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Master Thesis in Neuromarketing – MSc in International Marketing and Management

The role of stimuli display method and cognitive goals on consumers' visual attention to product packages

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ABSTRACT

The competitive landscape is intensifying for many industries, particularly for the FMCG industry. This increases the need not only for differentiation in terms of offering a distinct visual identity but also for understanding of consumer information processing, given that (purchasing) decisions are made in-store and packages need to stand out from the competition on the shelf. In a retail context, the principle is that what is not seen, is unsold – which makes it important for firms to understand how consumers allocate their attention and interact with package designs. As product package is the closest point of contact between the consumer and a brand, it is attracting more interest and investment from academics and practitioners. Packaging is a relevant means of product differentiation and an integrated marketing tool. One approach to understand what attracts consumers attention to a package is to study their eye movements as they are reflective of their information processing. On account of this, eye-trackers are gaining more relevance and thus are being applied more in both commercial and academic practices. Yet, most of the existing eye-tracking studies investigate visual attention to stimuli on screen as two-dimensional pictures. This poses a question regarding the generalizability of screen-based findings to real-life behavior, as there are evidence that suggests a difference. Therefore, this study investigates visual attention to different package design elements presented as screen images (two-dimensional) and as physical products (three-dimensional), employing both a free-viewing paradigm and a task-viewing paradigm.

The empirical study presented in this thesis demonstrates that when consumers free-view package designs, the total viewing time on package elements differs in the two conditions. In addition, a significant difference between cognitive goals and participants' allocation of attention was found for both real-life setting and screen-based setting. More specifically, free-viewing led to an increased viewing time on AOI Text, whereas the task-viewing triggered a more uniform viewing pattern, implying that the cognitive goal overruled the impact of the stimulus presentation method. However, this study showed significant difference between the free-viewing and the task-viewing and participants allocation of attention in both viewing conditions, in terms of TTFF. More specifically, the results showed that during the task-viewing the AOIs Brand (in physical and screen condition) and Pictorial (screen condition) were viewed significantly faster indicating that participants particularly relied on the brand element to perform the task. Thus, our findings revealed that the stimulus display method has an impact on how consumers allocate their attention, thereby challenging the assumption that results from screen-based studies can be generalized to viewing behavior (information processing) in the three-dimensional world. This has important implications for both commercial and academic research.

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1. INTRODUCTION

In an industry like the FMCG where competition is fierce and inevitably intensifying, it is imperative for firms to stand out by focusing on product differentiation, innovation, brand awareness or price-strategy, in order to create consumer value. The growing worldwide competition has made consumers' purchasing decisions more difficult and entangled as they are faced with a broad range of increasingly similar products within the same category. At the same time, consumers are subject to large amount of advertisements in different media and in several points-of-purchase everyday (Wedel and Pieters, 2008). It is well-known that consumers make 73% of their purchasing decision at the point-of-sale (Rettie and Brewer, 2000; Rundh, 2013) and they are likely to reach a decision within a few seconds (Clement, Kristensen and Grøhaug, 2013). The large amount of information and products in conjunction with consumers limited cognitive capacity is causing confusion and decreasing satisfaction. Therefore, it is necessary to understand what is capturing and driving consumers' visual attention in order to better address their behavior and impact their purchasing decision (Clement et. al, 2013) by attracting consumers' attention at the point-of-sale. This is also supported by the key role played by visual attention in marketing, which has the ability to affect consumer behavior by contributing to preferences selection, decision making and learning (Wedel and Pieters, 2008).

While consumers' visual attention to print advertisements has been thoroughly researched, consumers' visual attention to marketing stimuli such as shelf design and layout, product and brand packages has been subject to less considerable research (Lim, 2018; Wedel and Pieters, 2008). This highlights the importance of using other types of marketing stimuli when researchers investigate consumers' visual attention. Therefore, further focus should be placed on visual attention to product packages as some scholars have only recently tried to do (Tonkin, Ouzts and Duchowski, 2011; Nikolaus and Lipfert, 2012; Mehmedovic, Omeragic, Batagelj and Kolar, 2017), however it is argued that it still suffers from lack of investigation (Lim, 2018). Further investigation is imperative and supported by the key role packaging plays in attracting and retaining consumers attention at the point-of-sale through their form (Rundh, 2013) which is especially true for FMCG where packaging and presentation are the closests brand touch point to consumers (Lim, 2018). For this reason, companies are increasing budgets and investments on packaging and package design (Rajan, 2018: Know the importance of product packaging design in branding & marketing, 2017; Lim, 2018) recognizing that packaging plays different roles aside from just protecting the product.

The importance of a product package stands in its role as integrated marketing tool, due to its multiple functions. Its communication role consists in providing information about the brand, the product, its values and benefits, as well as making the product distinctive through its design elements at the point-of-sale, allowing it to stand out from the crowded in-store shelves. Its functional role consists in protecting the product and ensuring an efficient distribution (Rundh, 2016). Recent research investigates the influence of package designs of different products on consumers' attention (Tonkin et al., 2011; Nikolaus and Lipfert, 2012; Clement et. al, 2013) and could provide valuable knowledge for investment opportunities. For a long time, managers, marketers and researchers have sought to understand what consumers wanted, what they were thinking and how they made their decisions, by relying on traditional techniques such as interviews and surveys (Bosak, 2013).

Both researchers and managers spend a lot of money trying to predict, understand and influence consumer behavior. As a result, an increasing number of companies are now investing in tracking consumers' visual behavior, thereby trying to make their marketing efforts more concrete and effectual. This explains the increasing diffusion of commercial and academic application of eye-trackers. Hundreds of studies involving eye-tracking technology are conducted every year, specifically the infrared eye-trackers are used to study eye movements in laboratories and in natural settings (Tonkin et al., 2011; Suurmets, Clement, Stets, Nyberg and Nikolaou, 2019; Wedel and Pieters, 2008) in order to reach the objective of predicting and influencing behavior. To date, limited research has been conducted on the impact of exposure conditions on eye movements. Regardless of there being evidence showing that viewing behavior differs based on the stimuli display method (Foulsham, Walker and Kingstone, 2011; Suurmets et al., 2019; Tatler, Hayhoe, Land and Ballard, 2011; Tonkin et al., 2011). Companies are adopting eye-tracking technology to test and design marketing stimuli mainly as two-dimensional screen images. In fact, most of the studies are carried out in controlled settings in a laboratory where visual marketing stimuli are displayed on computer screens (i.e. two-dimensional), which is little representative of real-life conditions under which subjects are generally exposed to those stimuli (i.e. three-dimensional). As these setups are different in visual complexity it is an oversimplified approach to generalize the on-screen results to real-life setting e.g. supermarkets.

Yet the majority of eye-tracking studies do not question whether the findings of on-screen studies are in fact representative of how consumers act in real life. Therefore, they are based on the assumption that consumers allocate visual attention in the same manner, regardless of the stimuli presentation method. As a result, the marketing and packaging domains are in need of further knowledge regarding how the stimulus presentation method impacts on visual attention, consumers' evaluation and responses to the stimulus (Tatler et al., 2011; Suurmets et al., 2019). Consequently, it is critical to explore and recognize how the viewing condition affects visual attention and gaze guidance. This is supported by the uncertainty and ambiguity of generalizing the findings of on-screen viewing studies of stimuli to real-life viewing behavior. Previous studies have shown that there are significant differences in eye movements between viewing images on screen and in real-life settings (Foulsham et al., 2011; Suurmets et al., 2019; Tatler et al., 2011; Tonkin et al., 2011). However, to our knowledge the topic has only received limited attention in research. Therefore, the purpose of this study is to validate and extend previous finding by investigating:

1. Whether it is justified for researchers and marketers to conduct studies based solely on on-screen display of stimuli and generalize these results to real-life setting;
2. Whether and how consumer information processing and visual attention are influenced by cognitive tasks.

PROBLEM STATEMENT AND RESEARCH QUESTION

Understanding, predicting and influencing consumers behavior is a riddle that has been extensively investigated by managers and researchers for a long time. This has led them to explore and apply new techniques and approaches involving psychological, neuroscientific and neurophysiological methods (Karmarkar and Plassmann, 2019). For this reason, neuromarketing has gained substantial popularity. Most of the largest marketing research companies currently have neuromarketing divisions (ibid) specifically dedicated to gaining insights on consumers behavior through the application of neuroscientific measures to marketing related problems (Touhami et at., 2011). Increasingly more companies choose to expand their investment in applying neuroimaging methods to marketing over traditional marketing research techniques based on the claim that analysing how consumers see and elaborate marketing stimuli is better at predicting consumer behavior. In addition, the number of research companies offering eye-tracking research has substantially increased (Murphy, Illes and Reiner, 2008).

Popularity and advances in neuromarketing are reflected in the popularity and advance in its methods and techniques. Among these, eye tracking is one of the most accessible to companies (Holmqvist et al., 2011). Eye-tracking can provide important information in regard to consumers visual attention which essentially is predictive of their likelihood to purchase (Gidlöf, Anikin, Lingonblad and Wallin 2017; Karmarkar and Plassman, 2019). Several experiments have shown that the viewing duration of a specific product has an influence on the likelihood to buy the product. In fact, the likelihood of buying that specific product is higher the longer consumers gaze at it (Karmarkar and Plassman, 2019). However, the results of eye-tracking studies like these are mainly based on products displayed to consumers on-screen and generalizing the findings to in-store behavior.

Contrary to what has been previously thought and assumed, consumers allocation of attention has been shown to be different when they are exposed to the stimuli on-screen compared to when they are exposed to them in a physical form. Tatler (2009), Tatler et al. (2011), Tonkin et al. (2011) and Suurmets et al. (2019) suggest that consumers tend to visually and cognitively process the visual stimuli differently depending on the stimuli presentation method. To date, only a limited number of scholars have studied this phenomenon (‘t Hart et al., 2009; Foulsham et al., 2011; Tonkin et al., 2011; Tatler et al., 2011; Suurmets et al., 2019) and actually chosen to challenge the generalizability of screen-based results to real-life settings.

According to most neuromarketing studies using eye-tracking, it is possible to generalize the results found by viewing images or pictures on a screen to a real-life setting. Therefore, the literature indicates that the assumption underlying most eye-tracking studies is that no difference is found in the way consumers processes stimuli (both visually and cognitively) in two completely different settings. In the study by Chandon, Hutchinson, Bradlow and Young (2009) and Huddleston, Behe, Minahan and Fernandez (2015), they test for and conclude on consumers in-store visual attention, yet both studies use designed planograms and/or displays (images) to explain this real-life behavior. Consequently, both studies assume that screen-based results are representative of how consumers act in a real-life context such as in-store or supermarkets without validating their results beyond the displays or even questioning the validity of the assumption. These are just two of a myriad of examples of studies that apply this assumption thereby disregarding the stimuli presentation method as a possible influencer.

As more than one study has already found this to be completely incorrect, not only the underlying assumption of the field is questioned but more importantly also the results of numerous articles that have relied on this assumption are being challenged. The difference found in attention allocation ist rather relevant and influential in both the past and more recent papers and it questions whether the results of screen viewing can be generalized to non-screen viewing (‘t Hart et al., 2009; Foulsham et al., 2011; Suurmets et al., 2019; Tatler et al., 2011; Tonkin et al., 2011). Furthermore, it underlines that there have clearly been researchers interested in the topic before, but it has faded away in the myriad of neuromarketing articles published over the years (Ulman, Cakar and Yildiz, 2015, p. 1272). Nevertheless, results like those found by Foulsham et al. (2011), Tatler et al. (2011), Tonkin et al. (2011) and most recently Suurmets et al. (2019) are expected to have notable and influential academic and managerial implications.

This emphasizes the necessity and urgency of more research investigating the phenomenon as Suurmets et al. (2019)’s study is just one of the most recent examples of how allocation of attention differs in two viewing conditions and the importance of visual attention in consumer behavior as well as in marketing. Therefore, it becomes imperative for researchers to test the robustness and validity of the assumption underlying much eye-tracking research and as a result this study will replicate the previous study conducted by Suurmets et al. (2019). It will apply the same setup and also extend the quantitative work by providing more insights into the effects of cognitive goals given that many authors have demonstrated a strong top-down influence of task on fixations specifically in natural scenes and natural tasks (Hayhoe, Shrivastava, Mruczek, & Pelz, 2003;

Foulsham et al., 2011; Pieters and Wedel, 2007; Tatler et al., 2011; Tonkin et al., 2011). However, to date, less is known about the impact of top-down factors such as having a task over attention allocation compared to bottom-up factors (Wedel and Pieters, 2008). Thus, there is a clear need to conduct more research on the top-down effects and the interplay between bottom-up and top-down to visual marketing stimuli. With the purpose of validating and extending previous findings, this study will challenge the aforementioned assumption and investigate the impact different cognitive goals has on the assumption by applying product packages as marketing stimuli. Product packages offer a great tool and wide enough surface to track and trace consumers visual attention through their eye movements, allowing to answer the following research question.

Research question:
How do consumers attend and process package designs when exposed to stimuli on screen versus in physical form and how do cognitive goals impact these viewing patterns?

THESIS STRUCTURE - Reader's Guide

In order for the reader to understand how the gap in literature and thereby the defined problem will be tackled, an overview of the structure is here outlined. An introduction has been presented above to provide a first glimpse on to the matter and define the background as well as the relevance of the topic in marketing. Then the narrower problem statement and research question have been presented. Following the introduction is the literature review which is divided into four main topics: (1) neuromarketing and eye-tracking; (2) consumer behavior; (3) visual attention; (4) packaging.

In the first section it is outlined how neuroscientific methods are increasingly being applied to marketing related issues as a result of the growing interest in looking into consumers' minds by understanding cognitive processes, consumer behavior and information processes. For this reason, a definition of neuromarketing is provided and the importance of eye-tracking in measuring consumers' attention is explained. Thereafter, eye-tracking technologies are investigated by defining the human eye with the related movements, eye-tracking equipment and research setups. The second section describes information processing, how consumers process stimuli and the ELM (elaboration likelihood model), then it moves to eye movements with the main classification into fixations and saccades. After that, a background on decision making is provided acknowledging that consumers have limited cognitive capability, they rely on visual attention to orient their decision behavior. The third section revolves around the relevance of visual attention in marketing is highlighted before going into depth with the two mechanisms of bottom-up and top-down processes. Furthermore, different stimuli presentation methods are discussed along with the differences between screen-based and real-life viewing conditions. In the last section, packages are discussed as important integrated marketing tools in virtue of their roles which are found in the ability to both protect the product and communicate its main features as well as value and benefits.

After the literature review, the philosophy of science is introduced by applying critical realism to this study. This is followed by the research design including the overall design, the quality evaluation criteria and hypotheses and is further followed by the methodology. The former covers the basis of a conclusive design, reliability and validity of the study, while the latter describes the setup of the experiment, including visual stimuli selection, areas of interest, dependent and independent variables, as well as pilot study. The subsequent section comprises the collection of data with the related presentation and analysis of the results obtained from testing the hypotheses. Thereafter, the results are examined in connection with the research question and the study objective. Moreover, the study and its result are discussed in terms of managerial and academic implications, presenting the advantages and positive outcomes of the research but also the involved risks and precautions to account for. The quality of the experiment is then evaluated and discussed based on replicability, reliability and validity. Subsequently, the discussion shifts to the limitations and ends with the conclusion of the whole study tracing relevant points and areas where further research is required.

