2.642	1.928
3	4.205	3.144	1.215	0.000	0.710	1.428	1.624
4	4.914	3.854	1.924	0.710	0.000	0.718	1.801
5	5.632	4.572	2.642	1.428	0.718	0.000	2.340

Lastly, to categorize linguistically the variables, one last step was required. Using 7 categorizations (inclusive of the five centroids plus the minimum and maximum answers recorded for the sub-goal being analyzed) it was possible to generate a belonging table calculated using an exponential function relating the centroid, its diameter and the  $C_i$  value selected. For simplicity purposes, the  $C_i$  was kept constant across all the different trials and phases, in 3.5. Table 8 exemplifies what this step looked like for the *Value for Money* category. In bold, the input components for Value for Money which were used in R-studio to initiate the variables.

Table #8. Belonging for sub-goal 1 Value for Money Phase 1

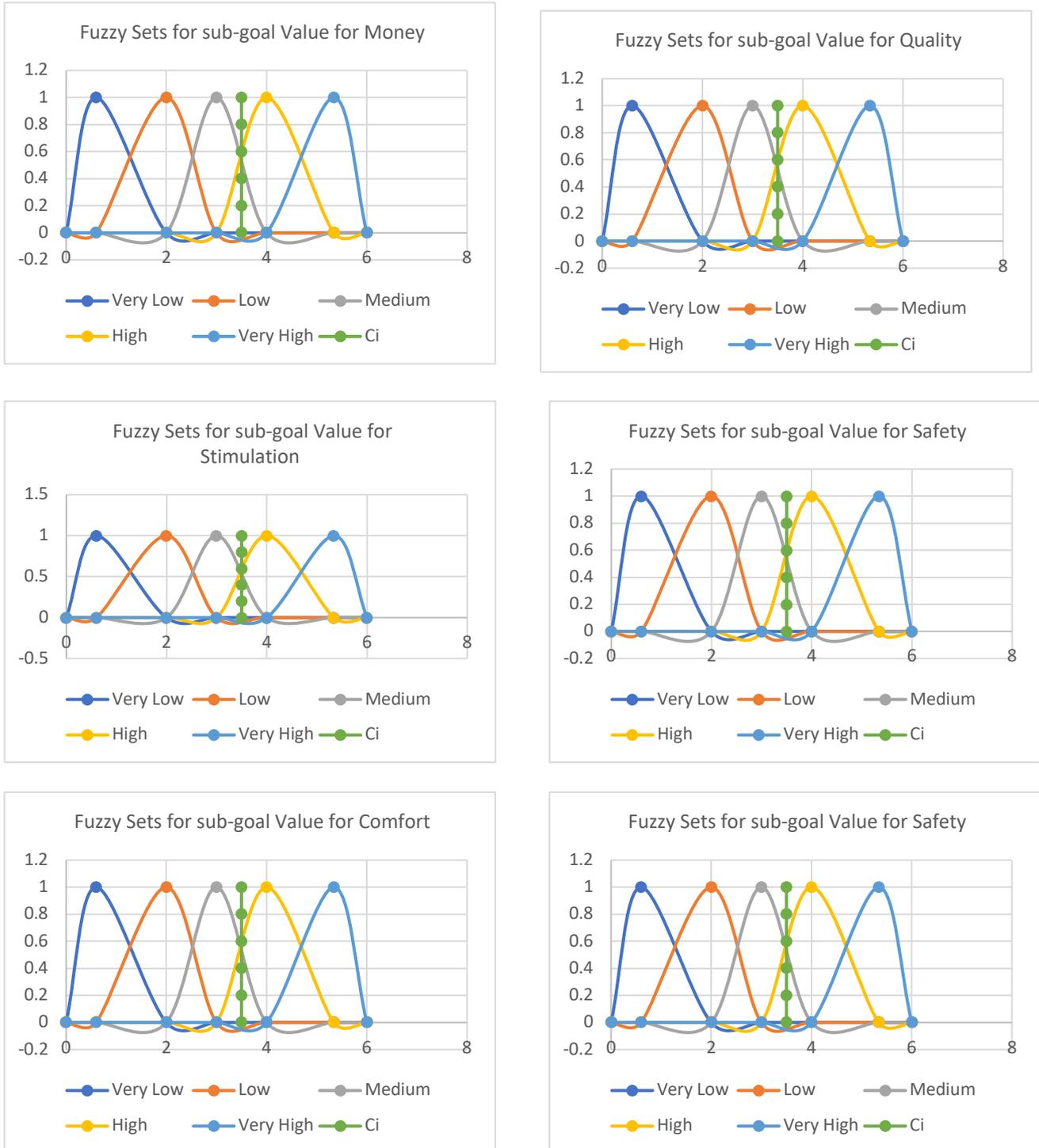
	Minimum	Very Low	Low	Medium	High	Very High	Maximum	$C_8$	
Centroid	0	1.06025641	2.98981685	4.204573171	4.914084507	5.632261905	6	3.5	0
1	0	1	0	0	0	0	0	3.5	0.2
2	0	0	1	0	0	0	0	3.5	0.4
3	0	0	0	1	0	0	0	3.5	0.6
4	0	0	0	0	1	0	0	3.5	0.8
5	0	0	0	0	0	1	0	3.5	1
Diameter		3.375	1.928	1.624	1.801	2.340			
Belonging		<b>0.770054494</b>	<b>0.965586</b>	<b>0.910187003</b>	<b>0.734848879</b>	<b>0.660250732</b>			

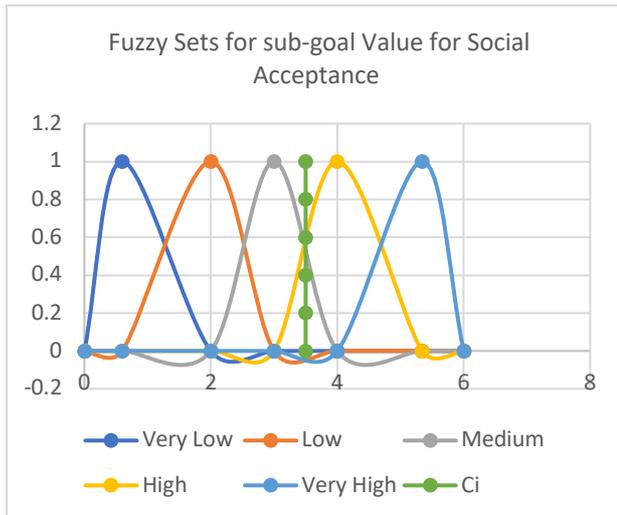
Then, the above process was repeated across all the different subgoals, and the finalized input vectors were collected to later be entered into the R-studio fuzzy map code. Seven different input vectors were studied, three of them coming from the “Very Low”, “Medium”, “Very High” fields; one of them with the extremes, one with expert knowledge of what the weight of the variable should be and a last one with sign changing to analyze how rapid the sign change and value stabilization takes place. The very interesting one to perform was the “Extremes” vector, as it tested on the three initial fuzzy maps where the specific sub-goal had the most extreme change and then used that number within the vector. This method aimed at producing a fuzzy cognitive map which would show-off the most extreme changes of all the variables to analyze which of them have the most drastic immediate change, and which of them remain at the very top with the highest of all values.

In the below figure, the fuzzy set for each of the subgoals can be observed. In this way, allowing a visualization of the numerical values in set of intervals and showing the  $C_i=3.5$ . The value of the  $C_i$  allows analysis to determine under which fuzzy set the number will be categorized as. Basically, it looks for the belonging in the five

different fuzzy sets and the line then falls under the set which has the most relation or belonging to.

Figure #31. Fuzzy set graphs for the seven sub-goals





### 3.3.3 Fuzzy Cognitive Maps

In order to understand all the different relationships which are present in all the models, it is important to present a graphic representation of their respective cognitive maps. In this way, it is possible to identify the relationship between the variables  $C_i$  and  $C_j$  through the direct or indirect relationship denoted by  $W_{ji}$ . The direct and indirect relationships is denoted by either a positive or negative sign, positive for direct and negative for indirect. With that in mind, the below three rules can be drawn:

- $W_{ji} < 0$ : negative causality between the concepts  $C_i$  and  $C_j$ .
- $W_{ji} = 0$ : no relationship between the evaluated concepts.
- $W_{ji} > 0$ : positive causality between the concepts  $C_i$  and  $C_j$ .

At the same time, the different matrixes are exposed. The matrix exposed on phase 1, is based on a previous research which created a consumer motivation scale based on a set of bibliographical references (I. Barbopoulos & Johansson, 2017b). Then, the next matrix was constructed with the use of the clean data set for the 988 individuals. According to the different average rating per sub-goal it was possible to determine the relation that one variable had with another with the use of R-studio and its function “corr”. For the matrixes, a selection criterion to validate the relationships was implemented. This was mainly based on the rankings provided on the previous study mentioned, using the Scimago Institutions Ranking Tool. Here, the specific article could be analyzed which enabled calculation on the quality of the research and the social impact it had. Other than that, the researcher Ian Barbopoulos was contacted directly through LinkedIn and email. He provided different validations and explanation for the data, along with two additional spreadsheets of further research that was done to cross check the validity of the results and further dig into different scenarios to study the effects of the sub-goals chosen as the final ones with the first research. All the above validated both the matrix for phase one, and the fundamental basis for phase two which is also essential to study.

Recognizing that the journal to which the article below is categorized on the first quartile, which clearly demonstrated its high quality and the importance of the field of knowledge analyzed, the article could be granted full validity to carry out the process.

Table #2. Final Correlation Table Model 1

	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Value for Money	0	0	0	0	0	0	0
Quality	0.25	0	0	0	0	0	0
Safety	0.41	0.35	0	0	0	0	0
Stimulation	0.06	0.32	0.28	0	0	0	0
Comfort	0.46	0.41	0.45	0.18	0	0	0
Ethical	0.27	0.32	0.39	0.35	0.26	0	0
Social	0.13	0.19	0.33	0.17	0.2	0.18	0

Table #4. Final Correlation Table Model 2

	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Value for Money	1	0.25559	0.429861	0.062336	-0.461187	-0.271167	-0.127142
Quality	0.2555902	1	0.365878	0.326385	0.414075	-0.316135	0.199951
Safety	0.4298609	0.365878	1	0.278165	-0.452191	0.393332	-0.331767
Stimulation	0.0623363	0.326385	0.278165	1	0.175409	0.370189	0.176296
Comfort	0.4611868	0.414075	0.452191	0.175409	1	0.264431	-0.197182
Ethical	-0.2711669	0.316135	0.393332	0.370189	-0.264431	1	0.190195
Social	0.1271416	0.199951	-0.33177	0.176296	0.197182	0.190195	1

### 3.3.3.1 Cognitive Map Representation for Model 1

To execute each one of the models, it is essential to understand what the relationship between the different variables refer to, or in other words the way in which this relationship will impact the trajectory of the model moving forward. In this way, the direct or indirect relationship, which has a determined  $W_{ji}$  value. As for phase one or model one the relationship table, or correlation between the variables was taken from secondary research, it was essential to further validate its veracity. By supporting and testing the correlation matrix with scalar invariance for each sub-goal dimension, scalar invariance for each of the dimensions in the sub-goals the presented issues in the previous matrix, and a final structural and strict invariance, it was possible to validate the veracity of the research and substantiation of the matrix. The above claims will be shown below as a validation of the precaution and background information utilized by the researchers (I. Barbopoulos & Johansson, 2017b). Lastly, a confirmatory analysis was also completed and will be shown below with different models in place, where the researchers previously mentioned expanded the research into similar models to ensure the validity (as mentioned in the conversation with Ian Barbopoulos).

Table #9. Scalar Invariance for each of the sub-goals. Source: (I. Barbopoulos & Johansson, 2017b)

	$\chi^2$	DF	$\chi^2/DF$	RMSEA	CFI	$\Delta CFI$
Metric	4293.06	2638	1.63	.04	.77	
VFM	4375.34	2658	1.65	.04	.76	-.008
<b>Quality</b>	<b>4411.63</b>	<b>2658</b>	<b>1.66</b>	<b>.04</b>	<b>.76</b>	<b>-.013</b>
<b>Safety</b>	<b>4477.24</b>	<b>2658</b>	<b>1.68</b>	<b>.04</b>	<b>.75</b>	<b>-.022</b>
<b>Stimulation</b>	<b>4503.30</b>	<b>2658</b>	<b>1.69</b>	<b>.04</b>	<b>.74</b>	<b>-.026</b>
<b>Comfort</b>	<b>4423.08</b>	<b>2654</b>	<b>1.67</b>	<b>.04</b>	<b>.75</b>	<b>-.016</b>
Ethics	4327.59	2658	1.63	.04	.77	-.002
Social Ac.	4365.66	2658	1.64	.04	.76	-.007

Items highlighted represent non equal dimensions.