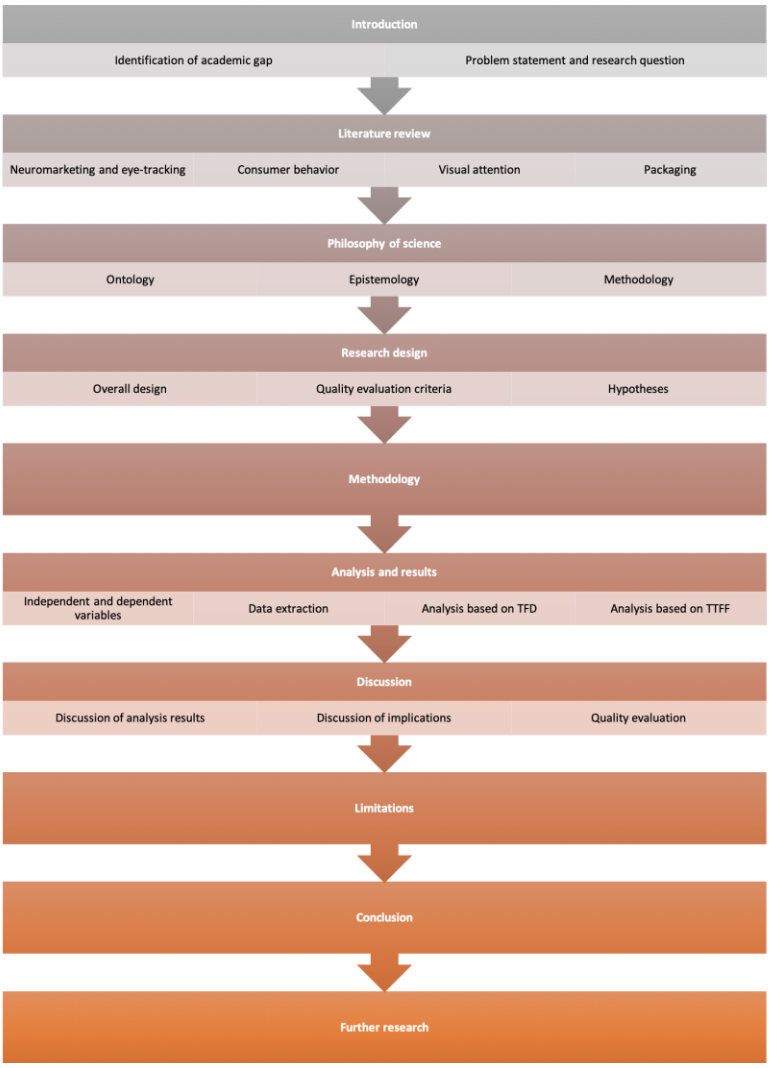


Figure 1: Graphical readers guide. Authors own depiction.

2. LITERATURE REVIEW

The literature review will cover various aspects suggesting that neuromarketing contributes to the development of sturdy explanations of how marketing affects consumer behavior. The neuroscientific method (eye-tracking) applied allows for extraction of information which benefits marketing as it establishes preference formation, choice, sales and learning (section 1). The review also reveals that consumers process (visual) information differently as decisions are generally based on different stages of interaction between them and a stimulus. Nevertheless, little is known about how consumers visually and cognitively process stimuli in physical form compared to stimuli shown on a screen and much less is even known about the outcome of the interaction between the physical form and consumers (section 2). To understand how consumers process information and attend to the stimuli visually and cognitively, it is necessary to define the human eye and its basic movements as eye movements are good behavioral measures of both constructs. Therefore, eye movements are found to be tightly connected to higher order cognitive processes (section 2).

Literature on visual attention suggests that it exerts an essential impact on consumer information processing and behavior justifying its great importance in the field of marketing (section 3). This is further supported by the fact that consumers attend to objects differently when they are presented on the screen compared to real life. Therefore, it is highly relevant to account for the differences in attention allocation to a stimulus in order to increase the validity of the results and predictability of consumer behavior (section 3). Given the central role played by visual attention in influencing consumer behavior and purchasing decision, product packaging and package design represent an increasing focus for companies in the FMCG industry due to its function as a integrated marketing tool (section 4). Packaging holds two distinctive roles (protective and communicative) which makes it a key means in breaking through the competitive clutter, meaning that it can make a product stand out from the overcrowded shelves in a landscape where products are increasingly similar one to the other (section 4).

2.1 Neuromarketing and eye-tracking

Research within marketing has for far too long relied solely on conventional techniques such as surveys and interviews to understand and predict consumer behavior, thus compromising the effectiveness of their marketing initiatives as these techniques are generally believed to have a minimal effect (Kumar, Mathur and Jauhari, 2016; Lim, 2018; Touhami et al., 2011). The reason for the minimal effect can be traced back to the fact that most consumers cannot explain their decision to purchase a product due to the fact that 95% of the decision-making processes occurs subconsciously in the case of consumer goods (Ungureanu, Lupu, Cadar and Prodan, 2017). This limits the value of asking consumers why they buy a specific product or what they want as the majority of conventional techniques does, making it necessary to apply alternative techniques and theories. Conventional theories and techniques are now increasingly being supported by neuroscientific theories and methods that do not require effortful cognitive processes or conscious active participation (Bosak, 2013; Kumar et al., 2016). The application of neuroscientific techniques and theories to marketing related problems is said to be a new way of studying marketing. These problems are concerned with branding, advertising effectiveness, shopper decision making, online experience, entertainment effectiveness and product design and innovation (Bosak, 2013). Product design and innovation are considerably important for this study as neuromarketing can measure the unconscious attention and reaction of consumers to new product ideas and/or packaging designs (ibid).

Acceptance of neuromarketing is upheld by the fact that it is considered the most effective way of explaining and measuring the impact of marketing on consumer behavior as it provides insights into the subconscious mental processes, besides improving marketing strategies, driving new marketing theories and/or supplementing existing theories in marketing and related disciplines (Bosak, 2013; Lim, 2018). In fact, neuromarketing combines what is known from two different domains, marketing and neuroscience, making it interdisciplinary and providing several application possibilities (Bosak 2013; Lim, 2018). Given the combined knowledge of the two domains, it is possible to study the variety of reactions of human behavior. More specifically, it is possible to investigate what consumers really think and how they reach their decisions (Bosak, 2013), giving researchers and managers access to information that would otherwise be concealed or not readily available to them (Kumar et al., 2016; Lim, 2018).

These neuroscientific measurement techniques that are used in neuromarketing, can be broadly classified into two categories: *neurometrics* are measurement techniques focused on changes in brain activity while *biometrics* are measurement techniques focused on physical changes (on/in the body) meaning outside the brain. The neurometrics techniques consist of electro-encephalo-graphy (EEG), magnetoencephalography (MEG), functional magnetic resonance imaging (fMRI), positron emission tomography (PET) and steady state topography (SST). The biometrics measures include facial expressions, galvanic skin response (GSR), '*facial*' electromyography ('f'EMG), eye tracking, pupilometer and electrocardiography (ECG) (Clement, 2018; Lim, 2018; Touhami et. al, 2011). Measurement techniques and technologies like these have and will continue to expand our knowledge of how consumers take decisions and how marketers can influence consumers decisions (Kumar et al., 2016).

Summing up, Lim (2018) states: the aim of neuromarketing is to apply neuroscience concepts and techniques and link them with methods and theories from marketing and related domains in order to establish reasonable and well-grounded evidence of the influence of marketing on target consumer behavior. To date, there are several definitions of what neuromarketing really is or what it implies. A more comprehensive definition is unfolded below:

“Neuromarketing is an interdisciplinary branch of knowledge that is predicated on the use of neuroscientific concepts, theories, and methods (or tools and techniques to record brain and neural activity during behavior) to study the brain and nervous system in the pursuit of understanding instinctive (or natural) human behavior, in terms of cognitions and emotions, conscious and unconscious, in response to a marketing stimulus (e.g., markets, marketing exchanges), whereby the knowledge resulting from a neuromarketing investigation contributes to the development and advancement of marketing theory and the planning and implementation of marketing strategies, with (e.g., to make a sale) and without (e.g., to influence behavior for a social good) commercial marketing goals” (Lim, 2018).

2.1.1. Eye-tracking

As previously stated, one neuroscientific measurement technique is eye-tracking. It has been widely acknowledged that visual attention holds a central role in consumers’ cognitive processes and behavior (Clement et al., 2013; Gidlöf et al., 2017) and that eye movements accurately mirror them. This has lead eye-tracking to be increasingly engaged not only in academia but also for commercial purposes (Nikolaus and Lipfert 2012). Accordingly, literature suggests that the eye and eye movements play an important role when it comes to understanding information processing (information acquisition) and visual attention in relation to certain stimuli. In fact, several eye-tracking studies proved that eye movements accurately reflect the cognitive processes and behavior that trigger consumers visual attention, thus allowing researchers to better understand how consumers process visual stimuli and the effectiveness of marketing stimuli (Chandon et. al, 2009; Clement et. al, 2013; Mehmedovic et al., 2017; Nikolaus and Lipfert, 2012). Consequently, it is also recognized that visual attention has a central role in determining purchasing behavior (Nikolaus amd Lipfert, 2012; Clement, et. al 2013; Gidlöf et al., 2017) which could help explain the increasing research on eye movements in academia (Nikolaus and Lipfert, 2012, p. 338).

The popularity of eye-tracking is not a surprise given that approximately 25% of brain functions are related to vision (Kumar et al., 2016). Therefore, studying consumers vision, and more specifically their visual attention, by using eye-trackers can provide more precise and relevant answers than using fMRI (Karmarkar and Plassmann, 2019). Eye-tracking offers new opportunities to accurately describe consumers information processing and visual attention ultimately describing preferences and decision making, contributing to the existing theories, as it represents a detailed measurement approach to analysing natural attentional flow. On that account, it has been used to observe consumer behavior in regard to real-life stimuli and the related consumer choice, such as when consumer is exposed to products at the point of purchase. This allows researchers and marketers to study variables such as display characteristics or package design which are known to have the ability to influence consumer attention in the environment but are still insufficiently researched (Tatler et al. 2011; Lim, 2018).

Over time, eye-tracking technology has gained popularity and is increasingly being employed for commercial purposes in order to evaluate and determine the degree of effectiveness of visual marketing (Wedel and Pieters, 2006). Current neuromarketing research has recognised the high potential of studying eye movements and gaze guidance in helping companies to survive the rising competition for the shelfspace (Lim, 2018), given that visual attention is predominantly an unconscious phenomenon driven by eye movements (Mehmedovic et al., 2017). As a result, numerous studies are starting to adopt eye-tracking equipment to record and measure consumers' eye movements in order to gather relevant information about what guides selection and attention to certain points of interest (Kumar et al., 2016). More specifically, eye-tracking allows for identification and recording of both fixations and saccades as well as the pattern between them (scan path) to explain consumer behavior when viewing a certain marketing stimulus, thereby answering neurological marketing-related problems (Lim, 2018). Consequently, eye-tracking has been widely accepted as a valid and adequate measuring method of visual attention.

Investigating and mapping out consumers pattern of fixations and saccades on marketing stimuli can generate realistic and relevant evidence of the locations people are most likely to fixate on. This makes eye-tracking a strong prediction and evaluation tool for marketing effectiveness (Lim, 2018) as well as unlocking many other application possibilities in the business world (Kumar et al., 2016). By using eye-tracking it is possible to identify and measure not only fixations and saccades but also other variables such as pupil dilation and eyelid closure, which have been considered indicators for attention, emotions and arousal (ibid). Over the years, the technology of eye tracking has progressed by becoming more advanced, resulting in more accurate and stable, and thus consistent data as well as improvements in sampling rates (Fu, Wei, Camastra, Arico and Sheng, 2016) while still being affordable (Wedel and Pieters, 2006).

Type	**Duration (ms)**	**Amplitude**	**Velocity**
Fixation	200-300	-	-
Saccade	30-80	4-20°	30-500° / s

Table 1: The characteristics of fixations and saccades (Holmqvist et al., 2011)

2.1.2. Eye trackers

With the help of specialized hardware and software, it is possible to precisely record gaze patterns to assess how visual attention is addressed (Meyerding and Merz, 2018). The very first eye trackers were developed in the late 19th century. They were cumbersome, challenging to build and uncomfortable for whoever was wearing them. Only during the early 1900s less invasive eye trackers devices and techniques were introduced by Dodge and Cline (1901). They developed what has become nowadays the predominant approach to record and examine eye movements. This has led to design and build more refined eye-trackers which are built on specific and progressing measuring systems (Holmqvist et al., 2011), whose underlying principle consists of measuring the pupil-corneal reflection. A light coming from an external source (typically infrared light source) is projected on the eye in order to avoid any natural light reflection. As a result, the infrared light is reflected back on different points of the eye, including the cornea and lens, and the reflection from the cornea, which is also referred to as "glint", is the brightest one (ibid). When the light is reflected back from the pupil, it passes through it, resulting in a bright pupil. In the majority of common cases, the pupil appears dark. There is no consent nor study on which system provides better data quality which rather is dependent upon the quality of the camera and other components of the eye-tracker.

2.1.3. Types of eye-trackers

Even though eye-trackers are characterised by the same pupil-corneal reflection method, there are several different types. Starting from some basic setups, manufactures can create hardware setups combinations allowing researchers and marketers to build various eye-trackers from the same basic set of devices. According to Holmqvist et al. (2011) there are three types of eye-trackers which can be defined according to where the eye camera and illumination are positioned but mainly with respect to the resulting type of data produced and the way it can be analysed. The underlying technology comprises infrared illumination, a camera recording the eye movements and an additional scene camera in case of head-mounted eye-tracking devices.

(1) Static eye-tracker (stationary): both the eye camera and the illumination source are located in front of the participant and stimuli are typically displayed on a monitor. This type can be subdivided into *tower-mounted* eye-trackers, which set limitations to head movements and are closely positioned to the subject, and *remote* eye-trackers, which implies some distance from the subject.

(2) Mobile eye-tracker (also defined as head-mounted eye-tracker by Holmqvist et al., (2011) or portable): both the eye camera and the illumination source are located on the head of the test subjects, they can be incorporated in a helmet or in a pair of glasses. A scene camera is engaged to record the stimulus and where the eyes move.

(3) Head-tracker: less common than the first two, it entails the addition of a head tracker to a mobile eye-tracker in order to individualise the head position. This allows a far easier analysis of the data generated throughout the eye-tracking study.

The difference of the two variants of *static eye-tracker*s is reflected in the difference in the quality of the data. The more restrained the head movements, the better the data. In tower-mounted eye-trackers, the camera is inside a box positioned on top of the eye-tracker, while in remote eye-trackers the camera is near the monitor that shows the stimuli. The distance between the participant and the eye-tracker allows for imperfections in gaze monitoring due to head movements and lower resolution of the device. Remote eye-trackers are less invasive and easier to use which explains why they are preferred by many users, even though they generate less accurate data and require some time to resume measuring eye movement in case the participants is distracted and divert the gaze away from the screen.