Table #10. Scalar Invariance for the items highlighted . Source: (I. Barbopoulos & Johansson, 2017b)

	$\chi^2$	DF	$\chi^2/DF$	RMSEA	CFI	$\Delta CFI$
Metric	4293.06	2638	1.63	.04	.77	
Quality1	4342.16	2642	1.64	.04	.76	-.006
Quality2	4325.29	2642	1.64	.04	.77	-.004
Quality3	4308.09	2642	1.63	.04	.77	-.001
Quality4	4301.89	2642	1.63	.04	.77	.000
Quality5	4314.14	2642	1.63	.04	.77	-.002
<b>Safety1</b>	<b>4398.45</b>	<b>2642</b>	<b>1.67</b>	<b>.04</b>	<b>.76</b>	<b>-.014</b>
<b>Safety2</b>	<b>4392.01</b>	<b>2642</b>	<b>1.66</b>	<b>.04</b>	<b>.76</b>	<b>-.013</b>
<b>Safety3</b>	<b>4375.08</b>	<b>2642</b>	<b>1.66</b>	<b>.04</b>	<b>.76</b>	<b>-.011</b>
<b>Safety4</b>	<b>4398.12</b>	<b>2642</b>	<b>1.67</b>	<b>.04</b>	<b>.76</b>	<b>-.014</b>
Safety5	4359.77	2642	1.65	.04	.76	-.008
Stimulation1	4361.66	2642	1.65	.04	.76	-.009
<b>Stimulation2</b>	<b>4402.37</b>	<b>2642</b>	<b>1.67</b>	<b>.04</b>	<b>.76</b>	<b>-.014</b>
Stimulation3	4327.80	2642	1.64	.04	.77	-.004
<b>Stimulation4</b>	<b>4383.14</b>	<b>2642</b>	<b>1.66</b>	<b>.04</b>	<b>.76</b>	<b>-.012</b>
<b>Stimulation5</b>	<b>4421.29</b>	<b>2642</b>	<b>1.67</b>	<b>.04</b>	<b>.75</b>	<b>-.017</b>
Comfort1	4374.40	2642	1.66	.04	.76	-.010
Comfort2	4370.11	2642	1.65	.04	.76	-.010
Comfort3	4326.79	2642	1.64	.04	.77	-.004
Comfort4	4330.58	2642	1.64	.04	.77	-.004

Table #11. Structural and strict invariance before scalar invariance. Source: (I. Barbopoulos & Johansson, 2017b)

	$\chi^2$	DF	$\chi^2/DF$	RMSEA	CFI	$\Delta CFI$
Configural	4131.53	2530	1.63	.04	.78	
Metric	4293.06	2638	1.63	.04	.77	-.008
<b>Scalar</b>	<b>5069.14</b>	<b>2774</b>	<b>1.83</b>	<b>.04</b>	<b>.68</b>	<b>-.089</b>

Table #12. Structural and strict invariance after scalar invariance . Source: (I. Barbopoulos & Johansson, 2017b)

	$\chi^2$	DF	$\chi^2/DF$	RMSEA	CFI	$\Delta CFI$
Partial scalar	4520.09	2718	1.66	.04	.75	
<b>Structural</b>	<b>4831.25</b>	<b>2746</b>	<b>1.76</b>	<b>.04</b>	<b>.71</b>	<b>-.039</b>
<b>Strict</b>	<b>5305.49</b>	<b>2882</b>	<b>1.84</b>	<b>.04</b>	<b>.66</b>	<b>-.047</b>

Table #13. Confirmatory Factor Analysis. Source: (I. Barbopoulos & Johansson, 2017b)

	<b>k</b>	$\chi^2$	<b>DF</b>	$\chi^2/DF$	$\Delta\chi^2$	$\Delta DF$	<b>p</b>	<b>RMSEA</b>	<b>CFI</b>
Model 1	1	7879.98	950	8.30	–	–	–	.12	.29
Model 2	3	5354.03	942	5.68	–2525.95	–8	.000	.10	.55
Model 3A	5	4202.28	935	4.49	–1151.75	–7	.000	.08	.67
Model 3B	4	4727.81	939	5.04	–626.22	–3	.000	.09	.61
Model 3C	4	4191.43	939	4.46	–1162.60	–3	.000	.08	.67
Model 4A	7	2398.28	924	2.60	–1793.16	–15	.000	.06	.85
Model 4B	7	1089.49	506	2.15	–1308.79	–418	.000	.06	.89

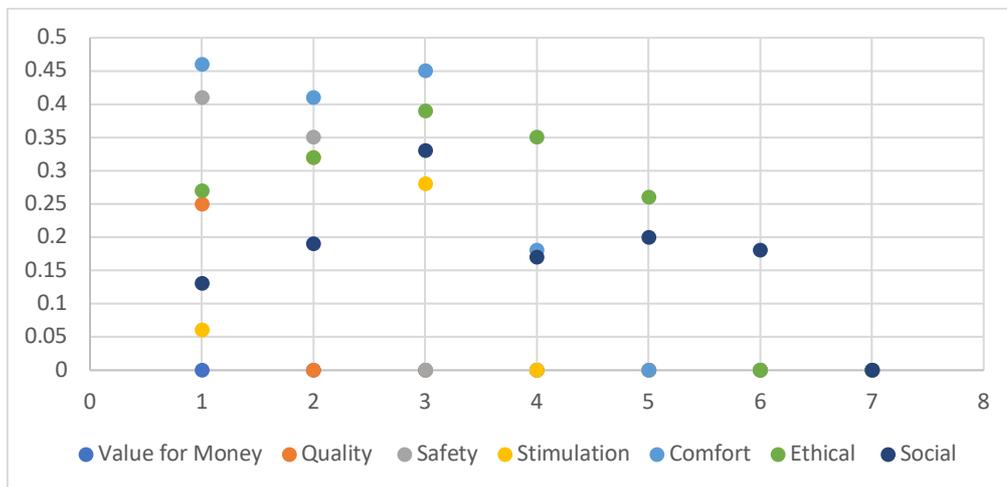
With the above in mind, it is then possible to illustrate the correlation in model 1 and shown in *Table 2 below*.

*Table #2.* Final Correlation Table Model 1

	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Value for Money	0	0	0	0	0	0	0
Quality	0.25	0	0	0	0	0	0
Safety	0.41	0.35	0	0	0	0	0
Stimulation	0.06	0.32	0.28	0	0	0	0
Comfort	0.46	0.41	0.45	0.18	0	0	0
Ethical	0.27	0.32	0.39	0.35	0.26	0	0
Social	0.13	0.19	0.33	0.17	0.2	0.18	0

Graphically, the correlation can also be seen with the below figure, where the different Wji relationships can be inferred. Important to mention all the relationships are direct with this first correlogram as seen with the graph.

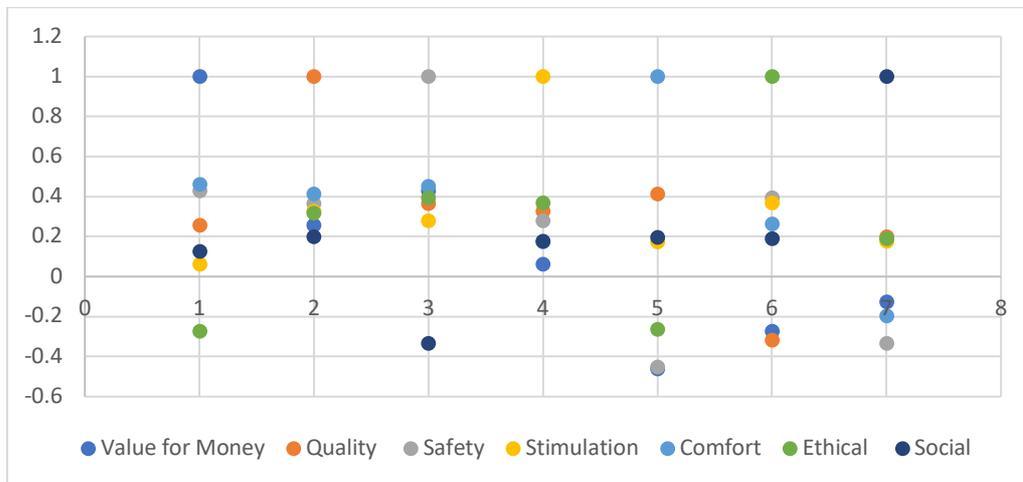
*Figure #32.* Correlation Representation Model 1



### 3.3.3.2 Cognitive Map Representation for Model 2

Model 2 was much simpler as it was composed only of primary sourced information. The correlation map came straight out from R-studio based on the relationship between the weighted average for the different sub-goals. Hence, as the data was confirmed previously across a confirmatory factor analysis and several sets of metric and scalar invariance it was possible to take the data as valid.

Figure #33. Correlation Representation Model 2



In contrast to Model 1, Model 2 accounts with both direct and indirect relationships. R-studio only returned some correlation values and then by observing the 988 individual sample and applying general concept social rules it was possible to denote a positive or negative relationship between one another. As well, this relationship was verified previously with the researchers. Also, a secondary opinion to validate the signs used was done by one head researcher, Janelle Sullivan, user and purchasing experience coordinator at Curtin University’s (Perth, Australia) marketing department.

### 3.3.4 Case Study

The evaluation of the different fuzzy cognitive models will be done with the use of different case studies, both for model 1 and model 2, which are aimed at evaluating both the middle grounds and the extremes for the different variables, along with other sign changing scenarios and other expert scenarios based on what is expected from the variables based on experts in the field and bibliographical research. For this reason, the different scenarios will be initiated by specific input/activation vectors and then waiting for the algorithm to reach balance after 20-30 iterations, the final values will be analyzed. It is important to specify that the different activation vectors were found as per below:

*For the “Very Low” Category: the values were found by using the data clustering-centroid and belonging method as described in the methodology*

*For the “Medium” Category: the values were found by using the data clustering-centroid and belonging method as described in the methodology*

*For the “Very High” Category: The values were found by using the data clustering-centroid and belonging method as described in the methodology*

*For the “Extremes” Category: the above three graphs handed back by R-studio were used to combine the input vectors that generated the biggest correction for each of the variables. This then represented a combination of the above categories to experiment correction with the highest changing environment for all the variables*

For the “Expert Knowledge” Category: the values were found by using the bibliographical review in objective number one and evaluating based on all the different articles the relationship between the different variables.

For the “Sign Changing” Category: the values were found by alternating between a positive and negative sign, with a fixed 0.5 value. With fuzzy maps the result of the value won’t ever be under 0, but this was done to analyze how fast or slow the different variables would switch back into the positive sign again.

Below, a demonstration of each activation vector, along with the resulting fuzzy map will be shown an analyzed for each of the six different input vector scenarios, and across the two models described. The initial vector that describes each case study will be created as per below:

Adef/Bdef = [Value for Money, Quality, Safety, Stimulation, Comfort, Ethical, Social]

A= Model 1

B= Model 2

Note: matrix A and B shown below as a reference for all the proceeding case studies.

Table #14. Matrix A- Correlation Table Model 1

	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Value for Money	0	0	0	0	0	0	0
Quality	0.25	0	0	0	0	0	0
Safety	0.41	0.35	0	0	0	0	0
Stimulation	0.06	0.32	0.28	0	0	0	0
Comfort	0.46	0.41	0.45	0.18	0	0	0
Ethical	0.27	0.32	0.39	0.35	0.26	0	0
Social	0.13	0.19	0.33	0.17	0.2	0.18	0

Table #15. Matrix B- Correlation Table Model 2

	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Value for Money	1	0.25559	0.429861	0.062336	-0.461187	-0.271167	-0.127142
Quality	0.2555902	1	0.365878	0.326385	0.414075	-0.316135	0.199951
Safety	0.4298609	0.365878	1	0.278165	-0.452191	0.393332	-0.331767
Stimulation	0.0623363	0.326385	0.278165	1	0.175409	0.370189	0.176296
Comfort	0.4611868	0.414075	0.452191	0.175409	1	0.264431	-0.197182
Ethical	-0.2711669	0.316135	0.393332	0.370189	-0.264431	1	0.190195
Social	0.1271416	0.199951	-0.33177	0.176296	0.197182	0.190195	1

Each of the individual input vectors will have two graphs, one with 20 iterations and one with 100 iterations; the first one used to analyze the short-term behavior and biggest changes, and the latter to look at the long-term behavior and stabilization of the different variables.

### Case Study No. A1

A1 = [0.770054494 0.775812214 0.590105896 0.724775345 0.459012715  
0.893063271 0.750078861]

Figure #34. Case Study A1 20 iterations

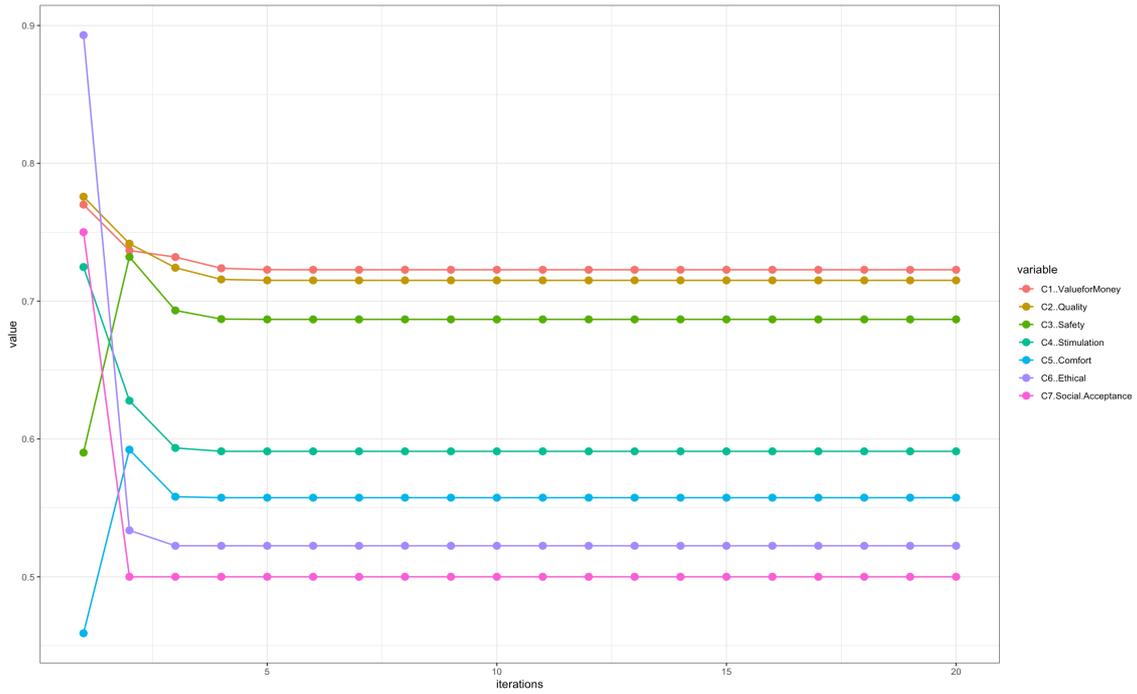
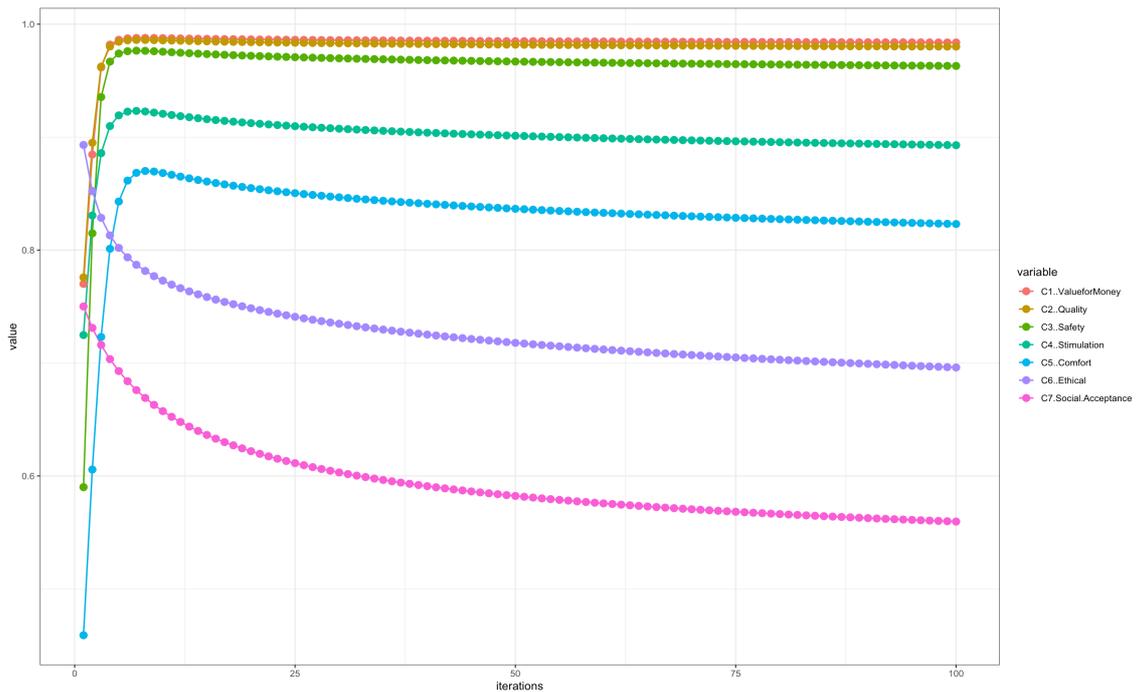


Figure #35. Case Study A1 100 iterations



A major correction can be observed for the purple variable-ethical, seconded by the social acceptance variable in pink. Then, Value for Money, Safety and Quality remain the highest, with a value close to 1 across the 100 iterations and with a small correction in the beginning.