Mobile eye-trackers consist of cameras installed on an accessory worn by the subject. They give mobility and therefore allow participants to be tested in a real-life setting and activity such as buying grocery at the supermarket or driving. The additional scene camera is able to film at the eye height and it overlaps the gaze reference point on the scene video which presents a crosshair cursor at the gaze position indicating where the subjects are looking at. By combining mobile eye-tracking with magnetic head tracking, researchers can trace associations between the objects in the scene and the collected data samples. On that account, the motion of the head is measured, along with the motion of the eyes. Moreover, it would be possible to measure the surfaces in the recording environment as well.

One feature that distinguishes eye trackers, besides mono/binocularity (Appendix 1), is the sampling rate, i.e. rate at which they capture the location of the eye. The basic and most diffused sampling rate is the low-resolution rate which is 50Hz/sec. Eye trackers characterised by this sampling rate are more suitable merely for measuring fixations. While high-resolution sampling rate is around 1250Hz/sec which enables detailed analysis of both fixations and saccades. High resolution eye-trackers can detect the speed of eye movements as well as the level of accuracy at which an eye can stop at a targeted stimulus. Generally, for marketing research low resolution eye-trackers are mostly used since researchers mainly study what people look at by means of fixation measures.

There are some eye-tracking properties and risks that eye-tracker users should be aware of. Lightning conditions, sunlight, lamps and brightness of the stimulus can interfere in the measurement of eye movements as they can lead to optic artefacts, impresion and data loss. Vibrations can generate variable noise and low precision of the recording. While lack or insufficiency of scientific competence, knowledge and experience of individuals applying these techniques can cause time-consuming studies, there is also the risk of misinterpreting the data and therefore compromise the results (Clement, 2018; Holmqvist et al., 2011). In conclusion, eye-trackers are advanced tools that generate streams of data and can be classified in different types, depending on the purpose of their use, the combination of hardware components and the software properties. All of these, including the resolution of the camera, contributes to the quality of the data produced and determine the kind of analysis the recorded data can undergo. Therefore, gaining basic knowledge about eye-tracking is highly relevant for the experiment design, subjects test, data recording and analysis (Holmqvist et al., 2011).

2.1.4. Eye-tracking as a new opportunity for package designs

More specific to the study at hand, eye-tracking is highly relevant for studying visual attention to package design, and thus it provides a new opportunity to study packaging. This is supported by the evident lack of research and knowledge related to the use of packaging as a marketing stimulus as well as elements of package designs and their impact on consumers purchasing decisions. As a result, investigation into this rather under researched issue is required in order to understand which package element(s) trigger attention and possibly enhance the buying process (Clement et. al, 2013; Mehmedovic et al., 2017). To fill this gap in literature and understand the rationale behind, eye-tracking can be used to objectively and accurately measure visual attention to specific packages and their elements.

According to Mehmedovic et al. (2017), the design of a package is to be considered an important visual marketing tool, yet it is only partially understood. It is known that packaging can help a product to stand out from the crowd and consumers will most likely purchase the products which are more noticeable and attract their attention (Clement, 2007; Mehmedovic et al., 2017; Rettie and Brewer, 2000). Therefore, studies applying eye-tracking to better understand this relationship can systematically review packaging designs and the elements in the design in order to comprehend what captures consumers visual attention and interest. This could allow to reach the most optimal (consumer oriented) design in the marketplace where breaking through the competitive clutter is crucial.

Consequently, the eye-tracking technology is capable of providing valuable insights into important issues (Mehmedovic et al., 2017). Prior research has shown that eye-tracking can play a crucial role in assessing, understanding and advancing existing package designs (Nikolaus and Lipfert, 2012; Rundh, 2016). In addition, the findings of Karmarkar and Plassmann (2019) extend this to include the significant role of eye tracking in offering explicit or precise recommendations about how to apply certain design elements in fields like food packaging. Thus, eye-tracking has the ability to create new opportunities for package designs as it is the only unobtrusive tool for measuring package visibility and visibility is said to be vital in package design and competitive landscape (Tobiipro, n.d.).

The application of this technique is considered an improvement and opportunity for the field of marketing compared to applying interviews or surveys as the technology has provided revolutionary results (Tobiipro, n.d.). This would explain the recent increase in the amount of eye-tracking experiments that investigate packaging and package designs (Clement et. al, 2013; Mehmedovic et al., 2017; Nikolaus and Lipfert, 2012; Tonkin et al., 2011), consequently providing the much-needed research within packaging which is still rather scarce when compared to advertising (Mehmedovic et al., 2017).

2.1.5. Ethical considerations in neuromarketing

Although the application of neuroscience in the field of marketing seems to have several advantages and the ability to provide new opportunities on many fronts (e.g. advertisement, packaging, banners), it has raised ethical issues. Given that marketing serves a double function of supporting the design of the product based on consumers' needs and compatibility with their preferences, on one hand, and facilitating and possibly manipulating consumers' choice in order to maximize sales, on the other hand, many concerns have been brought up regarding neuromarketing (Ariely and Berns, 2010; Murphy et al., 2008). More specifically, these concerns arise as there is the possibility that through the application of neuroscientific methods and thereby neuromarketing consumers can be manipulated consciously and subconsciously.

The two main areas of concern are related to how information is collected in terms of boundaries of privacy and how information is interpreted and handled in terms of the scientific accuracy, validity and reliability of the findings. When conducting a neuroscientific study, it is fundamental to ensure protection for the participants to tackle any problem of privacy, confidentiality, vulnerability and informed consent (Lim, 2018). The concern is whether the information obtained through neuroscientific methods would be exploited for purposes outside of the company's tested task (Ariely and Berns, 2010) or whether the methods will give researchers a way on how to manipulate consumers without any detection of it (Murphy et al., 2008). The former is especially intensified when the adequate protection measures are not taken and thus researchers do not ensure that participants' privacy and informed consent are preserved (Ulman et al., 2015).

This issue can be mitigated by offering transparency into the purpose and procedures of the study, explaining the risks and benefits involved, informing how the collected data will be used and ensuring that private information and preferences outside of the intended scope will not be disclosed to the public sphere (Ariely and Berns, 2010). Moreover, according to Ulman et al. (2015), it is crucial to protect vulnerable groups. This group includes children, prisoners, psychologically unstable people, patients, addicts and people affected by neurological disease, need special care as they are believed to be more easily manipulated and affected in a negative way by the application of the neuroscientific technology (Lim, 2018; Ulman et al., 2015).

Scientific validity, reliability and transparency are also subject to ethical questioning. In terms of validity, although many different spheres of consumer behavior and decision making have been explored, the number of research and studies involving the empirical foundations of neuromarketing is still limited. Reliability is assessed based on the scientific competences of the researchers. Therefore, e.g. classifying brain responses into specific reactions such as "excitement", "arousal", "engagement", "disgust", "frustration" etc., using predetermined parameters and software is oversimplifying and highly questionable. The obtained data should be analyzed with more appropriate and tailored methods for the specific study (Lim, 2018; Ulman et al., 2015). Likewise, scientific expertise and knowledge are fundamental for interpreting neuroscientific findings in order to transparently provide a valid and meaningful understanding of the results (Ulman et al., 2015). In absence of adequate competence, under- or overestimation of the neuroscientific observations may occur (Lim, 2018). Lastly, ethical concern can be raised in terms of misalignment between the interests of the company, on one end, and the consumers, on the other. In fact, companies aim to develop, produce and sell products that consumers are interested in and therefore will buy. At the same time, companies aim to maximize their profits, sometimes at the expense of the consumers. On that account, understanding consumer behavior and preference can be exploited to achieve a mutual interest of companies and consumers or it can be exploited by the companies in their pure lucrative interest but at the expense of the consumer (Ariely and Berns, 2010).

In order to mitigate the ethical issues outlined above, participants should be given the suitable protection and be informed about their rights as well as the risks and benefits involved. In terms of issues related to scientific validity, reliability and transparency, researchers should gain the adequate knowledge and competences before applying neuroscientific methods to marketing studies. This implies acknowledging the respective limitations and implications in conducting the study, analysing the findings and developing the conclusions (Lim, 2018). Primarily, neuromarketing should have as ultimate goal the welfare and health of people (Ulman et al., 2015). Thus, researchers should seek to satisfy consumers' needs avoiding any psychological and financial harms (Murphy et al., 2008). It is an ethical duty of researchers and marketers to engage in clear communication and truthful advertising as it contributes to educate the public, ensure scientific transparency, promote positive sentiment around the use of neuromarketing methods (Lim, 2018; Murphy et al., 2008; Ulman et al., 2015). Additionally, neuroscientific methods should be applied to marketing related problems only when the benefits overweight the risks (Lim, 2018).

2.2. Consumer behavior

2.2.1. Information Processing

Researchers and marketers have spent enormous resources on predicting, understanding and influencing consumer behavior. An important part of this is to get an in-depth understanding of the different stages involved in consumer information processing. The underlying concept is that consumer behavior and choice process are strongly influenced by visual search of information (Wästlung, Shams and Otterbring, 2018). It is widely accepted that the visual search is constrained due to human limited cognitive ability which implies limited capacity of perceptual stimuli processing and visual attention (Clement et al., 2013). Therefore, it is incorrect to believe that all information in a visual field can be processed simultaneously by our eyes as there is too much information available to process. As a result, consumers need to select what is important to process which normally results in moving their eyes to locations of interest to retrieve information (Chen and Choi, 2008). It is imperative to understand how consumers acquire and process information in order to better understand consumers visual attention. Investigation into information acquisition and processing that consumers experience on cognitive level when looking at an image or searching for an object has been conducted analyzing eye-movements (ibid). This has highlighted the tight link between information processing and eye movement.

One way to understand consumer information processing is through the well-known model called Elaboration Likelihood Model (ELM). The model represents a framework for information processing in relation to explaining advertising effects on consumers (Kitchen, Kerr, Schultz, McColl and Pals, 2014). It has been applied by marketing researchers to draw predictions on the type of information consumers would most likely direct their attention to and acquire through cognitive processes. In addition, the model has been used to examine the effect of consumers involvement and visual attention to products (Behe, Bae, Huddleston and Sage, 2015). Applying this dual-process framework to package designs rather than advertising suggests an extension of the theory to include possible differences in the way packages are processed by individuals depending on the information processing route they follow (Orth, Campana and Malkewitz, 2010). More specifically, this implies an investigation into the elaboration process of package design by looking into the two possible information processing routes namely the central and the peripheral route depending on the level of involvement which has also been linked to visual attention (Behe et al., 2015). Therefore, subject involvement becomes essential in understanding and explaining the chosen route (Te'eni-harari, Lampert and Lehman-Wilzig, 2007).

The two information processing routes can be placed on a continuum with the peripheral route on one end and the central route on the other, both representing the possibility or probability of cognitive effort being employed to process a specific message (Kitchen et al., 2014). Therefore, when processing happens via the peripheral route little cognitive effort is required and it relies on cues that are easy to process. In this case, it is more concerned with the attractiveness of the visual content and somewhat unaffected by its quality caused by the individual's low involvement. Whereas, when processing occurs via the central route information processing is high and considerable cognitive efforts are required for consumers to attend the message, process it and generate a response based on their judgement of quality (Kitchen et al., 2014; Orth et al., 2010; Te'eni-harari et al., 2007). Moreover, a central route is engaged when the individual's involvement is high. In both instances, it is important to determine the level of motivation and ability of the individual to processes the information in order to determine the involvement level and the information processing route. However, it is important to notice that the overall effectiveness of consumers information processing is additionally influenced by many other factors such as personal characteristics, content of the stimuli, settings and nature of the task (Skubisz, 2017).

The elaboration continuum has been criticized as it has been proven several times that the ELM is incapable of explaining movement along this continuum and between the two information processing routes making it rather inadequate. This has resulted in the belief that attitude change really results from both routes (Kitchen et al., 2014). Another issue that has been raised by several writers is that the core point of the model stands in integrating contextual factors and individual variables to explain information processing and yet it falls short on explaining the links, how the processes vary and how to make predictions about the results. The processes may potentially explain a set of different situations which might come from attributing multiple meanings to the variables. Although this can be considered an advantage of the ELM, it causes the model to be hard to test and falsify. Therefore, the issue of falsification undermines the theoretical utility of the model (ibid). Consequently, the argument stands in the model's framework being questionable (Kitchen et al., 2014) especially considering that the shopping environment (in particular the digital environment) and the way consumers process stimuli has changed a lot since its developments resulting in a drastic change in behavior and a possible change in the way consumers process things (Tonkin et al., 2011).

Based on information processing models, people would generally formulate decisions through different stages of interaction between themselves and a stimulus (Skubisz, 2017) which is assumed to apply to the majority of purchasing decisions. According to Skubisz (2017), these stages are described as following:

1. the subject must be exposed to a stimulus
2. attention should focus on the stimulus
3. adequate cognitive resources should be devoted to remembering the stimulus
4. understand the stimulus
5. generate a response in accordance to the context and stimulus

The *outcome* that marketers are usually trying to reach is a purchasing decision. Therefore, it can be argued that by extending the ELM to package design, it would be possible to understand the way consumers can either attentively attend to the package and investigate it (via central route using arguments), which in some cases will be predictive of an individual's subsequent behavior, or just briefly notice it or accidently come across the package design (via peripheral route - using cues). This may or may not impact their attitude and perception of desirability of the item. In this thesis, emphasis will be placed on exposing subjects to the stimuli (packages) and analyzing their visual attention to the package elements, classified into different areas of interest (AOIs). As aforementioned, not all input or information can be processed at once, as a result consumer select where and what to look at. Given that visual selection is performed by eye movements, it is critical to understand the underlying mechanisms of these eye movements.

2.2.2. Eye movements

Eye movements are a good behavioral measure of visual attention and information acquisition because they are tightly connected to higher order cognitive processes (Kumar et al., 2016). We change the position of our eyes to gather information and this information is used to achieve behavioral goals. More specifically, eye movements are performed in order for the fovea to provide information about the settings or surroundings thereby improving information acquisition or decreasing uncertainty around the visual stimulus (Tatler et al., 2011)

Eye movements perform overt selections, thus overt attention occurs when the eyes directly attend to an object while covert selections are performed by visual attention, therefore the objects are attended to in a way that is not immediately apparent to everybody else (Chen & Choi, 2008). Therefore, to understand the principles of visual attention and information processing, it is necessary to define the human eye and its basic movements. The light comes in the eye through the pupil, the rays are reflected into the lens of the eye and the image is projected upside down onto the back of the eye, called retina. This is covered by a high number of light-sensitive photoreceptors, cones and rods, which convert the incoming light into electrical signals which are then sent along the optic nerve to the brain for further processing. Cones are responsible for our color vision and are sensitive to visual detail, while rods are highly sensitive to light and are optimized for dim light settings (Holmqvist et al., 2011). As it has already been argued, it is widely recognized that eye movements reflect cognitive processes (Hayhoe & Ballard, 2005). Consequently, they are considered to be a powerful research tool to understand how the brain works. We as human beings rely on vision and focus our attention in order to generate prompt and responsive actions to what happens around us (Leigh and Zee, 2015).