**Case Study No. A2**

$$A2 = \begin{bmatrix} 0.910187003 & 0.972948579 & 0.963692593 & 0.981487334 & 0.740780694 \\ 0.597207547 & 0.903938702 \end{bmatrix}$$

Figure #36. Case Study A2 20 iterations

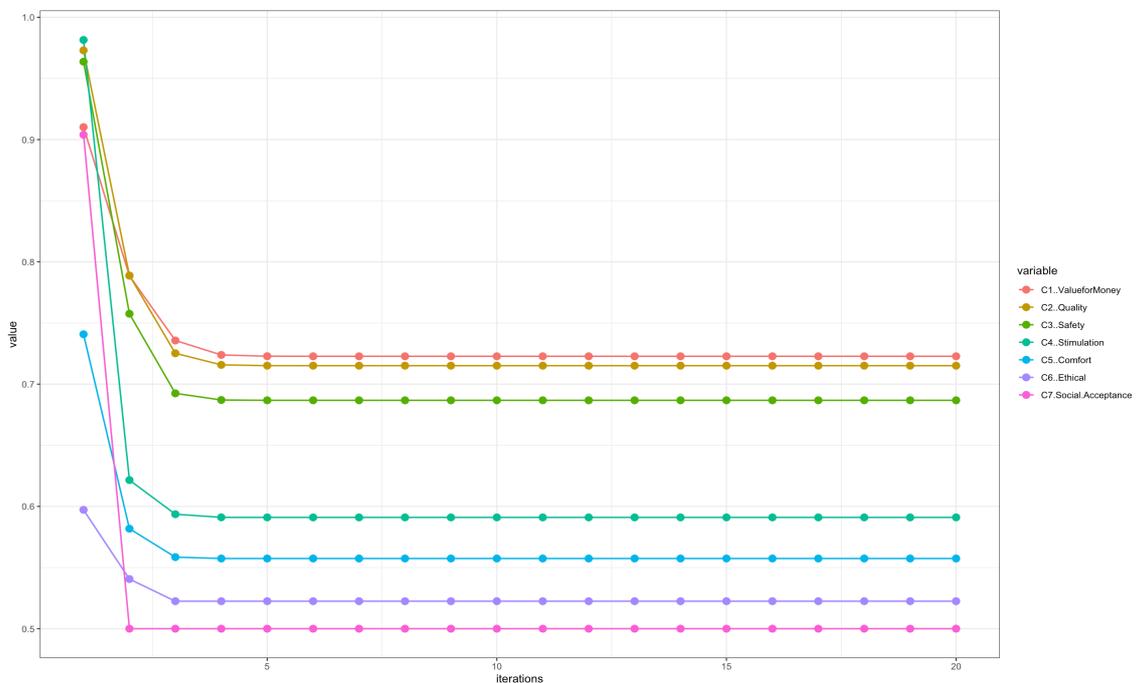
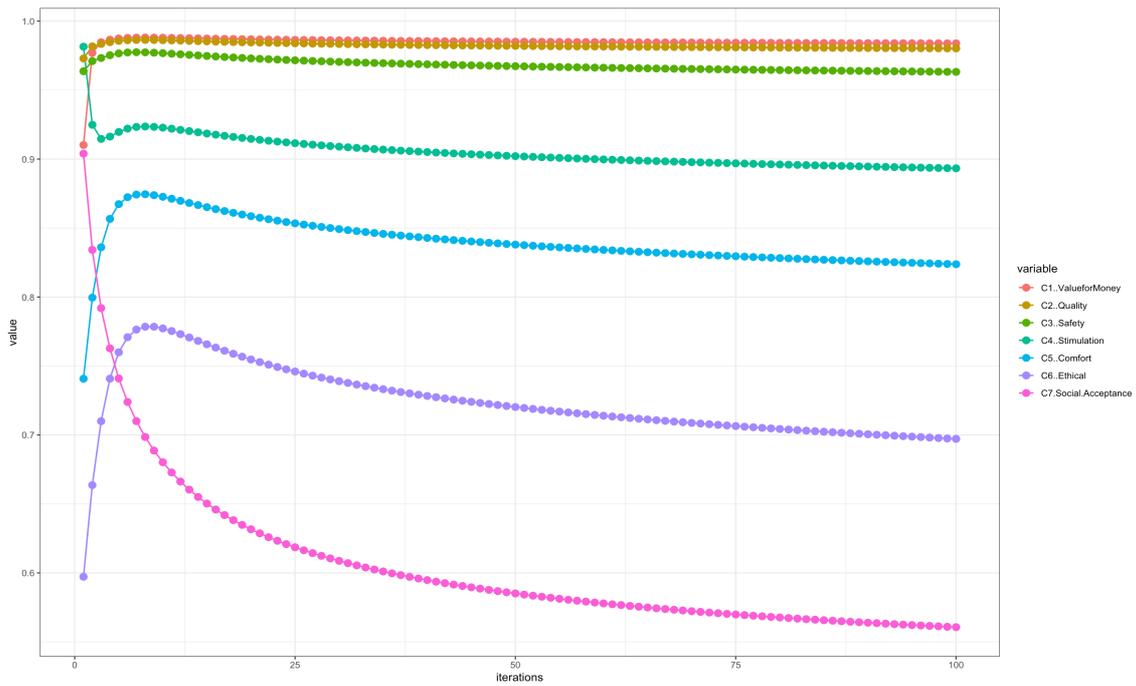


Figure #37. Case Study A2 100 iterations



A major correction can be observed for the purple variable-ethical, seconded by the stimulation variable in dark green. As before, Value for Money, Safety and Quality remain the highest, with a value close to 1 across the 100 iterations and a relatively major correction in the beginning. Important to note that the final value was not close to 1 for these three variables, but closer to 0.9, unlike the A1 case study.

**Case Study No. A3**

$$A3 = \begin{bmatrix} 0.660250732 & 0.667039809 & 0.866452835 & 0.727946729 & 0.912164468 \\ 0.438289582 & 0.690880219 & & & \end{bmatrix}$$

Figure #38. Case Study A3 20 iterations

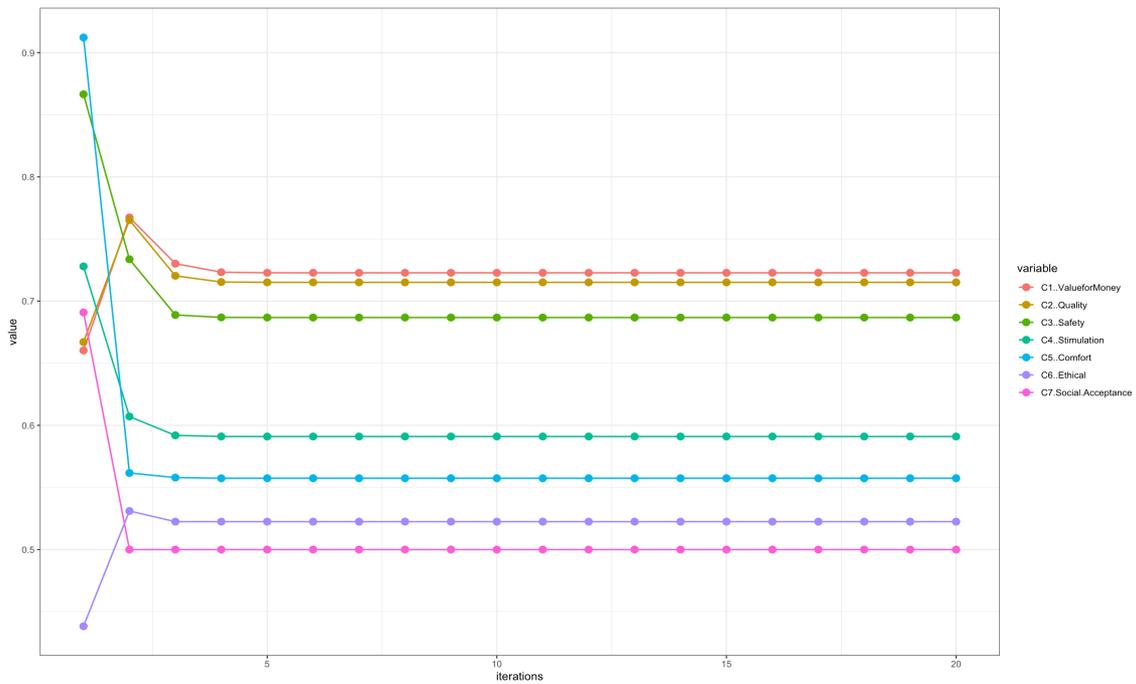
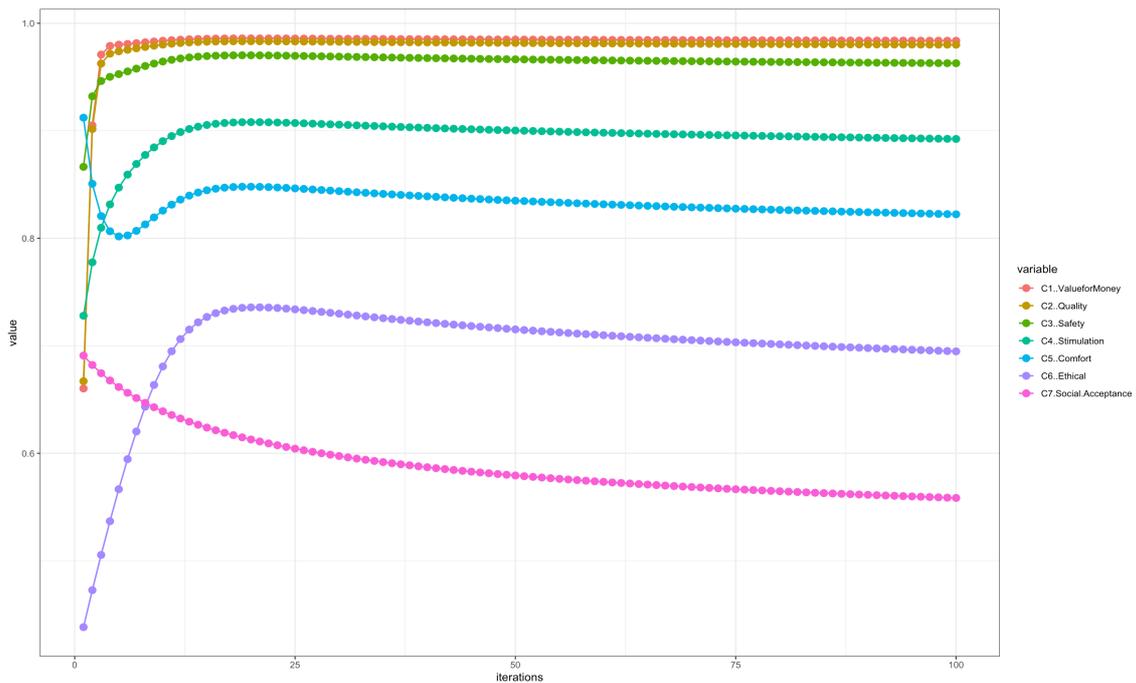


Figure #39. Case Study A3 100 iterations



A major correction can be observed for the blue variable-comfort, seconded by the stimulation variable in dark green. As before, Value for Money, Safety and Quality remain the highest, with a value close to 1 across the 100 iterations and a relatively small correction in the beginning. Important to note that the final value was again close to 1 for these three major variables.

**Case Study No. A4**

This case study was done upon observations of the above six graphs, the input vectors that generated the biggest correction were taken. Below, and highlighted a table which shows in red the input vector that created the biggest correction in each variable.