Eye movements can thus be classified as:

- Fixations: Fixations are short time periods during which eyes are approximately stationary on a single location and information acquisition takes place. They normally range from 200 ms to 350 ms depending on whether the participant or consumer are reading a text or viewing a scene (Kumar et al., 2016; Ricordel, Wang, Da Silva and Callet, 2016).
- Saccades: Saccades represent quick eye movements between fixations. They normally take between 30 and 80 ms before a new target has been chosen (Holmqvist et al., 2011).
- Scan Path: A scan path is represented by a series of fixations and saccades from consumers eye-movements (Kumar et al., 2016: 6).

During visual search in an environment the eyes move around and are sequentially positioned on features and areas of interest generating a scan path of vision. When eyes are fixated on a specific point, vision fades if the image is constantly stabilized on the retina because the visual system accustoms its reactions to constant stimuli

(Leigh and Zee, 2015). Consequently, we make small involuntary eye movements when we fixate on a location of the image in order to preserve high visual acuity. These movements, known as saccades, occur intermittently, on average two or three times per second (Kowler, 2011). It is generally considered that we are blind during saccades and therefore we do not acquire any information (Holmqvist et al., 2011).

Even though the close relationship between eye movements and cognitive processes has been greatly investigated, it is only in recent times that a more coherent and deep understanding has been achieved regarding the intricate function of eye movements in cognitive processes (Hayhoe & Ballard, 2005).
This has led to the classification of fixation patterns based on guiding factors. On one hand, eye movements are argued to be guided by the image properties, i.e. salience. On the other hand, eye movements are believed to be driven by task which operates as an external source of internal computations. There is a tendency for fixations to be highly connected to task-relevant areas of the scene (ibid), where viewers can acquire the needed information, following a "just-in-time" strategy, as defined by Ballard, Hayhoe & Pels (1995) and Hayhoe, et al. (2003). In natural tasks, eye movements patterns are usually learnt. More specifically, people must learn which areas are optimal to acquire specific information from. For example, when making a tea, subjects must have learnt which locations of the scene are relevant, because fixations are placed on the spout of the teapot and no fixations are located on irrelevant points (Hayhoe and Ballard, 2005).

Accordingly, the eyes should not be considered as passive receivers, rather they should be seen as closely related to complex motor tasks. Eye movements appear to be tightly coupled, both temporally and spatially, to motor actions ignited by a specific task (Land, Mennie and Rusted, 1999). However, the accuracy and specificity of the information collected during fixations is determined not only by an ongoing task, but also by the fixation duration, whose variation depend on specific information necessary for a particular point in the task (Hayhoe et al., 2003).

2.3. Visual attention

2.3.1 Importance of Visual Attention in Marketing

The human visual system is automatically engaged in conducting natural daily tasks. It is central in a wide range of functions, from processing basic information to decision making (Wedel and Pieters, 2008). Thus, vision mirrors a rapid, largely automatic information collection and interpretation system. It is the most developed sense in humans and therefore it acts as a valuable means that connects people to the world by allowing them to receive stimuli, process information, and generate a reaction or action (Land and Tatler, 2009). It affects consumer behavior by contributing to preference selection, decision making and learning (in particular memory) which highlights the important role visual attention has in marketing. Consumers are exposed to different stimuli every day comprising a combination of sources of information, e.g. textual and pictorial elements, and the eyes guide them through the stimuli by searching, exploring and making decisions (Wedel and Pieters, 2006). Eye-movements are employed across the scenes and they provide better understanding of the rapid and automatic perception process (Wedel and Pieters, 2008).

According to Wedel and Pieters (2008), attention advances or progresses speed, maintenance and accuracy of mental as well as behavioral processes over time. It is commonly considered as an early gatekeeper that serves as an information filter. However, there is more to this since attention has many different functions such as selection, preparation and maintenance. It simultaneously enhances the processing of some objects or information and suppresses others, with the former relating to the inclusion while the latter relating to exclusion. Despite visual attention being considered a gatekeeper and information filter by some authors, psychological research suggests that visual attention is more than, as it mirrors higher-order cognitive processing and reflects actual behavior. However, capturing and retaining visual attention in a competitive environment that is mostly visual is difficult due to the complexity in breaking through the levels of visual clutter (Pieters and Wedel, 2007). For this reason, companies try to make their products relevant and stand out to help consumers find them quickly and ease their purchasing choice (van der Lans, Pieters and Wedel, 2008). Being capable of attracting attention first is considered a key step towards a potential purchase (Clement et al., 2013).

With a competitive environment that is mostly visual and visibility of products is key to attract consumers' attention, visual marketing is an alternative way to market a product. Visual marketing is defined as the application of commercial and non-commercial visual cues and signs in order to connect with consumers through a reciprocal beneficial relationship (Pieters and Wedel, 2007). The importance of visual attention in marketing can be traced to the effectiveness of visually communicating data and information, influencing consumer purchasing decision. Thus, it is relevant to closely understand what and how consumers see. By tracking this, companies will be able to optimize profitability (ibid). This could explain why in recent years eye-movement research and visual attention studies have grown and gained more interest.

2.3.2. Bottom-up and Top-down Processes

In order to understand eye movements and thus the mechanisms guiding eyes and patterns of fixations in everyday life, it is relevant to define bottom-up and top-down processing and trace a distinction between the two (Land and Tatler, 2009; Nyström and Holmqvist, 2008). Bottom-up processing is characterized as gaze guidance being driven by properties of the image and more specifically by low-level features such as contrast, color, luminance and edge density (Nyström and Holmqvist, 2008). Eye-movements are controlled by the image salience, defined as the sum of the visually conspicuous image properties. Bottom-up processing is generally considered a fast and involuntary process which ignores higher cognitive processes. Whereas, top-down processing can be considered a semantic interpretation of the scene (Land and Tatler, 2009). It emphasizes that eye-movements are driven by individual traits of the consumer and influenced by the goals of the current behaviour (Wedel and Pieters, 2008) rather than by just image features.

2.3.3. Bottom-up mechanisms

Bottom-up factors are features that determine the perceptual salience of a scene or image (Pieters and Wedel, 2004). They capture attention in a rapid and automatic way and can drive the allocation of attention (Tatler et al., 2011). A salience-driven framework of eye-movement control is represented by the salience map. The map constitutes a series of low-level features of the image that is extracted in the "pre-attentive" visual search that occurs in the early stages of the visual pathway. These features are generally extracted in parallel across the retina by low-level detectors and they comprise color, brightness and orientation at different spatial scales. This multiscale low-level feature extraction leads to a feature map for each of the feature contrast (color contrast, brightness contrast, orientation contrast). The individual feature maps are then combined additively to create a single salience map (Itti & Koch, 2001), where salience, in terms of conspicuity, is the only element that initiates saccades and drives attention allocation to locations in the scene based on a "winner-takes-all" principle. Thus, only one point or feature at a time becomes the target of covert attention. To avoid attention to be stuck at the most salient locus, inhibition of return is applied to every attended point. Once the inhibition is removed, the viewer is free to revisit salient targets. According to this theory attention will be allocated to the most salient location again, suggesting an increased tendency to refixate (Land and Tatler, 2009).

Models and theories based on bottom-up factors, such as the salience map, can explain aspects of how attention is allocated. In particular, the relevance of the salience map stands in its ability to individualize the visually conspicuous spots and predict human search behavior, resonating in a superficial way the patterns of eye movements (Tatler et al., 2011). Nonetheless, several limitations and concerns have been raised regarding salience models explaining gaze guidance. Studies on bottom-up features have explained how the visual system can select fixation targets based on image conspicuity by examining computationally the salience at points that were fixated by viewers and comparing it with the salience at randomly selected fixation points (control locations) in the same scene. This comparison has shown strong differences between the two (Parkhurst, Law and Niebur, 2002). Under specific conditions image salience is good at explaining how people orient their attention. However, evidence shows that this applies only to simple visual search condition or when the target has simple visual features. Thus, it is important to evaluate whether this stands also in the presence of complex natural scenes where there is a greater range of information (Tatler et al., 2011). According to Einhäuser, Spain and Perona's (2008) findings, object-level information is better at distinguishing fixated and control locations rather than image salience, while according to Tatler and Vincent (2009), individual agendas based on which people move their eyes can be used to distinguish between fixated and control locations. Consequently, the saliency model is questioned and disproven to some extent. In order to accept salience-based models it is necessary to account for a set of assumptions that are source of conceptual and empirical concerns.

According to Tatler et al. (2011) these assumptions include pre-attentive features driving fixation selection, a default bottom-up mode of looking, eccentricity and oculomotor tendencies and inhibition of return.

- *pre-attentive features drive fixation selection*: there is a difference between low-level features content for fixated locations and for control locations. However, this difference tends to be small, suggesting a relatively weak correlation between fixations and features.
- there is a *default bottom-up mode of looking*: task-free, stimulus-driven viewing approach. The underlying assumption is that the viewers are given no task and therefore are free to choose their own internal agendas (Tatler, Baddeley & Gilchrist, 2005). This implies that it would hard to define whether attention is driven purely by the stimulus features when no precise task is given to the viewer or the internal agenda of the individual would override the stimulus features.
- target selection from the map:
    - *eccentricity and oculomotor tendencies*

  correlations between features and fixations are found only for small amplitude saccades. This suggests that there are limits in the peripheral sampling undermining the idea that all features can be extracted across the whole visual scene disregarding where they are located. Moreover, there are some tendencies in the way people move their eyes. They tend to allocate eye movements to targets in nearby locations rather than distant locations; horizontal saccades are more frequent than vertical ones, while oblique ones are the least frequent (Land and Tatler, 2009).
    - *inhibition of return* prevents attention to be stuck at the most salient point. However, it is unclear whether this happens because of inhibitory mechanisms or because of memory of previously fixated locations.

It is undoubtable that salient, visually conspicuous objects pop out and catch the eye, but it is very questionable whether image salience can be defined as an important and only determinant that guide eye-movements in our everyday life (Ibid).

2.3.4. Top-down mechanisms

Another determinant that is said to guide eye-movements is individual cognitive traits. Cognitive activity plays an important role in how people look at scenes (Land and Tatler, 2009). In line with Yarbus' study, when giving certain tasks to viewers, they are critically influenced by them (Nyström and Holmqvist, 2008). Yarbus (1967)'s findings revealed the relevant role of task in understanding the structure of human cognition. He showed that the subject viewing a painting engaged different eye fixation patterns according to the different questions and tasks he/she was given regarding the painting (Ballard and Hayhoe, 2009). The study proved that eye movements are not only related to the structure of the picture but also to instructions and cognitive goals of the observer (Land and Tatler, 2009). In line with Yarbus's findings, several experiments with eye-trackers have so far demonstrated and supported that eye movements and fixations extract specific information based on the ongoing task (Ballard and Hayhoe, 2009).

According to the cognitive guidance literature, attention is driven by the cognitive system to locations in the image that are high in semantic information and cognitive relevance in accordance with the observer's goals and tasks. Ballard and Hayhoe (2009) conclude that the main source of explanation of where and when people fixate is not image salience but rather cognitive-based processes and variables. Consequently, the cognitive goal or task assumes a describing power of the human cognitive system by highlighting the ability of semantically relevant components to attract fixations and guide gaze. This implies that the more informative the ad objects, the higher the attention they attract. Moreover, processing goals lead to the recall in the individual's memory of the objects encountered before and make comparisons in order to determine to which extent the objects currently viewed match with the ones that were previously encountered (Pieters and Wedel, 2007). Therefore, top-down processing can be defined as the reflection of the interaction between higher cognitive variables, i.e. task, goal and familiarity with the scene (Nyström and Holmqvist, 2008).

2.3.5. Combining bottom-up and top-down processes

Although top-down features appear to be highly relevant due to their ability to explain consumers' patterns of eye-movements, it is widely agreed that eye movements during decision processes are governed by both bottom-up and top-down processes (Henderson and Hayes, 2017). On one hand, saliency theories are compelling and can explain and predict fixation points but only to a certain extent. In fact, they can leave more than half of the fixations out and/or without explanation (Foulsham and Underwood, 2008). It has been proved that salience better correlates with gaze positions than at random and it coincides with areas of the scene that are considered important to the viewers (Elazary and Itti, 2008). Carmi and Itti (2006) showed that bottom-up processing has more influence early after the stimulus has been onset. When analysing consumer in-store visual behavior, it was found that consumers make decisions within a few seconds and therefore to optimize their selection process they focus on certain design elements. Early visual mechanisms are controlled by bottom-up process as initial attention is guided by package design features (Clement et al., 2013). However, salience has lower influence or explanatory power as the amplitude of saccades increases (Land and Tatler, 2009). Moreover, according to Parkhurst et al. (2002), image salience explains and guides eye gaze during the first fixations and then it slowly contributes less during the subsequent fixations.

On the other hand, Nyström and Holmqvist (2008) found that semantic interpretations of the image can override bottom-up processes. In order to provide a method challenging the concept of eye movements guided by salience, Henderson and Hayes (2017) developed *meaning maps*. The underlying concept is that the meaning map "*captures the spatial distribution of the semantic content of a scene in the same format as a saliency map captures the spatial distribution of image salience*" (Henderson and Hayes, 2017, p. 3). Therefore, the meaning map can present a way to formulate predictions regarding eye movements by applying the same methods used in the saliency map.

Fixations locations are important to understand where the viewers fixate their eyes on. However, not less important is the fixation duration. In fact, fixation durations vary across viewers and scenes, and this variability is caused by different determinants which include attention linked to both perceptual and cognitive processing (Henderson and Hayes, 2017). Hence, eye movements are dependent on both the location and duration of attention capture. The results by Henderson and Hayes (2017) show that both salience and meaning generated predictions on attention allocation, but under statistical control of the correlation between the two, only meaning explained the further variance in attention while salience did not. Therefore, meaning can influence attention distribution to a greater extent than salience both early and later when viewing an image. Areas with high semantic relevance attract fixations regardless of their salience. However, it has been proved that what is deemed as interesting and relevant coincides with salient, visually conspicuous features (Elazary and Itti, 2008). This can partly justify the emphasis that has been created around bottom-up control of eye movements (Nyström and Holmqvist, 2008). Nevertheless, as aforementioned attention has been emphasized to be a two-component construct defined by the combination of both bottom-up and top-down processes (Milosavljevic and Cerf, 2008).

2.3.6. Decision making

As visual attention is argued to be determined and affected by both top-down and bottom up processes, so is consumers decision to buy a product. It has previously been highlighted that consumers are continuously, consciously and unconsciously, exposed to multiple visual stimuli. They do not have unlimited time to make decisions (Bagdziunaite, Nassri, Clement & Ramsøy, 2014). Loewenstein (2001) has pointed out that behavioral researchers in the behavioral decision field are increasingly raising doubts about the validity and applicability of their own paradigm. Consequently, he has outlined the characteristics of an alternative perspective which aims to overcome the problems related to the traditional decision making prospect, among which is bounded rationality. When faced with decisions which involve attributes and alternatives, people follow and engage in cognitive shortcuts. They rarely adopt analytical processes such as creating options and evaluating them by weighting their strengths and weaknesses. Instead, it is more likely that people engage in cognitive processes based on well-developed capabilities such as visual attention and object identification, rather than effortful computational processes, like math calculations (Loewenstein, 2001).

Moreover, it is well-known that individuals are not perfectly rational decision makers as they possess limited cognitive capability (Scarpi, 2008). When there are several ways of reaching a goal and/or completing a task, people generally gravitate towards the least effortful and demanding action plan (Kahneman, 2011). Consumers tend to make their decision within a few seconds using simple visual elements and limited cognitive effort (Clement et al., 2013). They look and decide too fast to make a fully informed decision. In fact, it is argued that consumers' cognitive capacity is dependent on allocated resources, noise and dynamics of the environment. Therefore, when moving inside a store, consumers limit their capacity to few items reducing their ability to explore the whole range of objects (ibid).

In the field of visual marketing, growing popularity and application have been gained by the principle "what is unseen is unsold", meaning that products that are not seen or observed directly by consumers will most likely remain unsold, even though they may be evaluated by virtue of the peripheral vision (Wästlund, Shams and Otterbring, 2018). Findings show that the time engaged by consumers in looking at a specific product is a predictive means of how likely the product will actually be purchased. Furthermore, research reveals that there is a bidirectional relation between visual attention and purchase behavior. More specifically, visual attention is able to influence consumer behavior as it supports consumers in forming preferences, taking decisions and creating memory patterns on the observed products making it essential in marketing practices (Wedel and Pieters, 2008).

In experiments based on two-option choice, both theoretical models and eye-tracking studies found that the longer the exposure time of an item, the higher the likelihood of subjects to choose the product (Karmarkar and Plassmann, 2019). This also applies in the packaging domain where it was found that product packages which are looked at longer or repeatedly, are also more likely to be purchased. More specifically, empirical evidence shows that consumers rely on claims on the package, in particular on the facade, to evaluate the product. These claims impact their purchasing decision and can be found in different forms, from a quality symbol such as a check mark proving that the product is organic, to a detailed description of its features (Skubisz, 2017). Furthermore, there is evidence that claims on packages promote sales. A clear example is represented by natural claims which generated 40 billion dollars in sales in the US (Esterel, 2013). Consequently, visual attention at the point of purchase is the greatest prediction tool for which products are more likely to be chosen, supporting the principle that looking is buying and thus unseen products are unsold (Gidlöf et al., 2017; Wästlund et al., 2018).

2.3.7. Cognitive tasks or goals

Although the aforementioned concept of "looking is buying" is reasonable, it should be noticed that it does not take into consideration the way consumers attend to products nor the purpose of looking. Conversely, evidence shows that cognitive goals do exert much influence on how people look at products and therefore it helps to get an understanding of which elements of a product are to be highlighted in order to attract consumers' eyes and attention. It has been discussed that the "purpose" of viewing differs between looking at a static scene and looking at something in real-life context (Tatler et al., 2011). On one hand, during the viewing of static scenes, people engage in tasks such as individualize a target, remember the image, or formulate judgements regarding the content or specific details of the scene. On the other hand, during real-life viewing, with natural tasks, vision aims to extract information and conduct coordinated actions to complete the task. Even though most of the contemporary models explaining eye movements recognizes the importance of cognitive influence over gaze, only few acknowledge the relevance of considering visual selection in conjunction with action (Tatler et al., 2011).

2.3.8. Task viewing

Cognitive approaches to viewing scenes greatly impact viewers' eye movements (Land and Tatler, 2009). This is initially described by Buswell (1935) who proves that high fixation concentration could be spotted in places where people extract the required information. This study is further extended by Yarbus (1967), who finds that each question given to the viewers evokes a different pattern in the way they move their eyes and that this pattern is tightly allied with the information requested by the question (ibid).

Empirical evidence shows that salience models give little to no explanation of eye fixations when engaging in natural behavior. Whereas, a cognitive based explanation of eye movements finds reinforcing foundation through recent studies involving natural tasks. Indeed, a strong link between gaze and semantically relevant locations for the current tasks (behavioral goals) is outlined in all studies of eye movements in natural tasks. This link is further explained by the fact that during natural behavior all fixation land on task-related and task-relevant locations, whereas before engaging in a task there is no significant difference in fixation distribution between task-relevant and task-irrelevant locations (Hayhoe et al., 2003). Moreover, across different individuals a high degree of consistency is found in visual attention allocation in natural settings. Contrarily, a low degree of consistency is found in visual attention allocation across people viewing static scenes (Tatler et al., 2011).

In natural settings, one of the most relevant roles of gaze is to sample information to sustain ongoing activities (Gottlieb, Hayhoe, Hikosaka and Rangel, 2014). This implies that eye movements are tightly coupled with specific actions and driven by a specific goal that is to gather evidence and information related to the actions (Tatler et al., 2011). Another important role of gaze is to reduce uncertainty and minimize the lack of knowledge about visual information relevant to the task by selecting fixation targets. It implies that looking at specific points deemed informative to perform the task at hand reduces the uncertainty about what is relevant and what is not relevant for the task. This is supported by empirical evidence that implicit reward as well as uncertainty define where and when fixations are guided given the underlying task (ibid).

Task based on package design

As mentioned before, previous research highlights how visual attention is driven around the scene by giving a specific task to the subject. In marketing and consumer research a central topic has been the investigation of consumer judgements and price expectation of certain products (i.e. task), but little is known about how package design can help consumers develop these judgements and expectations (Orth et al., 2010). This study adopts product packages, more specifically cereal packages, as the main and only source of marketing stimuli to which participants are exposed to. As a result, the key premise is that visual cues of a package design function as means for consumers to perform a task, i.e. form price expectation.

Evidence supports that, in alignment with the ELM, price expectations can be generated through both central and peripheral routes when consumers elaborate evaluations based on visual cues. An extension of the ELM framework from advertising to product package designs is supported by Orth et al. (2010) which suggests that consumers may not all create price estimations using package design in the same way but the processing would rather be dependent on which route is followed and therefore whether a *central route via quality inference* or a *peripheral route via attractiveness judgement* is pursued (Orth et al., 2010). Moreover, another variable is considered to influence processing and therefore should be taken into consideration. This variable is the centrality of visual product aesthetics (CVPA), namely the overall degree of significance consumers attribute to visual aesthetics of a particular product.

The study conducted by Orth et al. (2010) classifies design effects into three factors, i.e. natural, harmony and elaborate factors. The findings demonstrate that quality operates as a mediator for all three elements meaning that consumers price expectation is higher as a result of attributing higher quality to all three design factors. However, only natural and elaborate elements are found to be predictors of attractiveness. Moreover, a correlation is proved to exist between attractiveness and quality. Thus, consumers judge more attractive packages to be of higher quality.

CVPA is associated with the ability of consumers to recognize and evaluate design factors. High-CVPA individuals are more concerned about visual aesthetics regardless of the environment or product category and they utilize visual appearance to elaborate quality assessment based on design factors. Moreover, high-CVPA individuals think that attractive products can satisfy higher-level needs and thus they are willing to pay a higher price. This is consistent with the results of Orth et al.’s (2010) study which point out CVPA’s ability to enhance the impact of attractiveness over price expectation. In contrast, low-CVPA consumers rely less on aesthetic judgement (ibid). They may have some interest in the aesthetic features of the product, but they do not anchor their quality assessments to visual design factors. Therefore, the impact of package design factors over quality is enhanced by CVPA.

Consumers can develop price expectations in relation to a specific product based on its judgements of quality and attractiveness. This outlines that consumers do not judge products solely on quality but also on a package's attractiveness which can significantly influence price expectation. Orth et al.'s (2010) study expands concepts that were at first conceived and diffused in the field of advertising into a package design context and they show that, despite only one exception, evaluations of quality and attractiveness generated by consumers partially function as mediators of the influence exerted by package design factors over price expectation.

2.3.9. Free viewing

In contrast to what has been discussed under task viewing (section 2.3.8), free viewing has been largely and frequently used in order to set a state in which people are free from precise tasks and high-level goals so that it is possible to study how visual conspicuous features (i.e. salience) of scenes affect gaze, uncontaminated by cognitive influence (Land and Tatler, 2009).

In truth, it is improbable that the viewers' minds are completely blank when asked to observe the image. It is conceivable that the subjects are simply free to choose their own tasks and high-level approaches when looking at the scene. Whether or not free viewing allows subjects to view the image without engaging in high-level processes, it is a natural behavior. The role of vision is indeed to support in gaining information that helps shaping actions into needs. When comparing free viewing with task-viewing, findings have shown that salience can predict eye movements in free viewing behavior to a certain extent, however it has limited ability in explaining gaze during search tasks (Ballard & Hayhoe, 2009; Tatler et al., 2011; Underwood and Foulsham, 2006).

When consumers are not given a task or they lack motivation needed to search efficiently, they incur in an exploratory search during which most of the information search is the consolidation of top-down and bottom-up factors. Janiszewski (1998) argues that both processes are an essential part of any activity directed to gather information. Different studies have developed designs where subjects of the experiment were asked to *"page through newspaper pages at your own pace, as you would do at home or in a waiting room"* (Pieters, Wedel and Zhang, 2007, p. 1820). The instructions given to the participants do not lead them to focus on a specific goal, and thus the study design mirror real-life context in which people are free to view the stimuli (Janiszewski, 1998; Pieters et al., 2007). Even though in such a condition, people are expected to have their own internal subjective task and agenda, their attention is likely to be guided towards informative and semantically relevant locations, in accordance with their own experience, memory, interests, habits and contextual environment. Overall, the free viewing framework generates insights on unconstrained eye movements which are mainly driven by visually conspicuous features in a context where people can freely view and explore, optimizing information acquisition based on the semantic relevance of the different areas of the stimulus. Therefore, whether free viewing or task viewing is applied it allows extracting information which "*contributes to downstream marketing effects of interest such as learning (memory), preference formation, choice, and sales".* (Wedel and Pieters, 2008, p.124). These two processes are intertwined, and therefore cannot and should not be clearly distinguished when analyzing gaze guidance and understanding its importance in marketing.

In conclusion, it might be more reasonable to study eye movements not engaging a perspective of comparison between bottom-up or top-down processes or adopting just the one that explains the best gaze guidance, but rather as a combined mechanism where stimulus features, cognitive factors, environment and study settings are variables influencing fixations and attention allocation. Although the influence of the study setting is often overlooked, increasing interest is leading researchers to conduct studies outside the lab and into more realistic and natural settings and therefore there is growing focus on investigating whether the results obtained from in-laboratory-study can be generalized to everyday, natural context (Suurmets et al., 2019; Tatler et. al., 2011).

2.3.10. Stimuli display method

Regardless of there being a link between visual attention and purchasing decisions as well as visual attention and cognitive goals, most of the studies conducted are based on screen-based results. Gaze guidance in natural settings has been investigated by many researchers, but most of the relevant eye-tracking research has been analysing how consumers view stimuli on screen in a laboratory setting. Several authors have raised concerns regarding whether established methods used to study eye movements in laboratory could be generalized and applied to natural and real-life settings (Tatler, 2009), but only very few in reality have researched the impact that the two different settings have on consumers eye movements (Foulsham et al., 2011; Suurmets et al., 2019; Tatler et al., 2011; Tonkin et al., 2011). The rising amount of studies moving towards more realistic and natural settings has led researchers to recognize the influence that different aspects related to a natural scene such as physical realism, contextual cues and oculomotor bias have on eye movements and visual attention. For this reason, understanding consumers eye movement and visual attention solely based on top-down and bottom-up factors is oversimplifying.

As a result, another key aspect that can influence visual attention is how visual stimuli are presented to the individuals. In fact, people view stimuli on computer screens (laboratory setting) differently than in natural scene (real-life setting). This has been proved by Land, Mennie & Rusted (1999) who found that saccade amplitudes are shorter when visualizing stimuli on a computer monitor in comparison to a natural scene while fixation durations have a wider range during real life tasks. In addition, fixations are reportedly being temporally guided and highly sensitive to the task details (Hayhoe et al., 2003; Land et al., 1999). Thus, it appears that fixations perform a distinct role in natural tasks and they are well-defined based on the task context (Hayhoe et al., 2003).

In a real-life setting, the viewer has the ability to partially control some of the dynamics of the scene, while also having the ability to interact with the object within the designated environment as the viewer is considered a representative of the environment itself (Smith and Mital, 2013). Meanwhile, in a laboratory setting, the viewer does not have the same ability to actively engage with or manipulate objects within the environment. According to Tatler et al. (2011), the *purpose* of viewing differs between when people look at static scenes, i.e. pictures or screen images, and when they are in a real-life setting. As previously mentioned, the purpose of vision in a real-life setting is to collect information while interacting with the object and act based on the information collected to complete the task. Whereas, when looking at static scenes and images, very little or no interactions with the objects are required by the task. Rather, vision's purpose might be to individualize a target, remember (elements of) the scene or comment on the content of the image. Therefore, the principles driving gaze and fixations targets during picture viewing are likely to be different from those applied in real-life behavior.

Another fundamental difference between the two environments or settings is closely connected to physical realism. When viewing images on a screen, the physical realism is remarkably diminished as images are less dynamic than real-life settings. In contrast, real-life environments offer many depth and motion cues compared to images which have a limited field of view determined by the screen and thus have no motion and depth cues. Static scenes are known to induce a strong bias in the way the images are processed and viewed by people (Ballard & Hayhoe, 2009; Tatler et al., 2011).

In addition to inducing a bias, the screen characteristics have shown to influence search times. In fact, Tonkin et al. (2011) evaluate visual behavior as consumers perform a product search task by looking either at a virtually projected shelf unit (snapshot of the physical) or physical shelf unit both populated with artificial cereal packages. They find that there is evidence supporting slower search time of stimulus when the images are virtually projected to consumers. The same results are reported in another study, which finds slower search time of stimuli presented on a laptop screen compared to stimulus presentation on large physical shopping displays (Tonkin et al., 2011). Although a screen presents limited area for visual search which should require less time to cover, large displays have better search time as they are considered to be a closer approximation of physical reality and provide better usage of peripheral vision (ibid). In addition, various studies using computer screens indicate significant central fixation bias when investigating allocation of visual attention

(Foulsham & Underwood, 2008). This does not completely apply to studies in natural settings which have found the bias to be less sturdy in choice task (Gidlöf, Wallin & Holmqvist, 2012) and non-existing in search task (Tonkin et al., 2011).

Another example of the central fixation bias can be found in the study by 't Hart et al. (2009) who analysed the eye movements of individuals viewing in a real-life environment, looking at continuous replay of a video sequence of the same environment and static frames of 1-s (from the video sequence). The study compares participants' natural viewing behaviour in outdoor settings with their viewing behaviour of video sequence from head-centred recordings. The study finds that eye movements are likely to be centrally located, suggesting a central fixation bias in the two contexts. However, this bias is found to be the strongest when people viewed the static frames. In addition, eye movements recorded when watching videos are found to be more reflective of real-world gaze compared to static frames. In a similar setup, Foulsham et al. (2011) find that in natural behavior such as walking the gaze distribution is constrained: no long fixations are detected away from the point towards which the head is directed. This means that in real world participants address their attention with head movements and that fixate their eyes on a "heading point", which is located just above the center of the head frame-of-reference Therefore, it is found that there is a tendency of the eyes to be located in a central position of the visual field when considering viewing behavior in the real world. Whereas, when participants are exposed to the same stimuli on a computer screen gaze is shifted more frequently towards the border of the visual field.