Table #16. "Extreme" activation vector composition

	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Very low	0.770054494	0.77581221	<b>0.5901059</b>	<b>0.72477535</b>	<b>0.45901271</b>	0.89306327	0.75007886
Medium	0.910187003	0.97294858	0.96369259	0.98148733	0.74078069	0.59720755	<b>0.9039387</b>
Very High	<b>0.660250732</b>	<b>0.66703981</b>	0.86645283	0.72794673	0.91216447	<b>0.43828958</b>	0.69088022

$$A4 = [0.660250732 \quad 0.667039809 \quad 0.590105896 \quad 0.724775345 \quad 0.459012715 \\ 0.438289582 \quad 0.903938702]$$

Figure #40. Case Study A4 20 iterations

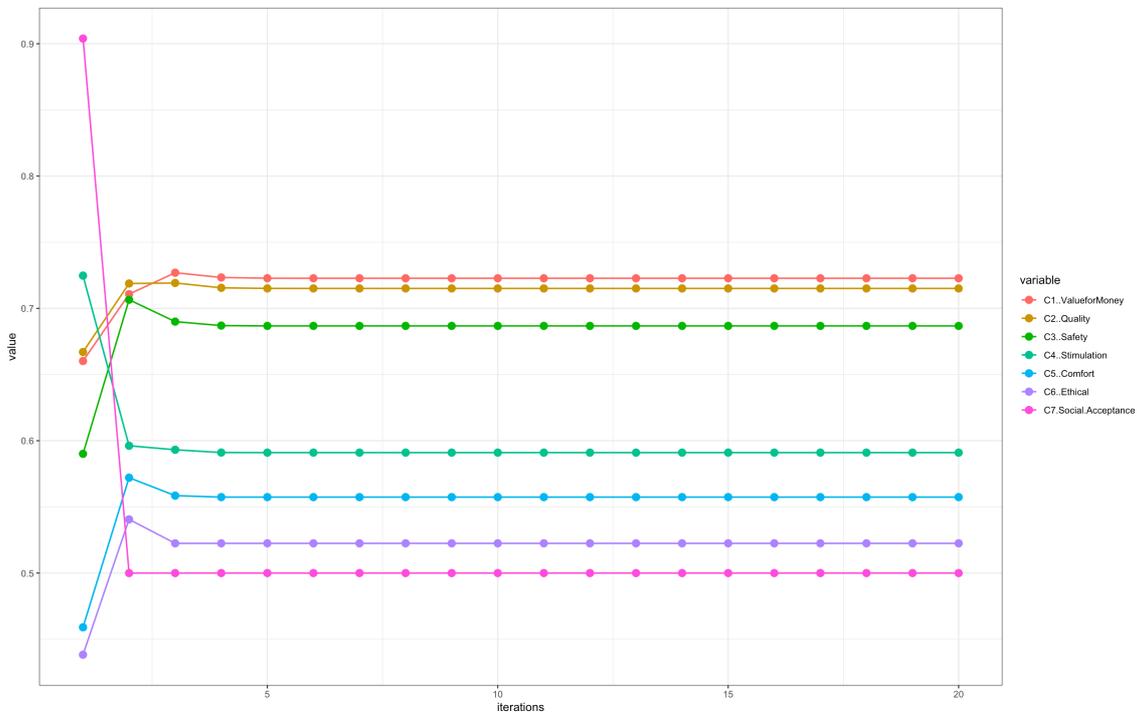
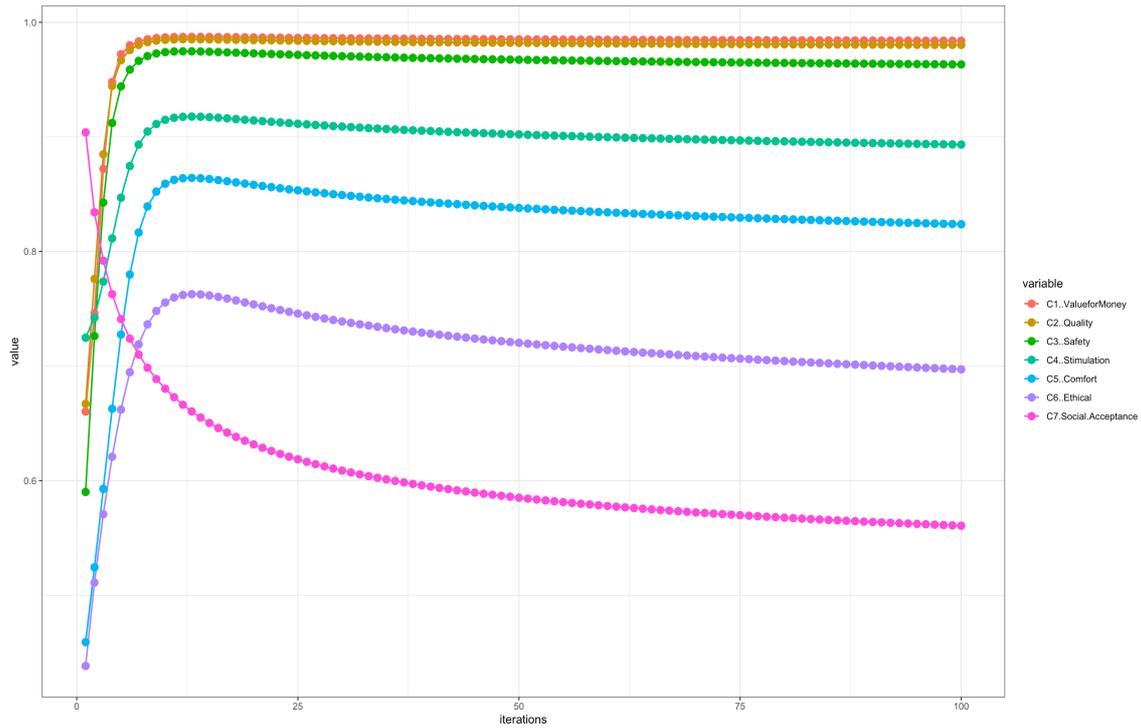


Figure #41. Case Study A4 100 iterations



A major correction can be observed for the pink variable -social comfort. The rest of the variables keep relatively stable across the correction phase (Initial 20 iterations). Value for Money, Safety and Quality remain the highest again with values near 1, however the safety variable remains a bit lower than the first two.

**Case Study No. A5**

$$A5 = [0.88 \quad 0.75 \quad 0.8 \quad 0.45 \quad 0.3 \quad 0.25 \quad 0.83]$$

Figure #42. Case Study A5 20 iterations

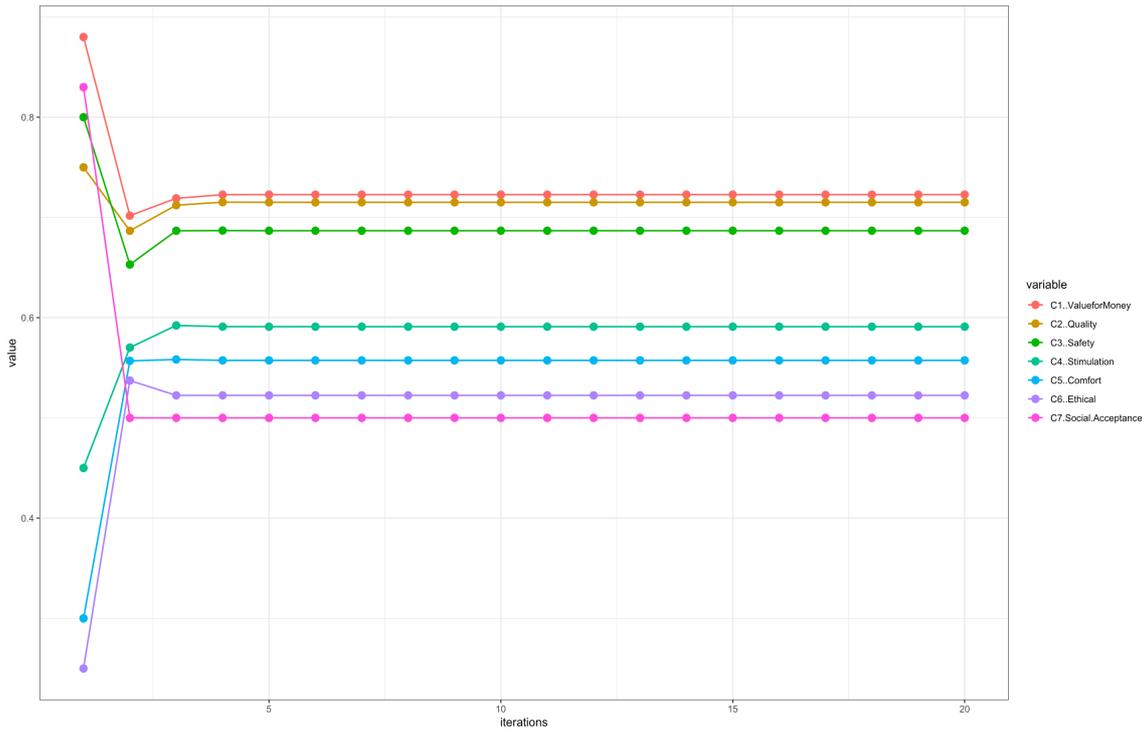
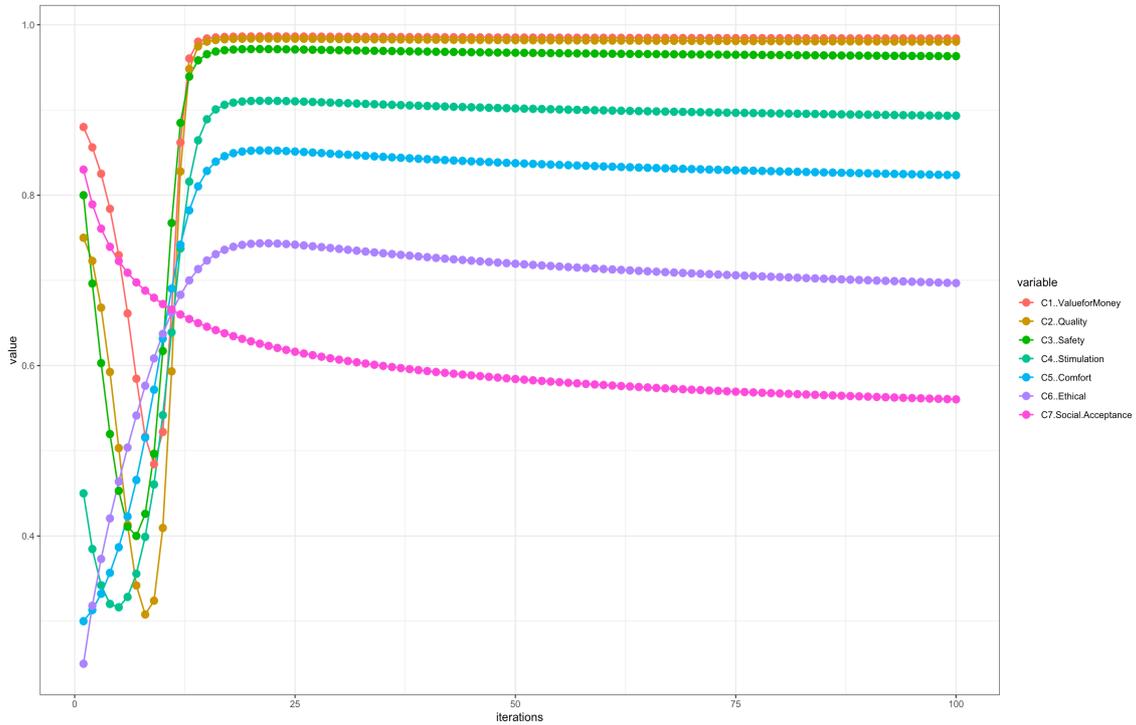


Figure #43. Case Study A5 100 iterations



A major correction can be observed for almost all the variables; however, it is easy to evidence with this trial the high importance and low importance variables as it is possible to basically divide in two the graph by building a horizontal line in 0.5 for the 20 iterations. As before, Value for Money, Safety and Quality remain as the top three importance variables.

### Case Study No. A6

$$A6 = [0.5 \quad -0.5 \quad 0.5 \quad -0.5 \quad -0.5 \quad -0.5 \quad 0.5]$$

Figure #44. Case Study A6 20 iterations

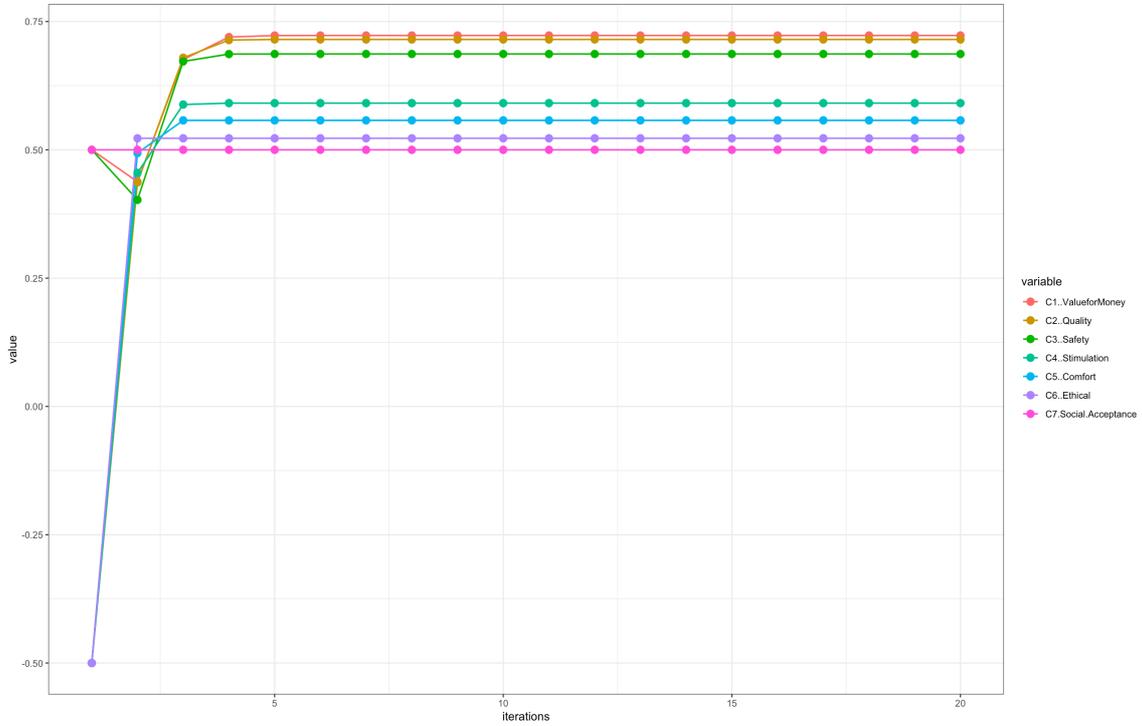
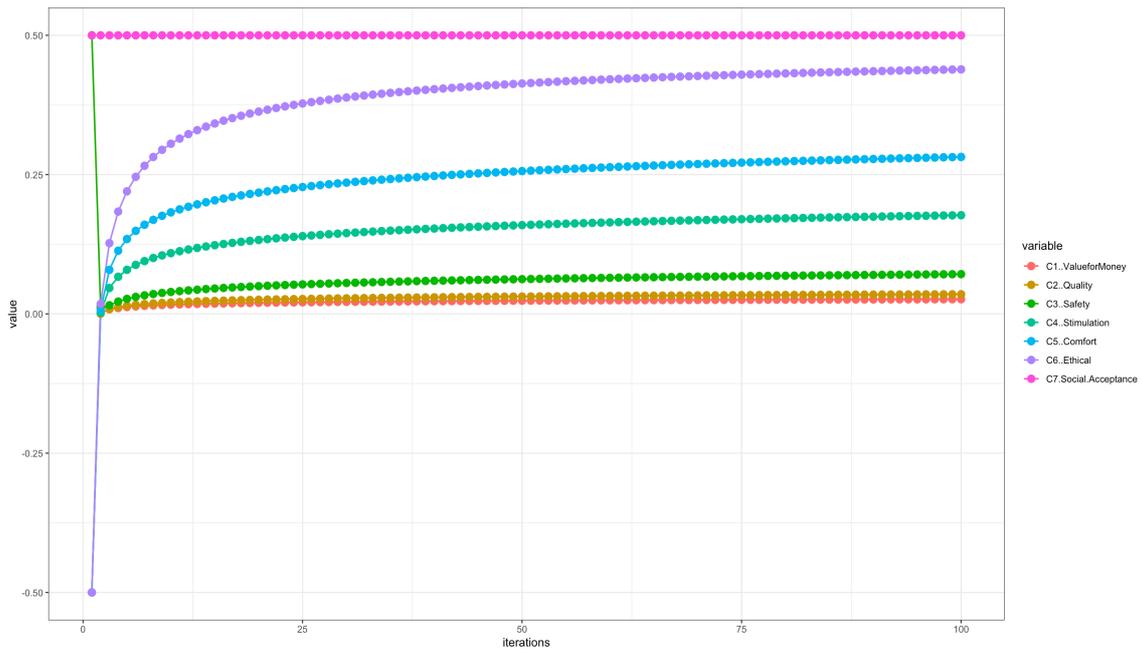


Figure #45. Case Study A6 100 iterations



A major and immediate correction can be seen immediately after the first two trials for the variables which started with negative values, as expected. The end result does vary substantially though and the variables which usually stabilize in the highest, stabilized in around 0.5, contrary to the ones that usually stabilize at the lowest, now stabilize close to 1.

**Case Study No. B1**

$$B1 = \begin{bmatrix} 0.770054494 & 0.775812214 & 0.590105896 & 0.724775345 & 0.459012715 \\ 0.893063271 & 0.750078861 \end{bmatrix}$$

Figure #46. Case Study B1 20 iterations

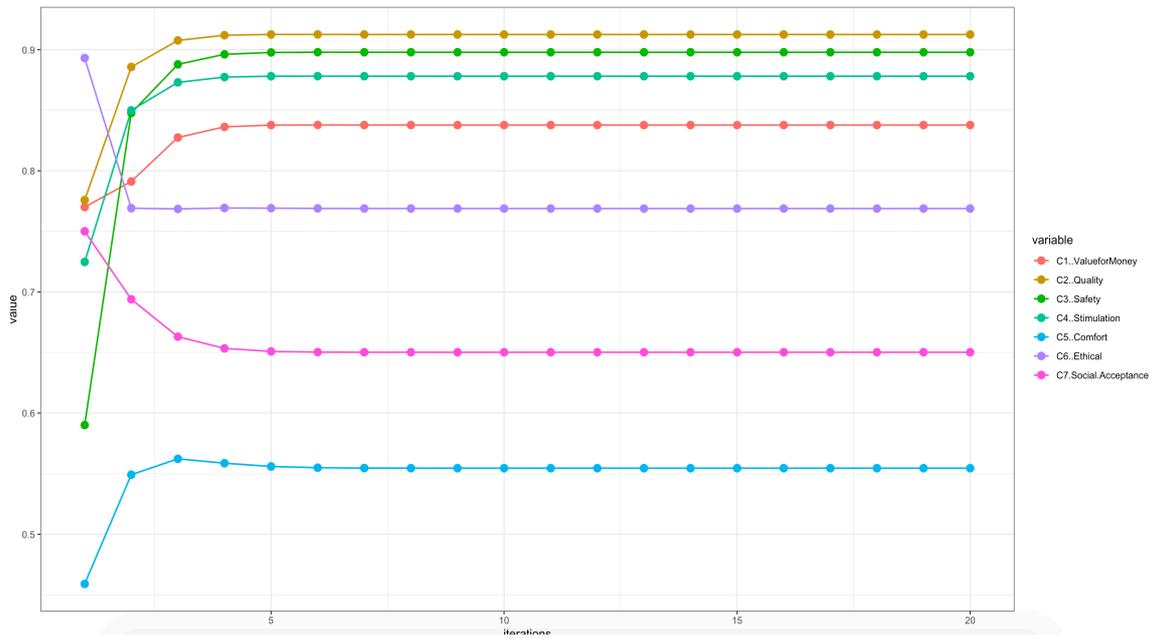
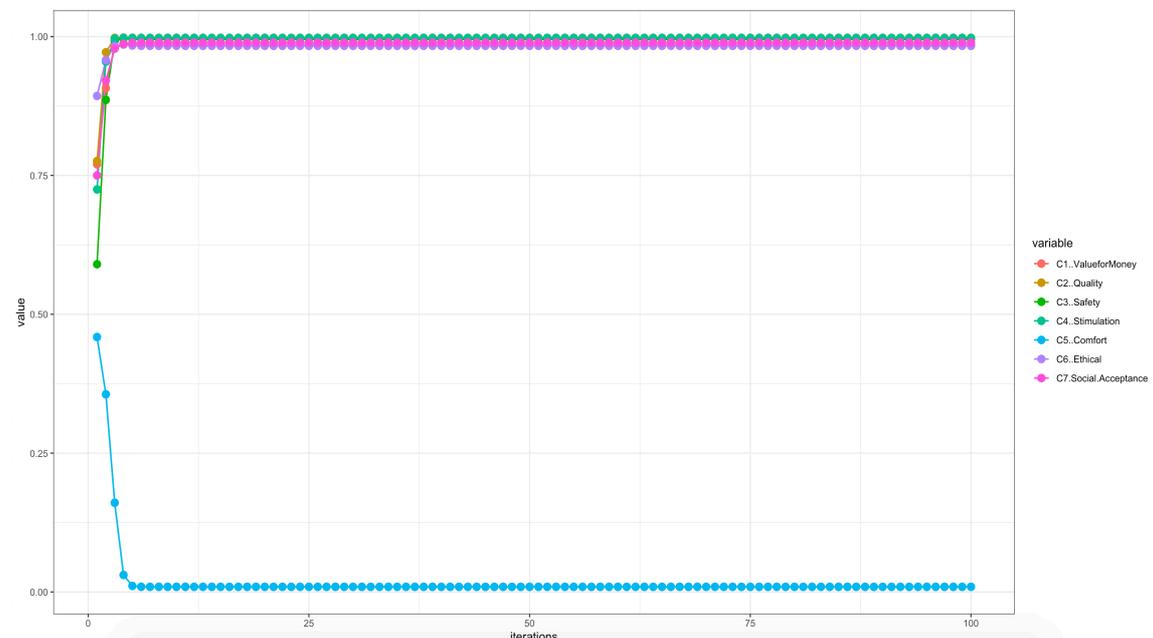


Figure #47. Case Study B1 100 iterations



A major correction can be observed for almost all the variables, but even stronger by the dark green line, safety. Contrary to before, almost all the variables stabilize at a high value close to 1, except comfort in light blue.

**Case Study No. B2**

B2 = [0.910187003 0.972948579 0.963692593 0.981487334 0.740780694  
0.597207547 0.903938702]

Figure #48. Case Study B2 20 iterations

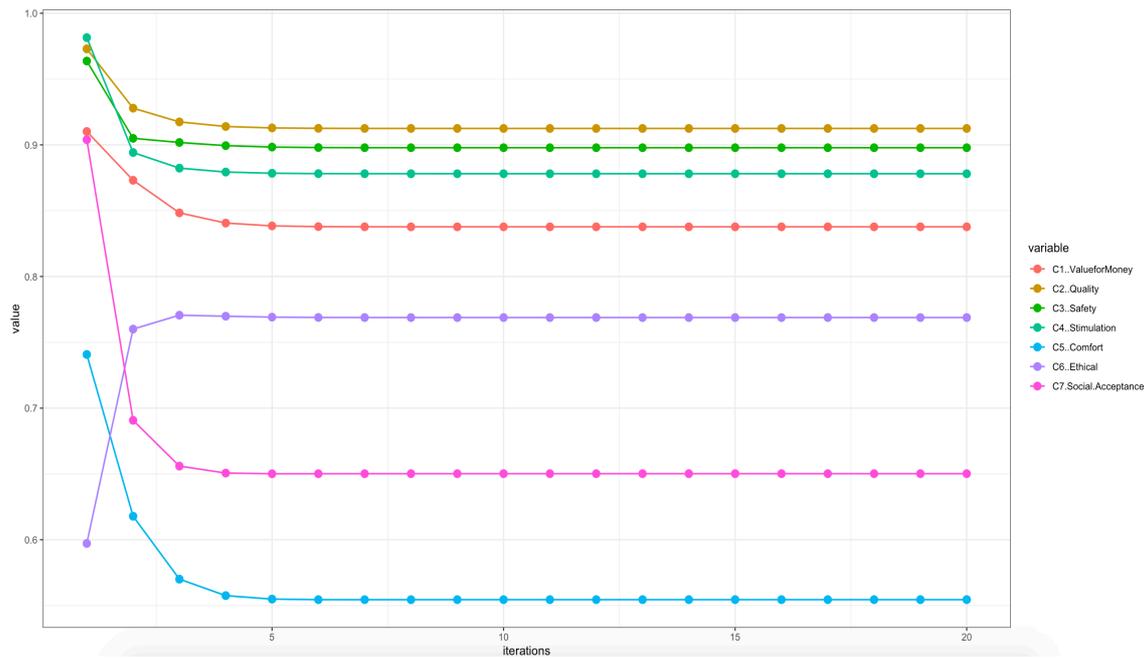
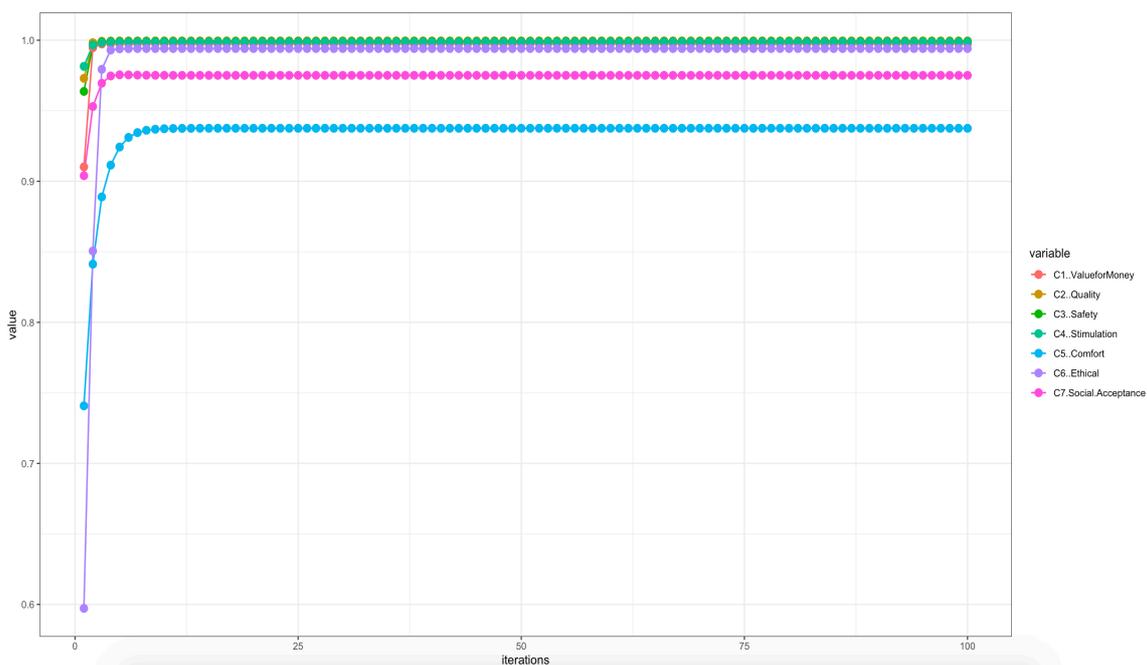


Figure #49. Case Study B2 100 iterations



A major correction can be observed in the pink (social acceptance), purple (ethical) and light blue (comfort lines). A major change occurs from the above case B1, where comfort escalates to be closer by the other variables, and closer to the value of one. Here it can be understood that all the variables have a strong importance, but comfort (in light blue) and social acceptance (in pink) have a lower comparative importance.