Findings support the notion that people's viewing behavior are different depending on the stimuli presentation methods. The differences are strong indicators of the viewing condition having an impact on allocation of visual attention to certain stimuli as well as visual attention being driven by more than visual scene features as it appears to be context dependent. Consequently, this implies that there are in fact numerous studies suggesting that the way people view stimuli on computer screens is different from the way people view stimuli in natural or real-life settings but there are not enough studies considering the impact that these differences have on their results. In conclusion, neuroscience is changing how marketers and researchers understand consumers as some eye tracking findings revealed that consumers process marketing stimuli differently depending on contextual cues triggered by the display method and the cognitive tasks.

2.4. Packaging

2.4.1. Product packages and cereal market

Previous research has provided important evidence that consumer's attention should be caught within less than a second as 73% of consumers purchasing decisions are made at the point-of-sale and 90% of them are made after only looking at the front of the package (Rettie and Brewer, 2000; Rundh, 2013; Sara, 1990; Tonkin et al., 2011). In today's intensified competitive environment where products are progressively becoming similar one to the other it is necessary and vital to find other ways to distinguish a specific product from that of the competitors (Rundh, 2013; Nikolaus and Lipfert, 2012; van der Lans et al., 2008). This is achievable through the format or design of the packaging which has the capability to attract and retain the attention of consumers (Rundh, 2013,) and promote the start of the in-store search process (Clement et. al, 2013).

For this reason, packaging can be crucial in making the product successful (Tonkin et. al., 2011). In fact, it helps consumers in choosing a product and get an impression about the product in its final form (Rundh, 2013; Vyas, 2015), thereby contributing to the assessment process that consumers experience in a purchasing situation. A product package is considered to be a crucial point of contact between the consumer and the product at the point of purchase (Agariya, Johari, Sharma, Chandraul and Singh, 2012; Rundh, 2013). As a consequence, consumers are said to be relying on the packaging more than other marketing communication forms to develop a first evaluation of the product (Rundh, 2013,). Thus, the packaging becomes an element of the marketing mix which connects the consumer and the product and more importantly it becomes an essential part of the selling process (Rettie and Brewer, 2000).

Evidence supporting the importance of packaging can be found in the fact that on a global level manufacturers are spending over $150 billion every year on product packaging (Know the Importance of Product Packaging Design in Branding & Marketing, 2017). Furthermore, the increasing investment in packaging is also endorsed by a survey conducted by L.E.K regarding upcoming product package initiatives and understanding of the effect of packaging at CPG companies. The results of this survey illustrate that around 80% of the brand managers and packaging decisions makers acknowledge the important role of packaging in a product's success and more than 50% of them will be investing in additional packaging related initiatives within a 5-year time frame. Furthermore, it shows that within the same time frame 22% of the companies are preparing to increase their packaging investment by 10% while 59% of the them have already launched new product and packaging innovations. Overall, short-term initiatives on product packages are expanding and anticipated to progress which could be explained by the fact that revised and new packaging design are known to retain and attract consumers' attention (Rajan, 2018).

This is further supported by the value of the market which according to Smithers Pira reports is forecasted to reach $998 million in 2020 and $1 trillion by 2021 as a result of global demand increasing 3.5% on a yearly basis from 2015 (Smithers Pira, 2016; Smithers Pira, 2018). The expansion of the global demand is said to be caused by a shift in the consumption behavior across the globe (Top 20 Companies in the Global Packaging Industry, 2019; Tonkin et al., 2011). Despite these developments, it is important to notice that this growth is unlikely to be uniform and like any other markets there are several disruptive trends that are critical and essential to take into account. In fact, these trends have the ability to change the competitive landscape within the packaging industry and therefore determine the long-term future growth potential. Some of these disruptive trends include *greater connectivity* with the consumers through the use of big data to deliver individualised promotions, improving *recyclability and sustainable materials* use to create circular economy, optimization of packaging for *e-commerce* to be professionally presented, protected and please consumer expectations, greater *customisations of packages* for promotional campaigns and design packages for optimal in-store location (Smithers Pira, 2016; Smithers Pira, 2018).

The great value of the packaging industry can help explain why product packages are extremely common. Indeed, a lot of our daily products have some kind of packaging but one product that many consumers have grown accustomed to for having a package is breakfast cereals. As a result, it is useful to additionally look into the cereal market and its trends instead of solely considering the packaging market developments. Some sources report that the breakfast cereal market is expected to grow 3.3% annually (CAGR 2019-2023) and generate €53.533 million in revenue in 2019 (Statista, 2019). The global food and beverages industry has experienced drastic changes as a result of changing lifestyles and preference for healthy food worldwide. These changes have caused a shift from the conventional breakfast towards breakfast cereals, especially cereals with whole grains and low sugar, as they are highly preferred by health-conscious consumers (Research and Markets, 2018). As the previous paragraphs have emphasized and as supported both on theoretical and practical grounds, packaging is extremely important and is considered to continue to be so in the future.

2.4.2. The functions of packaging and its importance in marketing

It has already been established that product packages and their designs are considered essential both in theory and in practice. This explains why the literature on packaging is increasingly focused on the significance of the design of a package and the role it plays (Agariya et al., 2012; Retti and Brewer, 2000; Rundh, 2009; Rundh 2013). Packaging has been acknowledged as a key element for marketing purposes, which over the years turned into a widely exploited marketing tool (Rundh, 2013). All the steps related to creating a product package such as selection of the material, the design in terms of size, shape and colors as well as logo, text and picture(s), are subject to strategically reasoned combinations. The different combinations of elements and the overall design of a package allow consumers to base their purchasing decisions on the distinctive visual features of a package making them visual sales arguments (Rettie and Brewer, 2000; Rundh, 2013). Consequently, the elements in the designs function as marketing stimuli that have the power of influencing consumers perception and information processing, hence becoming means of attention attraction and guidance (Nikolaus and Lipfert, 2012; Wedel and Pieters, 2006).

Functional role of packaging

Traditionally, packaging has performed the function of protecting the product inside the package all the way through the supply chain to the end consumers (Nikolaus and Lipfert, 2012; Rundh, 2009; Rundh, 2013). In other words, a product package serves the purpose of protecting and facilitating the contained product which involves its containment, transportation and storage during the whole process (Rundh, 2013). Both consumers and retailers chase specific qualities in terms of packaging such as convenience, ease of use, transportability; retailers in particular pay attention to packaging that ensures a long shelf-life (Top 20 Companies in the Global Packaging Industry, 2019). All of these qualities are embedded in the protective function of a product package indicating that choosing the right type of packaging and the right design for a specific product is an important decision for firms.

Several factors have led firms, retailers and consumers to reconsider the role of packaging (Rundh, 2013). Among these factors are the intersified market and shelf-space competition (Agariya et al., 2012; Rundh, 2013) along with the increased relevance of the self-service culture. Within this field, packaging is expected to execute sales-related tasks such as promoting the brand, attracting attention, providing information of the product and its features, and driving sales (Rundh, 2013). In order to stay competitive, major retail chains have been investing large amount of resources in packaging, in-store promotion and visual communication. As a result, packaging is not only a silent "salesperson" and "protector", rather it has acquired the role of a brand builder, information provider and persuader (Agariya et al., 2012; Rundh, 2013).

Communicative role of packaging

Since many people are reconsidering the role of packaging and recognizing that it is no longer just a silent protector, it is pivotal to grasp the essence of its recently acknowledged role. This role is specifically concerned with being a communicator in order to perform several tasks such as giving information, building the brand (both image and identity) and persuade to purchase. The main aspect of the communicative role involves conveying information to the consumers regarding product benefits, ingredients, price and value as well as providing direction on how to use and preserve the product (Agariya et al., 2012; Rundh, 2013; Rundh, 2009). In addition, packaging's role extends to facilitating brand and product recognition on-shelves at the point of purchase in order to make the products stand out from the others on the crowded shelves (Rundh, 2009). Furthermore, packaging contributes to building brand image and identity which makes it a medium for promoting the brand image (Rundh, 2013). This is accomplished by creating perceptions about a company and its products, thereby leveraging the associations between the two held in consumers memory. In order to infer information about the product consumers rely on brand image which foster consumers' consumption tendencies (Agariya et. al, 2012).

Since all the information communicated through the packaging lies in the design elements, it facilitates product search allowing consumers to find a specific product faster and easier (Rundh, 2009). Packaging can help firms break through the competitive shelf-clutter and provide the most essential point-of-contact in-store before a purchasing decision is made (Agariya et al., 2012; Rundh, 2013). As such it becomes the concluding communication endeavor to influence and persuade consumers before they select the brand and product to purchase (Rundh, 2009; Rundh, 2013).

Packaging as a strategy for differentiation and competitive advantage

The roles acquired by packaging has increasingly been recognized as a way for companies to achieve product differentiation and competitive advantage (Rundh, 2009; Rundh, 2013). In this respect, packaging can help companies carve out a favorable position in the industry and in consumers' minds by improving the reach of the product and its differentiation among increasingly similar products (Agariya et al., 2012; Rundh, 2013). Therefore, packaging helps companies to make their brand stand out, recognizable and considered in the consumers' set of choices (Agariya et al., 2012; Rettie and Brewer, 2000).

Several researchers state that packaging has become the "salesman on the shelf" which could be translated into the marketer making it the unique interface between the product and the end consumer (Rettie and Brewer, 2000; Sara, 1990; Vyas, 2015). Both the functional and communicative role of packaging are equally beneficial to the retailers since this role itself is what facilities the differentiation of the product package. This is also what makes it possible for firms to establish a competitive advantage considering the impact that differentiation has on attracting and retaining consumers attention (Rundh, 2013). Consequently, it assists companies in boosting retail performance (Rundh, 2009). This shows how packaging has become an essential element in marketing as it differentiates products and ensures a secure and efficient distribution of goods, which particularly applies to the FMCG industry (Rundh, 2016).

2.4.3. Package design elements

The functions of a package are embedded in the varied design elements (Vyas, 2015). The design elements will depend on the type of product that is being considered. More specifically, design elements such as shape, material, color, typography, picture etc. will depend on what type of product is being sold (Vyas, 2015). Consequently, the design will differ in terms of which visual components or elements are used and manipulated (Nikolaus and Lipfert, 2012), how many elements there are, where the elements are placed and how much space there is between the different elements, depending on the objective and type of product. Our study will examine package designs with specific and carefully considered design elements that are purposefully chosen to be included when the design of the package is made.

The visual components used in the designs are considered relevant in relation to existing non-artificial packages since the majority of the packages (within FMCG) applies some or most of the chosen visual components. Designs can vary in complexity ranging from simple to complex implying that real in-store and non-artificial packages may include all of the elements together while others may include fewer elements. The differences in complexity and its impact on visual attention are out of the scope of this study as the objective is to investigate how attention is drawn to the different elements based on viewing condition and cognitive goals rather than how many elements are represented on a package design. The chosen package design elements are pictorial, brand (logo), product name, and text and each of these elements will be defined and explained in the following paragraphs.

The ***pictorial element*** is defined as all illustrations, graphics and pictures on the package, but it excludes symbols used for the brand (Pieters and Wedel, 2004). The pictorial element is commonly argued to be the main element in capturing the attention of consumers. As a result, some scholars argue that the larger the picture the better because of the greater power to attract attention to the advertisements through the picture size (Pieters and Wedel, 2004). Traditionally, it is believed that the pictorial element can be processed faster than other elements. Moreover, it is considered to have higher ability to attract attention and generate greater emotional impact on consumers behavior (Nikolaus and Lipfert, 2012). The picture shown on the packaging can be reflective of its content and can therefore create expectations, especially when the pictorial element is a photographic image of the product itself. Photos and illustrations represent powerful design tools that can be used to diversify and distinguish products as well as communicate the product's features (Vyas, 2015). The results of the study conducted by Vyas (2015) find that illustrations on packaging draw attention, influence consumers perception of the product, trigger purchase and facilitate product memorization.

A worth noticing aspect of this research is none of the previous studies mentioned above considers and accounts for the impact the stimuli display method has on attention to the pictorial element on product packages. In contrast, some other studies did in fact account for stimuli presentation method. Suurmets et al.'s (2019) study finds that participants in the real-life viewing condition have longer gaze durations at the pictorial element on different packages compared to the screen viewing (difference of 805ms). This would indicate that when we see a product package in real-life we rely more on the pictorial element for information acquisitions.

Brand (logo) element is defined as all pictorial and textual reference to the brand which includes the name of the brand, logo, symbols and packshot (Pieters, Warlop and Wedel, 2002, p. 767). The fact that the brand (logo) is considered pivotal in information integration and directing consumer attention is demonstrated by Nikolaus and Lipfert (2012). Other authors also argue that the brand contains the information needed to help consumers with brand recognition and/or brand recollection after being exposed to the brand, thus achieving the necessary awareness (Wedel and Pieters, 2006). This is further supported by Vyas (2015) who finds the name of the brand to draw attention and make it easy to remember. Therefore, it is considered to be the reason why marketers and firms should enhance the brand element and direct consumer attention towards it (Wedel and Pieters, 2006).

The *product name element* is the name of the product in text. This corresponds to a headline (text) which is the largest text and it is considered to be important in capturing consumers attention. Pieters and Wedel (2004) state that most marketing scholars consider the headline to be the most relevant ad element as it plays a vital role in advertisements and packaging design. According to some studies, when viewing chocolate packages, the product name is the element standing out the most, and thus it is used as a visual anchor for the following viewing process. The product name is able to catch consumers attention faster which is expressed in early fixations and it can hold attention longer by recording longer gaze durations compared to the pictorial element. Studies in regard to the ad design offer support to the relevance of the product name since they find that the product name, here defined as headlines, is gaining more and more attention as well as importance (Nikolaus and Lipfert, 2012; Wedel and Pieters, 2006).

The *text element* is defined as all text on the package that is not the name of the brand nor the product name but rather all other text such as body text and value benefit statements. Text on the package informs the consumer about the product and its ingredients. According to the study conducted by Nikolaus and Lipfert (2012), the body text on pharmaceutical and chocolate packages attract great attention. This is further supported by the results of the survey conducted after the test which reveal that the text element plays a key role in helping participants to rate the emotional appeal of a packaging due to its great ability of catching the viewer's attention. For this reason, the text element should not be neglected in the packaging design. These results are also found in studies researching ad designs (Nikolaus and Lipfert, 2012). Nevertheless, other studies reach opposite conclusions. They claim that the text element is not suitable for drawing immediate attention at the point of purchase (Clement et al., 2013). However, the contradicting results might find explanation in the fact that the importance of the text element varies in accordance with the type of product. Some authors find, when considering low involvement products less time is dedicated to reading the information and looking at details displayed on the packaging, resulting in lower attention being placed on the text element (Agariya et al., 2012).

As mentioned before, none of the existing studies considered the impact of the stimuli display method on the results. According to Suurmets et al. (2019), a significant interaction exists between the screen viewing condition and the AOI comprising text. However, it should be noted that in this study the AOI text does not solely refer to body text, it rather deals with all the elements containing some text (e.g. nutritional values, grams, etc.). Consequently, brand name, product, pictorial element and text are closely connected to the (remote) on-screen viewing condition. On average, when looking at the textual information participants spend 680ms longer in on-screen viewing compared to real-life viewing (Surmeets et al., 2019). As indicated by the definitions of the design elements above, there are scholars advocating for each element to be important in capturing consumers attention in advertisements and packaging. More importantly, the influential role of each visual component in retaining and capturing attention is different when scholars also consider whether the stimuli is evaluated by the consumers on a screen display or in its physical form. The stimuli display method has in fact shown to impact which elements are capturing most attention and how much attention each of the elements are drawing.