**Case Study No. B3**

$$B3 = \begin{bmatrix} 0.660250732 & 0.667039809 & 0.866452835 & 0.727946729 & 0.912164468 \\ 0.438289582 & 0.690880219 \end{bmatrix}$$

Figure #50. Case Study B3 20 iterations

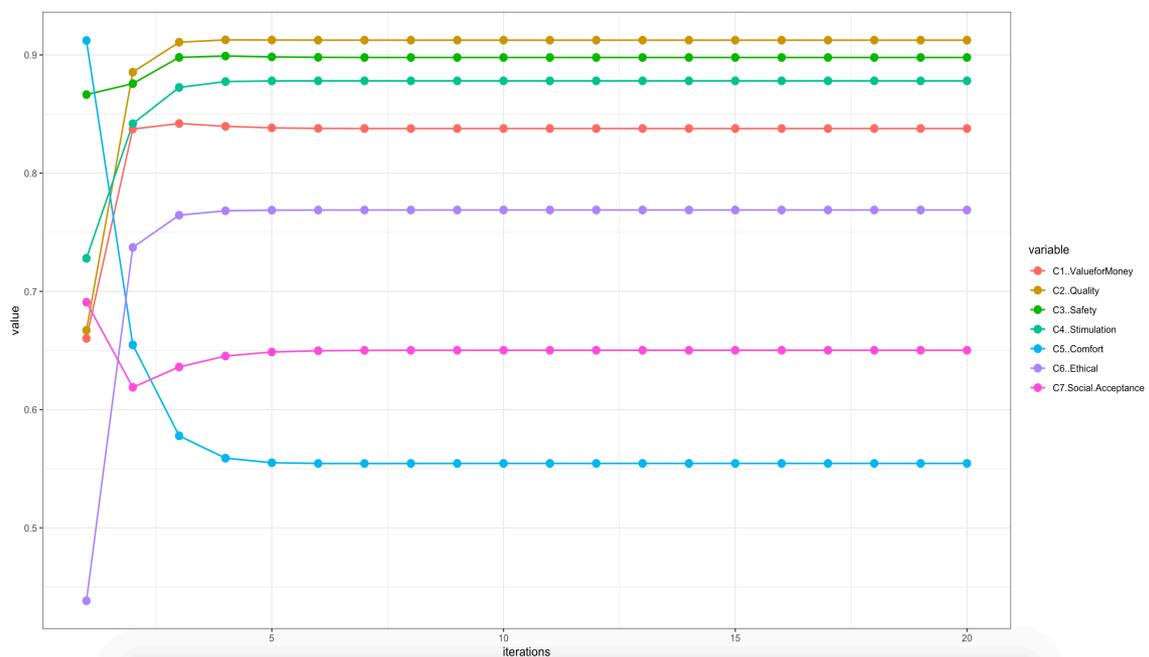
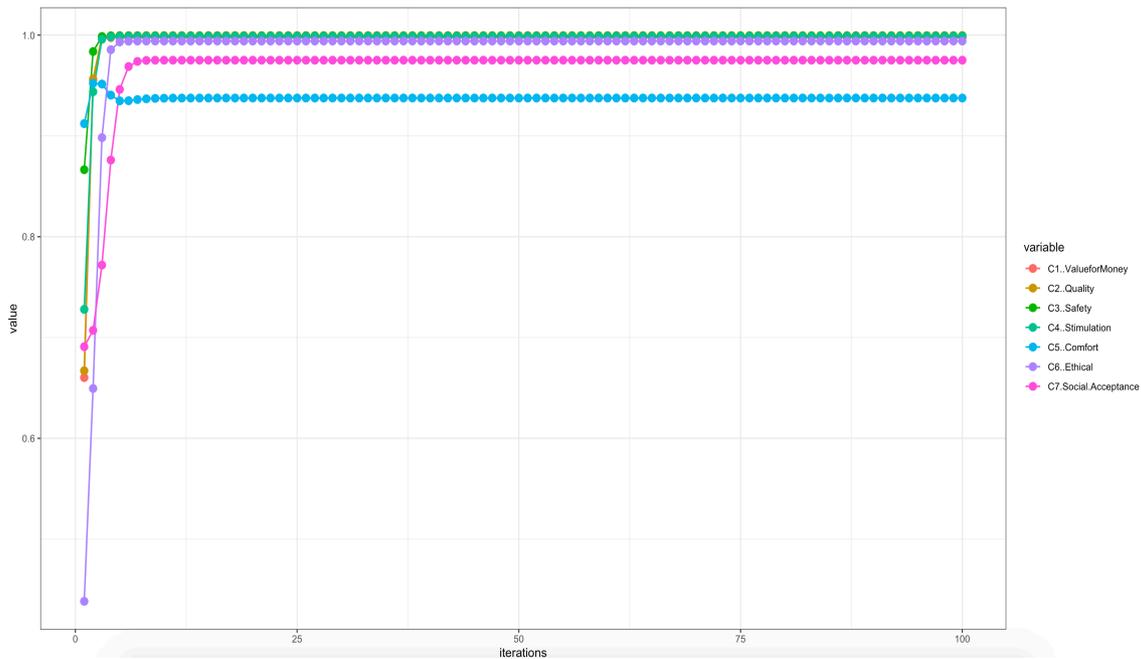


Figure #51. Case Study B3 100 iterations



A major correction can be observed in the purple (ethical line). Just like in the above case study, all the variables end up at the top with a high comparable importance value. The two variables which can be distinguished as lower, even though they are still above 0.9 in value are comfort (in light blue) and social acceptance (in pink).

### Case Study No. B4

This case study was done upon observations of the above six graphs, the input vectors that generated the biggest correction were taken. Below, and highlighted a table which shows in red the input vector that created the biggest correction in each variable.

Table #17. “Extreme” activation vector composition

	Value for Money	Quality	Safety	Stimulation	Comfort	Ethical	Social
Very low	0.770054494	0.77581221	0.5901059	0.72477535	0.45901271	0.89306327	0.75007886
Medium	0.910187003	0.97294858	0.9636926	0.98148733	0.74078069	0.59720755	0.9039387
Very High	0.660250732	0.66703981	0.8664528	0.72794673	0.91216447	0.43828958	0.69088022

$$B4 = [0.910187003 \quad 0.667039809 \quad 0.590105896 \quad 0.724775345 \quad 0.912164468 \\ 0.438289582 \quad 0.903938702]$$

Figure #52. Case Study B4 20 iterations

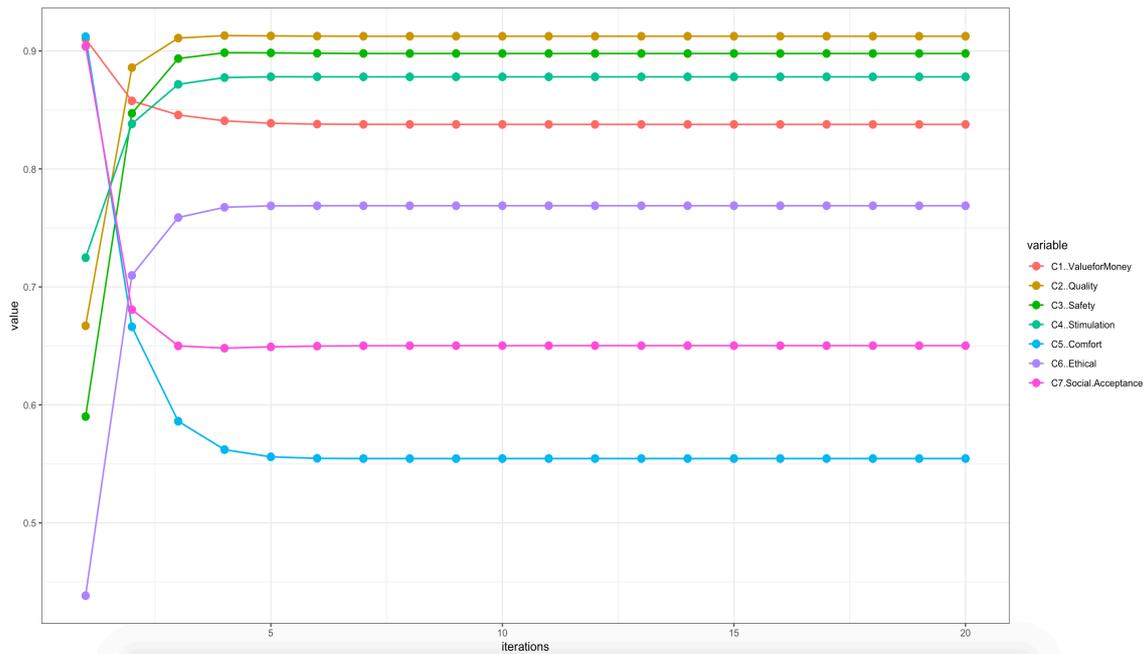
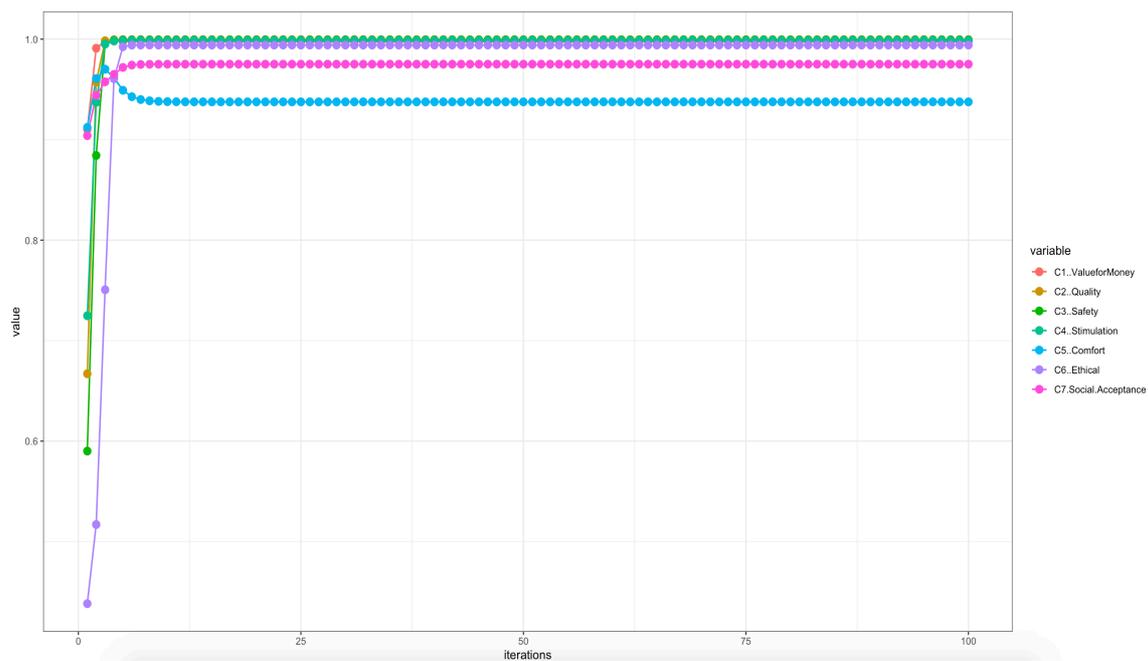


Figure #53. Case Study B4 100 iterations



A major correction can be observed in the purple (ethical line), once again. Other variables that present strong corrections are safety in dark green, quality in yellow and stimulation in a lighter green. Just like both cases above, all the variables end up at the top with a high comparable importance value. The two variables which can be distinguished as lower, remain constant from last example in around 0.9: comfort (in light blue) and social acceptance (in pink).

**Case Study No. B5**

$$B5 = [0.88 \quad 0.75 \quad 0.8 \quad 0.45 \quad 0.3 \quad 0.25 \quad 0.83]$$

Figure #54. Case Study B5 20 iterations

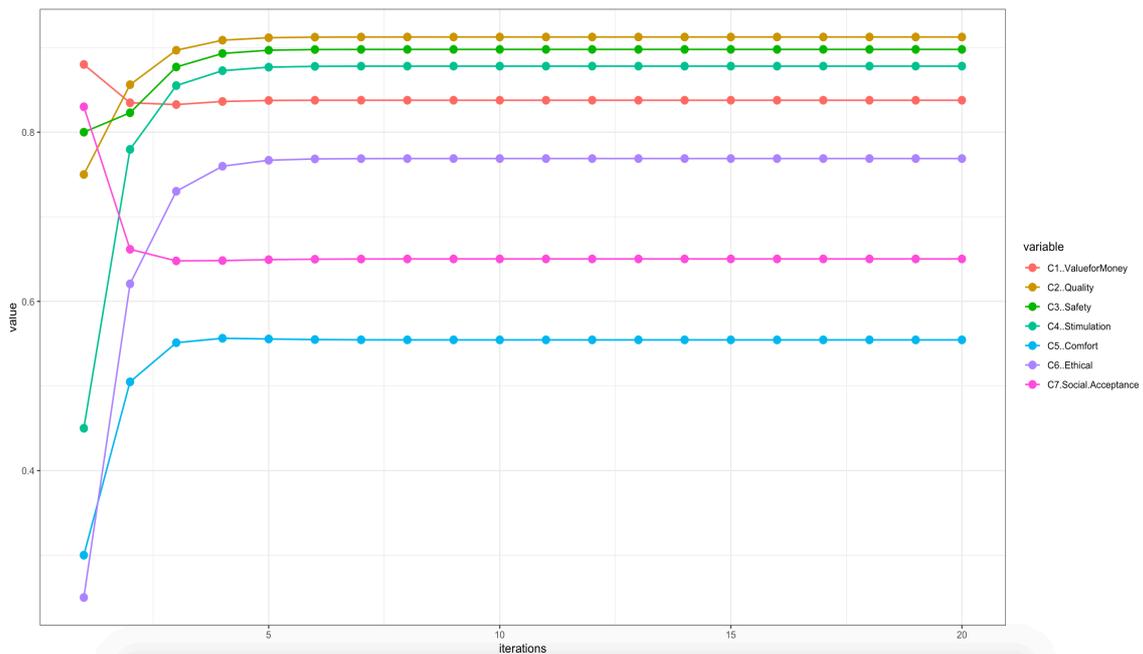
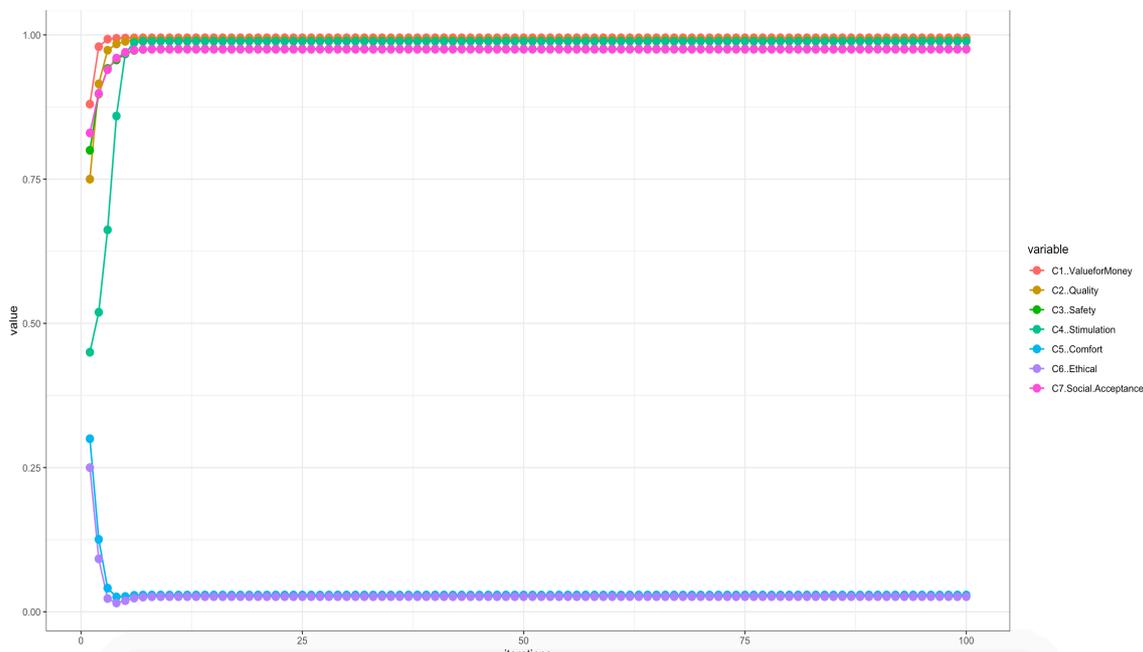


Figure #55. Case Study B5 100 iterations



A major correction can be observed in the purple (ethical line), comfort (light blue), and stimulation (light green). Other variables that present strong corrections are safety in dark green, quality in yellow and stimulation in a lighter green. Like in the first case of model 2 (B1), and unlike the above three cases (B1, B2, B3), the ethical line in purple, this time accompanied by the comfort line in light blue drop down to a value near zero.

### Case Study No. B6

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$$B6 = [0.5 \quad -0.5 \quad 0.5 \quad -0.5 \quad -0.5 \quad -0.5 \quad 0.5]$$

Figure #56. Case Study B6 20 iterations

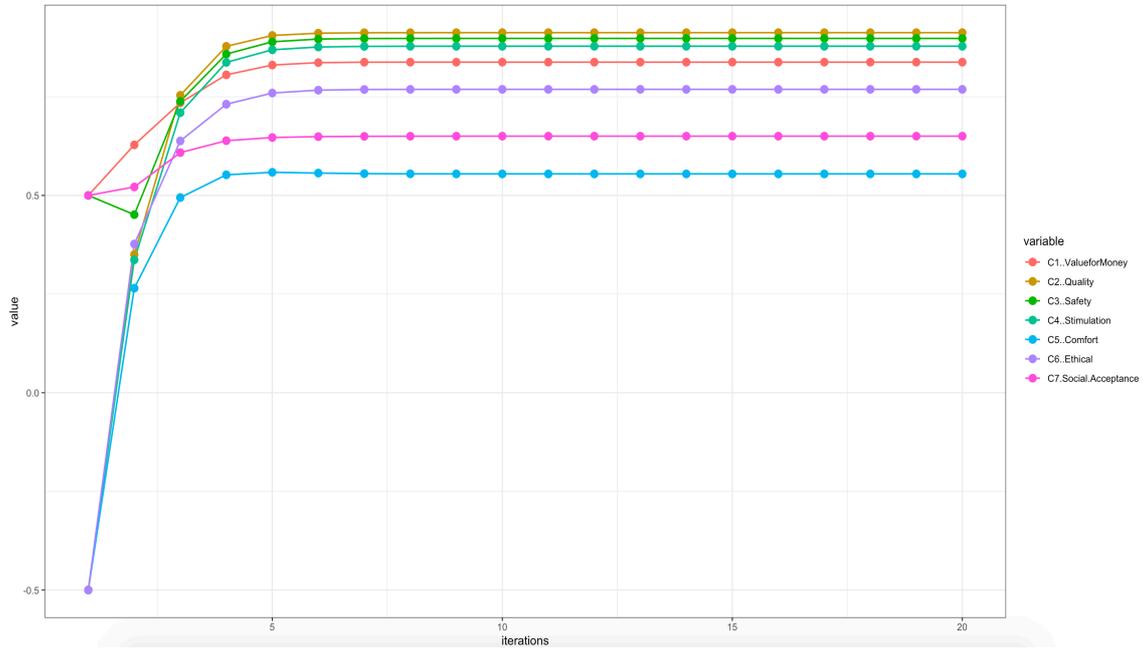
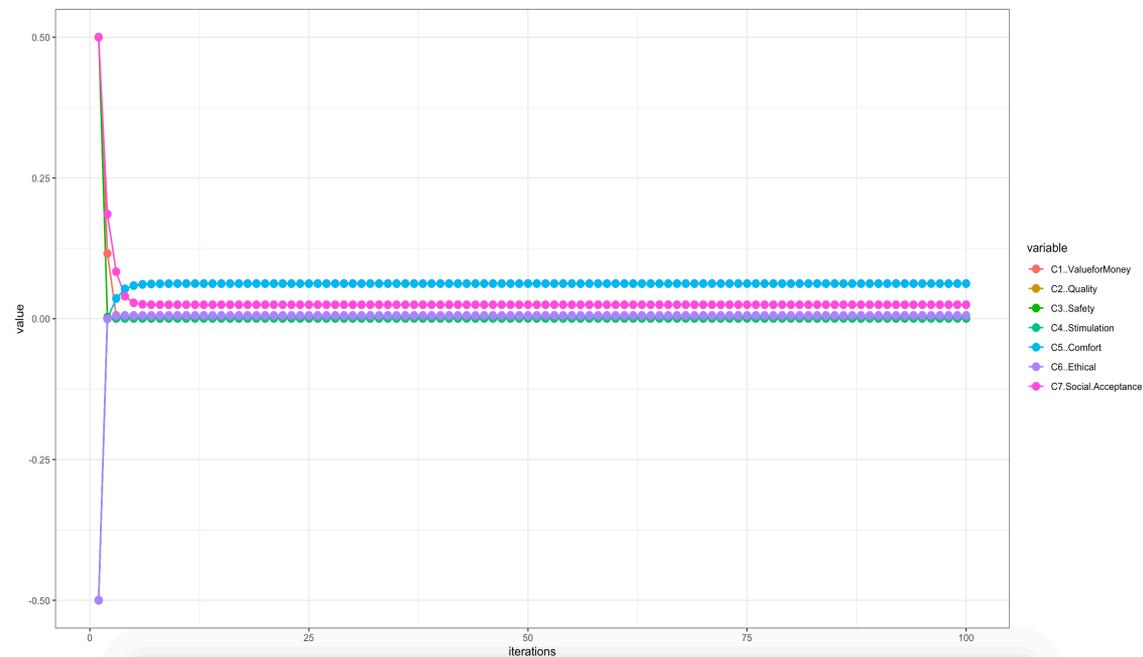


Figure #57. Case Study B6 100 iterations



In this last case, a major correction can be observed in the purple (ethical), light blue (comfort), dark green (stimulation) and yellow (Quality). The graph does evidence an abnormal behavior, or a different behavior to what was seen in all the previous cases as all the variables balance out in a value equal to zero. Due to the inconsistency of this results, this case study will be disregarded for research purposes.

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Based on all the results evidenced above, some major conclusions numbered below around the fuzzy cognitive maps could be reached:

1. Value for money, quality and safety are three goals which have an outstanding high value across model A and B, stabilized always around 1.0 value after 100 iterations. In this way it could be understood that this are the top predominant factors.
2. Model A and Model B present some major differences, in terms of how the variables stabilize after 100 iterations. Model A has evident differences between each of the variables which makes it possible to distinguish between the least to most important. On the contrary, Model B presents some more challenging lines as the variables tend to stabilize closer and either right next to the 1.0 value, or next to the 0.0 value.
3. The gain goals are dominant over the hedonic and normative ones. Across both Model A and B, the variables that end up in the lower importance value side are always the normative (specially the ethical), and also de hedonic goals (usually the comfort).
4. It is important to highlight that the fuzzy cognitive maps were done based on a survey conducted in one of the 20 richest countries in the world. Responses were recorded three years ago, hence, there might be a small twist in the behavior of the population, especially around all the ethical and sustainable side which started booming in the 20<sup>th</sup> century.
5. The social acceptance factor is a very complex to measure and should be highlighted, as people do not tend to respond honestly to this one due to fear of being judged or thought of as different in society.

### 3.4 Compare the different fuzzy neural models to select a final one to perform a deep learning evaluation and further understand the correlation between the strongest variable

Based on the above conclusions it is possible to select the three top variables that affect the consumer purchasing decision, to understand further if there is any interrelation between them or pattern that can be noticed. A pattern or a high correlation between these would not be a good finding as it would symbolize that the variables are not fully independent from one another. In this way, finding a pattern which comes with a high correlation would put in doubt the veracity of the findings for the above work.

To further research into the correlation between the different variables, a configuration of a neural program was developed in R-studio to test for the correlation between the three different variables: value for money, safety, and quality. As concluded in the above section, these three variables showed an outstanding value for both Model A and Model B, which is the reason for why they were selected to have further research completed. To complete the neural program in R-studio, the below linear model was used

$$Y_k = mx,$$

This one also known as the traditional linear model with y-intercept equal to zero. Important to state than unlike when using other types of models, like the logistic, the derivative for this particular one is equal to zero. Then, the actual grant model was built (code attached as part of the attachments further down), with the main aim of identifying the effect of the variables between each other, or the correlation that they have between them. The correlation is a value between 0 and 1, a higher value represents a closer relationship between the variables and vice-versa.

Later, the learning rules were found that allow the model to learn and save what it learns.

In this specific case as the derivative of a linear equation is equal to a constant, then these learning rules were not as long and extensive as they would usually be for a normal logistic function. The reason for why a linear one was selected is because it provided the most consistent correlation results across the different trials, logistic models would provide completely different correlation across different trials, which meant the data was not accommodating to this structure. On the other hand, the linear program made the correlation basically the same across the different trials.

After finding the learning and storage equation, the actual model was built in R Studio that allowed the first round of evaluation of the grant model. As input parameters of the model, a number of variables = 3, Number of Hidden Neurons = 10, Number of Data = 988, Alpha = 0.001, Number of Iterations = 1,000 and 10,000 were used.

It is important to highlight that Value for Money was taken as the independent variable when running the code, this because it obtained the highest importance value across all the different fuzzy cognitive models, hence it was important to analyze safety and quality against this one to validate the findings seen above in the numeral 3.3.

When running the model, a correlation of 28.34% and 34.44% was obtained respectively. Below the two different graphs which came out as a correlation demonstration from R-studio.

Figure #58. Correlation with 1,000 iterations

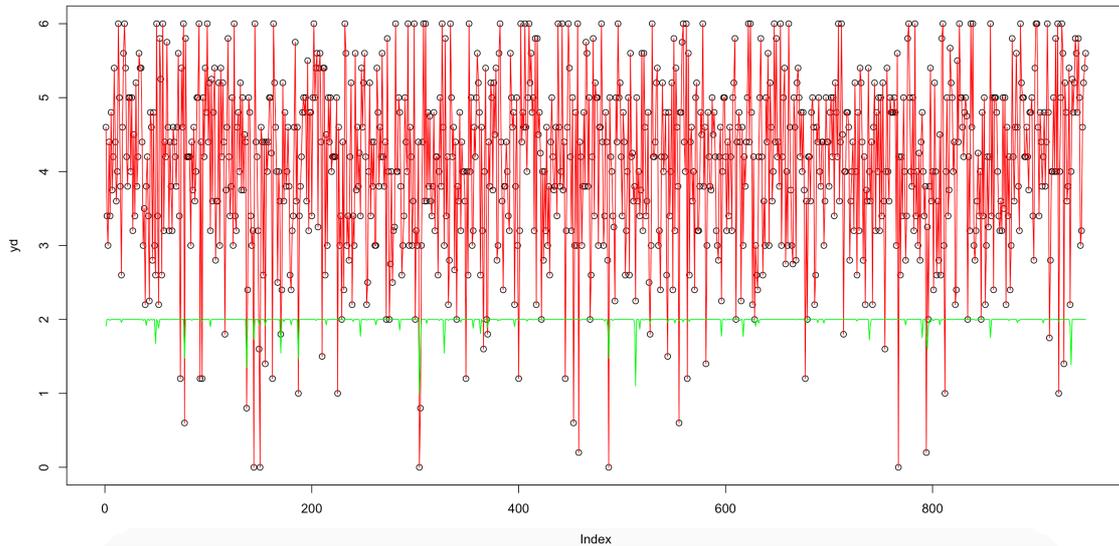
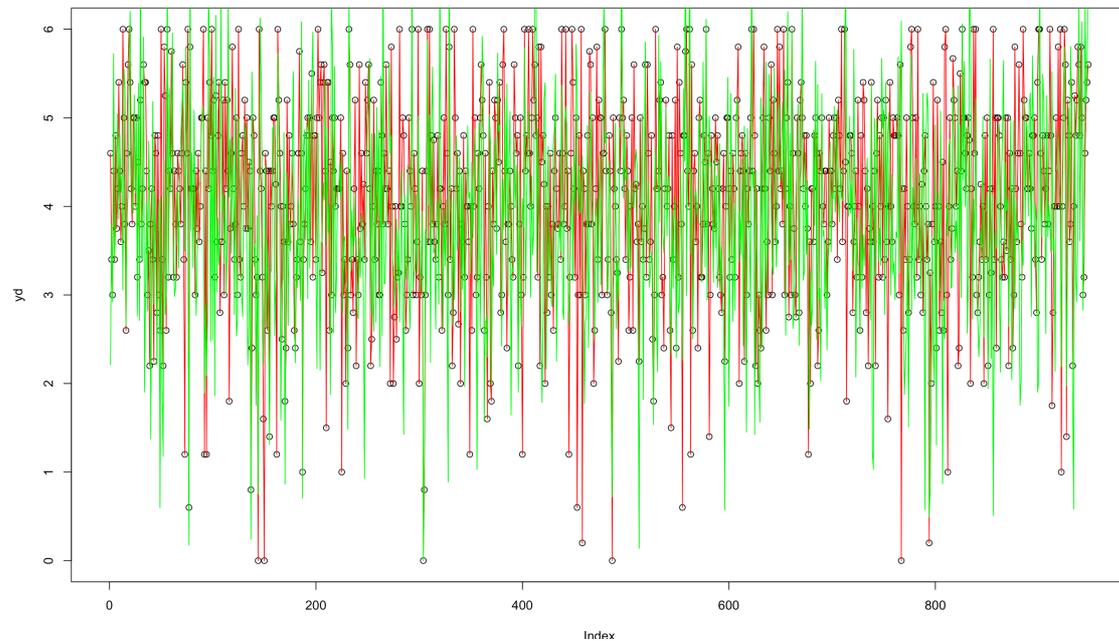


Figure #59. Correlation with 10,000 iterations



As expected, a correlation lower than 35% is classified as a low or weak correlation, therefore validating the importance of the findings in numeral 3.3. Due to the fact that the correlation turns out to be weak these three variables can be categorized as fully

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independent from one another, which then leads to validating the importance of the findings for the consumer behavior and psychology. The reason for why the correlation was found by using deep neural models instead of the traditional correlation functions available from R-studio (as used to identify correlation matrix in phase 2), is to allow data and machine learning to enrich the analyses and correlation from values that learn and interchange with time. If the variables were close enough, then the deep neural model would drive the correlation up, however in this case even after 10,000 iterations the relation between the variables still came back as weak.