3. PHILOSOPHY OF SCIENCE

It is highly relevant to consider the ontological and epistemological position that is applied to the study as it guides the reasoning throughout the paper and helps to determine the appropriate research design and method to follow. Therefore, it is necessary to undertake ontological considerations concerning the nature of social entities by asking whether the social entities are to be addressed as objective entities or social constructions (Bryman & Bell, 2011), stated differently investigating what the reality of these entities is (Darmer & Nygaard, 2005; Guba & Lincoln, 1994). Also, it is necessary to undertake epistemological consideration concerning the nature of knowledge by asking what is considered appropriate knowledge (Bryman & Bell, 2011). As a result of these considerations we are able to determine the appropriate research design and methodology by asking how we study the reality (Darmer & Nygaard, 2005; Guba & Lincoln, 1994).

The research primarily follows the deductive approach (conclusive) but at the same time acknowledges the aspects of the inductive approach (Malhotra, Nunan and Birks, 2017). This implies that the study quantitatively tests the differences triggered by contextual cues in screen and real-life viewing conditions as well as explore whether there are differences due to cognitive tasks. Given that the study acknowledges that there will always be subjective interpretations of scenes and it is not possible to predetermine these interpretations, the study includes the subjectivity of the mechanisms driving gaze behavior. Therefore, the research will lean towards a view of critical realism rather than approaching the research questions from a positivist view.

Critical realism is known to be simultaneously confronting the central concerns of both natural and social science regimes with a strong emphasis on ontology (Zachariadis, Scott and Barrett, 2013). Ontologically, the reality is perceived as something that prevails without regard to our knowledge or view of it, thus embracing a perspective of reality as a system that is both open and complex which allows multiple mechanisms to coexist. Reality is classified into the realms of *real,* the *actual* and the *empirical* which implies that we as researchers do not necessarily have direct access to *the* reality nor are we necessarily able to detect and comprehend its every facet or aspect. The *real* is considered the mechanisms that have caused the actual events, the *actual* is considered the actual events that have been produced by mechanisms and the *empirical* considered the visible or detectable experiences. Furthermore, it is believed that the unobservable events are what causes the observable ones thus the social world can only be comprehended if the structures that create such unobservable events are understood (Zachariadis, Scott and Barrett, 2013).

Epistemologically, the nature or generation of knowledge is relative. As it is a human process, it depends on specific features and steps of its construction ranging from established facts to theories, from models to techniques that are engaged by researchers in a certain space and time frame. Our understanding of the reality is believed to be a construction of our own standpoints and perspectives. Hence, the process of creating scientific knowledge is considered as an *historically emergent, political and imperfect* activity (Zachariadis, Scott and Barrett, 2013 p. 3) which implies that there is fallibility or relativity to our knowledge. However, this does not certainly imply that all knowledge is faulty in the same manner (Zachariadis et al., 2013).

In an experimental context, it becomes possible to distinguish between the event and what causes it when an understanding of the structures is reached. More specifically, the people who conduct the experiment create the conditions under which the experiment is performed (observable event) but the results are caused by the underlying structures meaning the laws and mechanism (unobservable events). Methodologically, the aim of this paradigm is not to establish any specific method for scientific work as Danermark, Ekstrom, Jakobsen and Karlsson (2001) state that the method of critical realism does not exist. Rather, critical realism offers contribution to social science by providing direction and guidance in the field of social science research in addition to facilitating the appraisal of existing methods. The paradigm relies on methodological pluralism due to the fact that the choice of method(s) is based on the objective of the study. Therefore, the choice of qualitative and/or quantitative research is dependent on the research question.

4. RESEARCH DESIGN

4.1. Overall design

A research design is a framework for carrying out data collection and analysis. It provides details and procedures for gathering information and structure the research project. Essentially, it lays out the groundwork for conducting the study and therefore the research method (Bryman and Bell, 2011; Malhotra et al., 2017). Generally, a research design implies certain steps: define the information required, delimit the overall design (exploratory, descriptive or causal), set the sequence of techniques and/or measurements, design and pre-test the data collection approach, describe the qualitative and/or quantitative sampling process and sample size, conduct qualitative and/or quantitative data analysis (Malhotra et al., 2017).

Research designs are widely categorized as exploratory or conclusive. The difference stands in the main objective. Exploratory research aims to gain insights and better understanding of a specific topic. The information required is broad, the samples are small and data is analyzed in a qualitative or quantitative manner. In contrast, conclusive research aims to test hypotheses and define their relationships. The information required is precise and well defined, the samples are large as they intend to be representative, and data is analyzed in a quantitative manner (Malhotra et al., 2017). In attempt to reach adequate clarification of the research question, a conclusive research design applies to the study by following a causal approach. Its objective is to test hypothesis and/or to acquire evidence of cause-effect relationships between independent (cause) and dependent (effect) variables (Malhotra et al., 2017). The empirical experimental study is conducted in a laboratory setting as this allows for high control over variables such as the position and placement of the product in both setups and viewing condition which is found to influence consumers visual attention (Mehmedovic et al., 2017; Suurmets et al., 2019; Tatler et al., 2011). The chosen approach is not uncommon as the majority of eye-tracking studies on visual attention and perception are performed in a controlled laboratory set up (Mehmedovic et al., 2017) and only recently this approach has been experiencing a change to in-store investigations (Clement, et. al 2013; Gidlöf et al., 2017).

Conducting an empirical study requires manipulating the independent variable to understand whether it generates an effect on the dependent variable. Following the classic design of an experiment, the subjects are divided into two main groups which establishes the basis for manipulating the independent variables. Therefore, it would be possible to determine to which extent the different results from the two groups are responsible for differences in the dependent variables (Bryman and Bell, 2011). In this case, the experiment allows for investigating the cause-effect relationship between the viewing conditions, task and AOIs (as independent variables) and allocation of visual attention measured by the metrics TFD and TTFF (as dependent variables).

As previously mentioned, there has long been and still is an underlying assumption in the neuromarketing field regarding the generalizability of on-screen results to real life in-store consumer behavior. Despite some studies showing that there is an actual difference in how people view stimuli in real life versus on-screen, there is still a rather limited focus on the matter by researchers. Consequently, this study challenges the assumption underlying most eye-tracking research by testing the hypotheses and carrying out an experiment to test our hypotheses. This allows for a verification of whether there is a difference between the two viewing conditions or not in order to validate the existing studies, which are mostly conducted under a free-viewing setting. Therefore, to further extend the study and gain deeper understanding of the difference in attention allocation, a task-viewing setting is also implemented. Therefore, the experiment tests participants' visual attention when given a task in the two viewing conditions.

4.2. Reliability, replicability, validity and ethics

According to Bryman and Bell (2011) the most common criteria used for evaluating a research study are reliability, replicability and validity. These are employed in this study given their role of assessing the quality of the research and in particular of quantitative research (Bryman and Bell, 2011, p.40). Moreover, ethical considerations are developed as a result of the applied neuroscientific method which theoretically can provide results that could possibly be used to manipulate individuals into buying specific products or could be used for purposes other than the objective of this thesis. Therefore, the application of neuroscientific techniques demands that a certain ethical conduct is followed. This implies guaranteeing that participants are sufficiently protected, the goals and risks of the study are fully disclosed and subjects provide informed consent. Furthermore, it is necessary to transparently define and demonstrate the scientific accuracy of the study by disclosing the procedure and details of the experiment to the public (Lim, 2018).

4.2.1. Reliability

Reliability deals with whether the study and its results are replicable, meaning whether they generate consistent results. More specifically, it relates to the question of whether the measures are consistent which can be assessed based on primarily one factor: stability. *Stability* is evaluated based on whether the results related to a measure do not fluctuate, meaning that if a certain technique is applied to a sample group and the same technique is then applied again, little variation is expected to arise in the results achieved (Bryman and Bell, 2011).

4.2.2. Replicability

Replication or replicability deals with the possibility of replicating a study previously conducted by others. The criterion of replicability is achievable only if the researchers of the study to replicate have described in great detail all the components of the research and all the procedures of the study.

4.2.3. Validity

Validity deals with whether the results and conclusions obtained from a study have integrity (Bryman and Bell, 2011). It is important to notice that there are different types of validity while the main ones are: measurement validity, internal validity, external validity and ecological validity. However, only internal and external validity are expressed in detail. *Measurement validity* primarily applies to quantitative research and it concerns the questions of whether the measure used to investigate a concept is truly reflecting the concept (ibid).

Internal validity is related to causality. It deals with whether the results and conclusions involving a causal relationship between (independent and dependent) variables are sound and valid. Hence, it refers to the degree of confidence that independent variables are responsible for variations in dependent variables. *External validity* deals with whether the results of the study are generalizable outside of the concerned research context It functions as an incentive for researchers to obtain representative samples that allow them to improve the validity of their study outside of the analyzed context. *Ecological validity* deals with whether the findings of the study are applicable to natural social settings in everyday context. It is related to the question whether the results, in addition to being technically valid, are very likely to recur in everyday life. Thus, the more the researchers intervene in the natural settings or the more unnatural settings they create (i.e. laboratory), the higher the probability of results being ecologically invalid (Bryman and Bell, 2011).

4.3. Hypotheses

It is well established by now that most eye-tracking studies and many of the studies mentioned throughout the paper assume that it is fair to generalize screen-based results to real-life settings and therefore these are to be considered problematic in terms of external validity. Investigation into consumers' visual attention and purchasing decisions in a real-life setting has attracted some academic attention in recent years. Some authors have begun to test the difference between a simple lab setting and a complex supermarket or in-store setting (Clement et al., 2013; Gidlöf et al. 2017). Although they appear to be attempts of questioning the underlying assumption, it does not tell us anything about if and how consumers visually and cognitively process visual stimuli based on the viewing condition. It rather investigates the impact of the study setting itself. Given that the impact of viewing condition is still a recent phenomenon, it becomes slightly more complicated to formulate the hypotheses or make specific predictions in particular when the task is introduced.
The hypotheses are defined as follows:

> H1a: There are no differences in how long (TFD) participants look at the different AOIs of the package design when *viewing condition* is considered.
>
> H1b: There are no differences in how long (TFD) participants look at the different AOIs of the package design when *cognitive goal* is considered.
>
> H2a: There are no differences in how quickly (TTFF) participants look at the different AOIs of the package design when *viewing condition* is considered.
>
> H2b: There are no differences in how quickly (TTFF) participants look at the different AOIs of the package design when *cognitive goal* is considered.

5. METHODOLOGY

As previously mentioned, the conclusive research design implies that researchers carry out an experiment which in this case results in a rather quantitative method. The overall methodology of the study is supported by previous research allowing for the comparability of our results with previous findings and higher control of the variables. The main structure of the research setup when testing real-life marketing stimuli is supported by

Belardinelli, Stepper and Butz's (2016) study. This allows to define the general setting of the experimental setup, and therefore it ensures that participants are tested in both viewing conditions under the closest and most similar circumstances, with the only difference being the stimuli presentation method. Both of our setups are additionally supported by Tonkin et al. (2011) and Suurmets et al. (2019) study and they are structured in a way that all participants tested for both real-life and on-screen viewing are exposed to the stimuli to get the most comparable results.

5.1. Participants

The total number of subjects recruited for participation in the experiments was 93 but due to technical problems e.g. eye tracker error, recording error, calibration issues, gaze disappearing or gaze being off and human error, the actual number of participants whose data was used for the statistical analysis was 74. As the above-mentioned errors could compromise the data and therefore the validity of the statistical analysis, these participants were excluded from the study. Out of 74 people 37 were recruited for the real-life viewing condition and 37 were recruited for the screen-viewing condition. Within each viewing condition, participants were then classified into two groups based on the stimuli block (i.e. stimuli A-G first and H-N last and vice versa), resulting in a total of 4 groups. The study had 33 female participants (accounting for 44.6% of total valid participants) and 41 male participants (accounting for 55.4% of total valid participants) with the average age being 25.

All subjects were asked if they would like to partake in an eye-tracking study that would take approximately 5-10 min. and would be used for our master thesis. All participants voluntarily took part in the study and prior to the test they were informed about the research setup, the functionality of the eye-track equipment, and that the data was used only for scientific purposes. At the end of the experiment the participants were asked a few questions such as cereals consumption habits and educational/profession status. In addition, each participant was told that there were free biscuits, candy, chocolate and soda as a reward for their participation. For the recruitment of participants, we invited family, friends and other social connections as well as recruitment on the spot (at CBS). This recruitment procedure allowed for a diverse set of participants in terms of gender, age, nationality and educational background. In both conditions we strived to have an equal number of participants so that we could have 4 approximately equal groups in terms of number of participants. All the participants were given a general introduction of what was going to happen in order to make them feel more comfortable without giving them too much information to bias them. In addition, they were told that they were allowed to ask questions and hear more about the study after its completion.

5.2. Product selection criteria

All of the participants were exposed to the same type of products. The products that were chosen as stimuli for this study were cereal packages since they were argued to have a good size in relation to estimating the gaze locations. This justified their greater ability to test specific package elements which were divided into distinctive areas of interest (AOIs). Various eye tracking studies have used cereal packages to analyze attention which further supports our decision (Gidlöf et al., 2017; Suurmets et al., 2019; Tonkin et al., 2011; Visschers, Hess and Siegrist, 2010). This also meant that the results of this study could be compared to what has previously been found. Even though more studies are applying general product packages as marketing stimuli, it is still less developed and used than advertisements. It is important to notice that this study tested the hypotheses based on cereal packages that were intentionally artificial which implied that they were not cereals that participants could buy in a physical supermarket. Therefore, the artificial nature of the packages indicated that the cereal packages were fictional and designed in Adobe Photoshop CC 2019 by the authors of this thesis since artificially constructed package designs have been successful and supported by other researchers (Suurmets et al., 2019; Tonkin et al., 2011).