#### 4. CONCLUSIONS AND FINAL CONSIDERATIONS

A complete bibliographic review, along with the utilization of a survey conducted, permitted identifying those variables that affect the psychology of a consumer before purchasing or acquiring a new product. It can be understood that humans are an extremely emotional and social creature, which many times defines what the consumer may or may not purchase. Independent of the context, it being: groceries, clothing, travelling, accommodation or entertainment; we are reigned by gain based on the findings expressed above and strengthened with deep neural analysis as well.

Across the articles used, seven variables were identified as relevant in the customer purchasing journey and across the different consumer context scenarios presented above. In total, 988 consumers were surveyed which allowed to build a strong trust towards the results. The consumers were not segregated by their age, gender, income, or any other socioeconomical factors; in other words, all the consumers were held as standards or the equal.

The characterization of the different variables related to three main acquisition goals: gain, hedonic and normative. Then, the different goals opened up into sub-goals as well, which is where the total of 7 variables could be observed.

The development of the presented thesis made it possible to establish a methodology to estimate the patterns that make the offering of a product more liked by the consumer brain. Now, marketers can be clear on how to structure the message to consumer and which emotions to be alluding, some examples of these: getting value for what is being purchased, triple your value with xxx product, having xxx has never made you feel safer etc.

In this way, the model is constituted as a proposal in terms of what marketers could offer to the target audience and what the difference in attention is going to be when alluding to the different consumer groups. Some big realizations can be done on how much focus things like ethics and comfort should have in the unique value proposal of a product, versus the focus that should be implemented on the value or return received from a product and the quality or security that this same one offers. All this understanding of the consumer brain allows an understanding of which products are aimed to fail, simply by how they are being offered. As customers, having so many places to pose the attention, it is simple to understand why looking at calling that attention should be the number one focus for any company that wants to increase sells and generate more revenue.

Thus, once the different models presented were analyzed, it was possible to understand how our purchasing decisions are highly correlated, regardless of our socioeconomic status, gender, etc. By having this work, it is possible to then determine the level of incidence that different unique value proposals (UVP) have in the generation of a program. This leads into the possibility to then investigate across different countries, cultures and religions; along with researching the specificity of the consumer context to see how these sub-goals could potentially vary between one another.

In this way, the human or consumer can be positioned as a target for attention, and by evaluating the reaction of different messages across different products, it could be possible to understand what can increase the possibilities of purchasing it.

As explained across the methodology and analysis of the work, in each of the models, the prevalent weights between the different variables were experimented with both by a bibliographical review and by the specific results from a survey conducted. Two different areas of knowledge leading up to one same conclusion specials for itself.

To in the future increase the validity to this methodology, it is considered pertinent that in subsequent studies. One of these studies could be replicating the same survey across different cultures, different religions or different continents. Another study could be around specifically analyzing the behavior under different consumer purchasing niches to be able to understand for the specific industry with which a company is involved, what a consumer is looking for. Anything and everything can be analyzed using the same methodology, as long as enough data is had to make the fuzzy map and the neural correction valid.

Recognizing that this approach evaluates a general scenario for the consumer purchasing journey, and for one set group of people without differentiating by age, gender or any other socioeconomic facet, makes it possible to understand all the avenues that can be taken to dig deeper into the journey.

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## 6. ATTACHMENTS

- 6.1 Research paper “Fuzzy Cognitive Maps to Model the Consumer Decision Journey against Tourism Products”
- 6.2 Code for building a correlation matrix through deep learning models in R Studio

```
plot(yd)
lines(yd, col="red")
lines(yr, col="green")
cor(yd, yr)
```

### 6.3 Deep Learning Model for Phase 1 R-studio

```
#General Configuration Deep Neural Model - matrix X -
NE=2;NO=7;NS=1;ND=988
W=rnorm(NO*NE,mean=0,sd=1)
W=matrix(W,NO,NE)
C=rnorm(1*NO,mean=0,sd=1)
C=matrix(C,1,NO)
alfa=0.000001

hj=matrix(0,NO,1)
ys=matrix(0,ND,1)
yr=matrix(0,ND,1)
ek=matrix(0,ND,1)

#Iterations of the table
NIT=1000
#NIT=10,000
for(i1 in 1:NIT){
  for(k in 1:ND){
    FeedForward
    hj=W%%X[k,]
    ys[k,]=C%%hj

    #Lineal Activation
    #yr[k,]=C%%hj

    #Logit Function
    #yr[k,]=1/(1+exp(-ys[k,]))
    #der=exp(-ys[k,])/(1+exp(-ys[k,]))^2

    #yr[k,]=2/(1+exp(-ys[k,]))
    #der=2*exp(-ys[k,])/((1+exp(-ys[k,]))^2)

    #Paso 2: Backpropagation – Error recovery
    ek[k,]=yd[k,]-yr[k,]
    C=C+alfa*ek[k,]*t(hj)*der
    W=W+alfa*ek[k,]*(t(C)%%X[k,])*der

  }
}

plot(yd)
lines(yd,col="red")
lines(yr,col="green")
```

## 6.4 Deep Learning Model for Phase 2 R-Studio

```
#General Configuration Deep Neural Model - matrix X -
NE=2;NO=7;NS=1;ND=988
W=rnorm(NO*NE,mean=0,sd=1)
W=matrix(W,NO,NE)
C=rnorm(1*NO,mean=0,sd=1)
C=matrix(C,1,NO)
alfa=0.000001

hj=matrix(0,NO,1)
ys=matrix(0,ND,1)
yr=matrix(0,ND,1)
ek=matrix(0,ND,1)

#Iterations of the table
NIT=1000
#NIT=10,000
for(i1 in 1:NIT){
  for(k in 1:ND){
    FeedForward
    hj=W%%X[k,]
    ys[k,]=C%%hj

    #Lineal Activation
    #yr[k,]=C%%hj

    #Logit Function
    #yr[k,]=1/(1+exp(-ys[k,]))
    #der=exp(-ys[k,])/(1+exp(-ys[k,]))^2

    #yr[k,]=2/(1+exp(-ys[k,]))
    #der=2*exp(-ys[k,])/((1+exp(-ys[k,]))^2)

    #Paso 2: Backpropagation – Error recovery
    ek[k,]=yd[k,]-yr[k,]
    C=C+alfa*ek[k,]*t(hj)*der
    W=W+alfa*ek[k,]*t(C)%X[k,]*der

  }
}

plot(yd)
lines(yd,col="red")
lines(yr,col="green")
```

## 6.5 R-Studio Fuzzy Cognitive Maps Code

### 6.4.1 Fuzzy Cognitive Model for Phase 1 R-studio

```
#vector muy bajo
#act.vec <- data.frame(0.770054494,      0.775812214, 0.590105896, 0.724775345,
  0.459012715, 0.893063271, 0.750078861 ) # Create the activation vector
#vector medio
#act.vec <- data.frame(0.910187003,      0.972948579, 0.963692593, 0.981487334,
  0.740780694, 0.597207547, 0.903938702 )
#vector muy alto
#act.vec <- data.frame(0.660250732,      0.667039809, 0.866452835, 0.727946729,
  0.912164468, 0.438289582, 0.690880219 )
#vectorextremos
#act.vec <- data.frame(0.910187003,      0.667039809, 0.590105896, 0.724775345,
  0.912164468, 0.438289582, 0.903938702)

#vectorexperta
#act.vec <- data.frame(0.88, 0.75, 0.8, 0.45, 0.3, 0.25, 0.83)

#jugandoconsignos
act.vec <- data.frame(0.5, -0.5, 0.5, -0.5, -0.5, -0.5, 0.5)

colnames(act.vec) <- c("C1: ValueforMoney", "C2: Quality", "C3: Safety", "C4:
Stimulation", "C5: Comfort", "C6: Ethical", "C7:Social Acceptance") # Change the
column names

C1 = c(1, 0.2555902, 0.4298609, 0.0623363, -0.4611868, -0.2711669,
-0.1271416)
C2 = c(0.2555902, 1, 0.3658778, 0.3263849, 0.4140751, -0.3161353,
0.1999508)
C3 = c(0.4298609, 0.3658778, 1, 0.2781647, -0.452191, 0.3933324,
-0.3317668)
C4 = c(0.0623363, 0.3263849, 0.2781647, 1, 0.1754085, 0.3701893,
0.1762959)
C5 = c(0.4611868, 0.4140751, 0.452191, 0.1754085, 1, 0.2644308,
-0.1971816)
C6 = c(-0.2711669, 0.3161353, 0.3933324, 0.3701893, -0.2644308, 1,
0.1901954)
C7 = c(0.1271416, 0.1999508, -0.3317668, 0.1762959, 0.1971816,
0.1901954, 1)

w.mat <- matrix(c(C1, C2, C3, C4, C5, C6, C7), nrow =7, ncol=7, byrow=TRUE) #
Create the weight matrix
w.mat <- as.data.frame(w.mat) # Transform w.mat as a dataframe
colnames(w.mat) <- c("C1: ValueforMoney", "C2: Quality", "C3: Safety", "C4:
Stimulation", "C5: Comfort", "C6: Ethical", "C7:Social Acceptance")
```

```

w.mat    # View the weight matrix

#Estimate the FCM Inference (using the default values of the function)

output1 <- fcm.infer(act.vec, w.mat)

#Visualization of output1:

iterations <- as.numeric(rownames(output1$values)) # create a numeric vector named
"iterations"
df <- data.frame(iterations, output1$values) # add "iterations" in the "output1$values"
dataframe
df2 <- melt(df, id="iterations") # transform the dataframe df into long formats
ggplot(data=df2, # Visualize the concepts' values
aes(x=iterations, y=value, group=variable, colour=variable)) +
theme_bw() + geom_line(size=0.7) + geom_point(size = 3)

#Estimate the FCM Inference (changing the default values)

output2 <- fcm.infer(act.vec, w.mat, 100, "r", "s", lambda = 2, e = 0.0001)

output2$values # View the concepts' values for each iteration

#Visualization
iterations <- as.numeric(rownames(output2$values))
df <- data.frame(iterations, output2$values)
df2 <- melt(df, id="iterations")
ggplot(data=df2,
aes(x=iterations, y=value, group=variable, colour=variable)) +
theme_bw() + geom_line(size=0.7) + geom_point(size = 3)

```

## 6.4.2 Fuzzy Cognitive Model for Phase 2 – R studio

```
#vector muy bajo
#act.vec <- data.frame(0.770054494,      0.775812214, 0.590105896, 0.724775345,
  0.459012715, 0.893063271, 0.750078861 ) # Create the activation vector
#vector medio
#act.vec <- data.frame(0.910187003,      0.972948579, 0.963692593, 0.981487334,
  0.740780694, 0.597207547, 0.903938702 )
#vector muy alto
#act.vec <- data.frame(0.660250732,      0.667039809, 0.866452835, 0.727946729,
  0.912164468, 0.438289582, 0.690880219 )
#vectorextremos
#act.vec <- data.frame(0.660250732,      0.667039809, 0.590105896, 0.724775345,
  0.459012715, 0.438289582, 0.903938702)
#act.vec <- data.frame(0.910187003,      0.667039809, 0.590105896, 0.724775345,
  0.912164468, 0.438289582, 0.903938702)

#vectorexperta
#act.vec <- data.frame(0.88, 0.75, 0.8, 0.45, 0.3, 0.25, 0.83)

#jugandoconsignos
act.vec <- data.frame(0.5, -0.5, 0.5, -0.5, -0.5, -0.5, 0.5)

colnames(act.vec) <- c("C1: ValueforMoney", "C2: Quality", "C3: Safety", "C4:
Stimulation", "C5: Comfort", "C6: Ethical", "C7:Social Acceptance") # Change the
column names

C1 = c(0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0)
C2 = c(0.25, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0)
C3 = c(0.41, 0.35, 0.0, 0.0, 0.0, 0.0, 0.0)
C4 = c(0.06, 0.32, 0.28, 0.0, 0.0, 0.0, 0.0)
C5 = c(0.46, 0.41, 0.45, 0.18, 0.0, 0.0, 0.0)
C6 = c(0.27, 0.32, 0.39, 0.35, 0.25, 0.0, 0.0)
C7 = c(0.13, 0.19, 0.33, 0.17, 0.2, 0.18, 0.0)

w.mat <- matrix(c(C1, C2, C3, C4, C5, C6, C7), nrow =7, ncol=7, byrow=TRUE) #
Create the weight matrix
w.mat <- as.data.frame(w.mat) # Transform w.mat as a dataframe
colnames(w.mat) <- c( "C1: ValueforMoney", "C2: Quality", "C3: Safety", "C4:
Stimulation", "C5: Comfort", "C6: Ethical", "C7:Social Acceptance")

w.mat # View the weight matrix

#Estimate the FCM Inference (using the default values of the function)

output1 <- fcm.infer(act.vec, w.mat)

#Visualization of output1:
```

```

iterations <- as.numeric(rownames(output1$values)) # create a numeric vector named
"iterations"
df <- data.frame(iterations, output1$values) # add "iterations" in the "output1$values"
dataframe
df2 <- melt(df, id="iterations") # transform the dataframe df into long formats
ggplot(data=df2, # Visualize the concepts' values
aes(x=iterations, y=value, group=variable, colour=variable)) +
theme_bw() + geom_line(size=0.7) + geom_point(size = 3)

#Estimate the FCM Inference (changing the default values)

output2 <- fcm.infer(act.vec, w.mat, 100, "r", "s", lambda = 2, e = 0.0001)

output2$values # View the concepts' values for each iteration

#Visualization
iterations <- as.numeric(rownames(output2$values))
df <- data.frame(iterations, output2$values)
df2 <- melt(df, id="iterations")
ggplot(data=df2,
aes(x=iterations, y=value, group=variable, colour=variable)) +
theme_bw() + geom_line(size=0.7) + geom_point(size = 3)

```