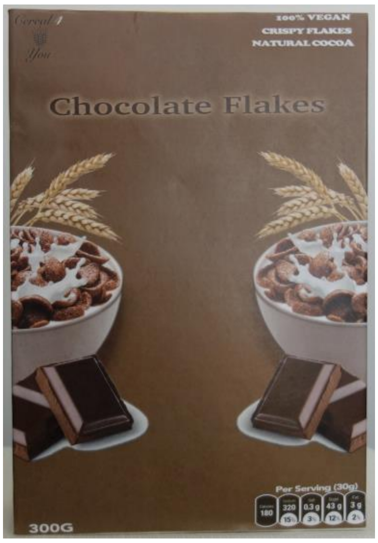
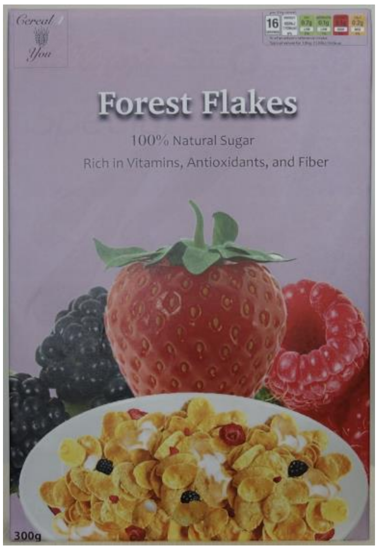
Having designed our own packages instead of using existing ones avoided biases caused by prior exposure to the cereal packages. This meant that none of the participants could have had any *a priori* knowledge regarding the cereals, thus it was possible to control for memory effect and brand bias which would most likely be present when people are frequently exposed to packages (Wedel and Pieters, 2008). In particular, the artificial packages avoided any bias on the brand element which has large impact on the memory and mind in general since it is a visual element with high semantic value (Clement et al., 2013). Moreover, the use of fictional cereal packages was supported by the fact that they guaranteed that the design elements were not overlapping and that they were large enough to be fixated on. Hence, it made it possible to distinctively draw the areas of interest with enough space between each AOI in order to locate where participants were looking at in a more specific and clear manner. In addition, all cereal package stimuli fulfilled the following selection criteria:

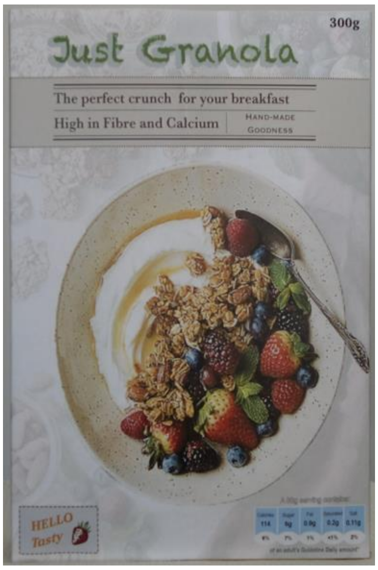
- Most common and regular purchase in a supermarket (Statista, 2019)
- Packaged products
- Include brand, product name, pictorial and text design elements
- Enough surface to allow distinctiveness of elements
- Non transparent package material

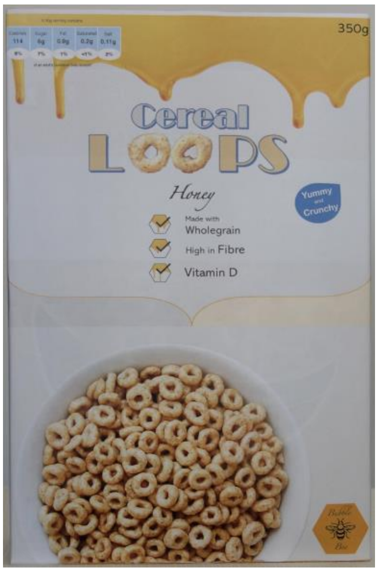
2019	EUROPE	US	WORLD
Volume (in million kg)	2,332.5mkg	2,135.67mkg	10,408.76mkg
Revenue (in million $)	$12,208.6m	$15,605m	$60,447m

Table 2 shows all the different designs of the cereal packages (not accounting for randomization of packages) which include cereals for both adults and children and do not account for gender. Additionally, during the study in both viewing conditions participants were exposed to the same first preliminary stimulus. It is common to have short training session to accommodate the participants to the conditions of the study. Likewise, in this study the first product package was used as a training stimulus, serving the same purpose. However, this stimulus did not generate valuable insights and results for the study based on the assumption that viewers engage a different viewing behavior on the first stimulus before they get acquainted with the experiment's routine. Consequently, the results from the first stimulus were not considered in the data analysis.

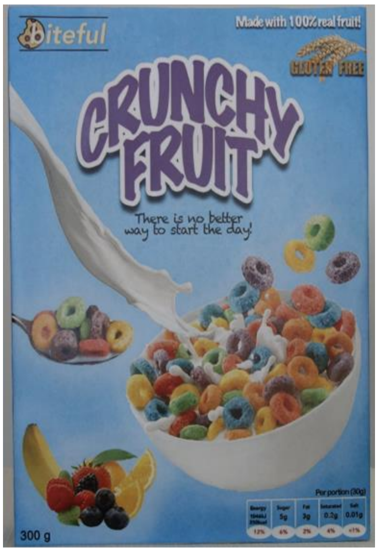
The cereal packages designs were printed out and glued on existing cereal packages which represented the fundamental structure. All the cereal packages were rectangular in shape, vertically oriented and had the measurement of 19.2cm (length) x 28cm (height). The packages designs comprised the front panel with the AOIs (i.e. brand and/or logo, product name, text and pictorial element), as well as the left and right-side panels with respectively additional information about ingredients and nutritional values and brand and/or logo (Appendix 2). The front panel served as primary visual stimulus as it incorporated all the AOIs to be tested. Whereas, the side panels played a minor but still relevant role in representing a real-life cereal package as well as covering the underneath cereal package that could have been source of bias due to the discrepancy between the fictional frontal panel and the sides of the underneath real-existing cereal package box.

	Stimuli	
 **Always first stimulus**		

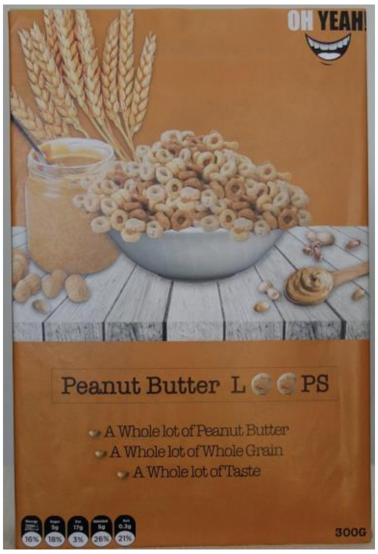

300g
Just Granola
The perfect crunch for your breakfast
High in Fibre and Calcium
HAND-MADE GOODNESS
HELLO Tasty

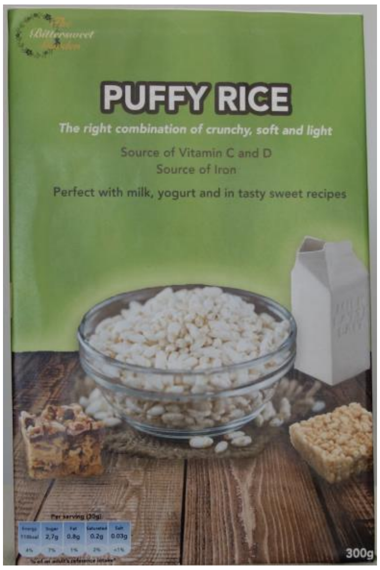

350g
Cereal LOOPS
Honey
Made with Wholegrain
High in Fibre
Vitamin D
Yummy and Crunchy


Morning
COCOA BITES
Made with all-natural cocoa beans!
Per serving (30g)
300g


Biteful
Made with 100% real fruit!
GLUTEN FREE
CRUNCHY FRUIT
There is no better way to start the day!
Per portion (30g)
300 g


NO ARTIFICIAL COLOURS OR FLAVOURS
HugsyPop
Choco Puffs
SOURCE OF VITAMIN B6
SOURCE OF VITAMIN B3
SOURCE OF VITAMIN B5
SOURCE OF IRON
TO HELP NOURISH KIDS' MINDS
300g


OH YEAH!
Peanut Butter LOOPS
A Whole lot of Peanut Butter
A Whole lot of Whole Grain
A Whole lot of Taste
300G


PUFFY RICE
The right combination of crunchy, soft and light
Source of Vitamin C and D
Source of Iron
Perfect with milk, yogurt and in tasty sweet recipes
Per serving (30g)
300g


WORLD OF BISCUITS
Serving (30g)
PLAZAMON
the biscuit for every occasion
Vitamins A, B1,B3,C and E
300G

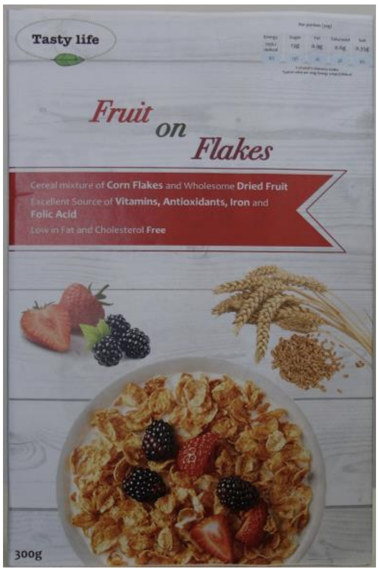

Tasty life
Fruit on Flakes
Cereal mixture of Corn Flakes and Wholesome Dried Fruit
Excellent Source of Vitamins, Antioxidants, Iron and Folic Acid
Low in Fat and Cholesterol Free
300g

Table 2: Artificial package designs

5.3. Visual stimuli

Based on the previous section the stimuli that were chosen for the study at hand were cereals packages. We designed 15 different cereal packages which were used both in on-screen viewing condition and real-life viewing condition. The cereal packages were randomized meaning that the order in which the participants saw them was random in both viewing conditions, thereby avoiding order bias. More specifically, in each viewing condition, participants were divided into two groups and were subject to a two-phased viewing process based on pseudo-randomization (Table 3 and 4). Therefore, in the **first phase** group 1 and 3 were exposed to the first block of packages (A-G) in a randomized order within the block. While group 2 and 4 were exposed to the second block of packages (H-N) in a certain order with randomized order within the block. Then, in the **second phase**, the task was introduced in both viewing conditions. Therefore, group 1 and 3 were exposed to the second block of packages (H-N) in a randomized order within the block, while group 2 and 4 were exposed to the first block of packages (A-G) in a randomized order within the block (see section 5.7 about set-up and equipment for detailed explanation). The two-phased viewing process is supported by the fact that limited research has been done to fully comprehend the effects of top-down factors while bottom-up factors have been thoroughly investigated when it comes to impact on visual attention. Thus, the two-phased viewing allowed for a clearer distinction between the factors. This study considers the viewing conditions and AOIs as bottom-up factors, while top-down factors are represented by cognitive goals meaning the individual's own agendas as well as the task given as part of the experiment.

In order to make the most reliable comparison between results, the representation of the stimuli was kept as identical as possible in particular between the two viewing conditions. As a result, all visual inputs other than the display method were held as constant as possible for both set-ups. In addition, participants were given the exact same task during the second phase of the viewing process. In order to perform the task, the participants were asked to estimate the price of the cereals and their price expectations were evaluated by applying Jun, MacInnis, and Park's (2005) approach. Thus, subjects were asked the following open-ended question: "*What is the retail price of this product in a supermarket*?". By answering this question, they expressed the expected prices in regard to the shown cereal packages (Orth et al., 2010).

5.4. AOI selection

In order to most effectively investigate the difference between the two viewing conditions and cognitive goals, elements on the package were classified into different and distinctive areas of interest (AOIs) in order to acquire information on allocation of attention. The selection of areas of interest (AOI) on the cereal packages was defined before designing the fictional packages, since the AOIs were used as a guideline of what to include in the front panel, where to position the package elements and how much distance to consider when spacing the AOIs (figure 2). Furthermore, the AOIs and therefore the design of the packages was defined based on what had been found as common on real existing cereal packages. Overall, elements such as brand, product name, pictorial and text were the most common AOIs in all package designs tested in eye-tracking research (Wedel and Pieters, 2006). Therefore, the main AOIs chosen for this study consisted of: (1) pictorial (2) product name; (3) text and (4) brand and/or logo. The text comprised: (3.a) main text with cereal type, key benefits and characteristics; (3b) nutritional values; (3c) grams contained in the cereal box; (3d) additional benefits (e.g. gluten free, no artificial flavors etc.). The positioning of the elements was mainly based on real cereal packages available on the market. As a result, the elements did not have a fixed position on the package. This found explanation in the objective of avoiding participants to associate an element to a specific area of the cereal package.

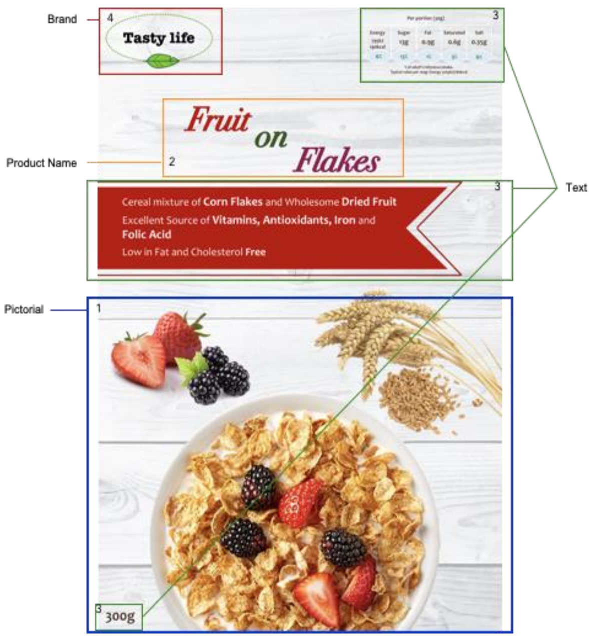


Figure 2: Illustration of AOIs. Authors' own depiction.

5.5. Variables (Metrics for AOI)

In order to test attention allocation to the different AOIs, visual metrics that relate to visual attention were therefore applied. Therefore, the metrics analysed were **total fixation duration** (TFD) and **time to first fixation** (TTFF).

Total fixation duration (TFD) indicates the total amount of time spent fixating on a specific element. It is the sum of all fixation durations on a specific AOI and it gives information about the attractiveness of that AOI. Theoretically, it is a variable that can be associated with top-down processes, it can be tested to assess how people engage in eye movements and attention allocation using their internal attentional processes, based on the influence of personal factors such as internal goals or agendas (Milosavljevic and Cerf, 2008).

Time to first fixation (TTFF) is a visual attention metric that theoretically can be associated with bottom-up processes. Hence, this metric gives us insights into the design of the stimulus or more specifically it provides understanding on whether the design of the stimulus visually stands out. It is able to capture this by showing the time it takes a subject to fixate for the first time an AOI, thus measuring the instant reaction to the shown stimuli.

However, as indicated in the section above the variables cannot and should not be strictly classified as related to only top-down and bottom-up processes as the two types of processes can take place simultaneously and therefore can occur and overlap. As a result, it is expected that the two processes are intertwined and should not be simplified in each metric. Support for this argument can be found in Ballard and Hayhoe (2009), Clement et al. (2013) and Wolfe (2000) where it is acknowledged that in it can be difficult to draw a clear distinction between top-down and bottom-up processes. Consequently, the eye movements of a participant are to be considered as a combination of fixations and saccades guided by both salience and cognitive goals. In this study, eye movements were used to gather information on the time participants fixated on every AOI and the time they first fixated on each AOI depending on the stimuli display method and especially on the cognitive goals. Therefore, participants engaged in fixations to the different packages based on the salience of each AOIs as well their internal agendas when they were free to view the stimuli and the given task when they were asked to estimate the price of the packages.

5.6. Exposure of stimuli

Participants in screen based and real-life viewing conditions were seated respectively in front of the computer monitor and the table where the visual stimuli were presented. As previously mentioned, the order of presentation of the stimuli was randomized with the exception of the first preliminary stimulus which was kept fixed as the opening stimulus in both conditions. In order to keep the same exact setup in both conditions, exposure time to the stimuli was kept the same in both viewing conditions. Thus, participants were exposed to each cereal package for 8 seconds with an interval of 7 seconds between each stimulus as this is supported by previous studies (Suurmets et al., 2019).

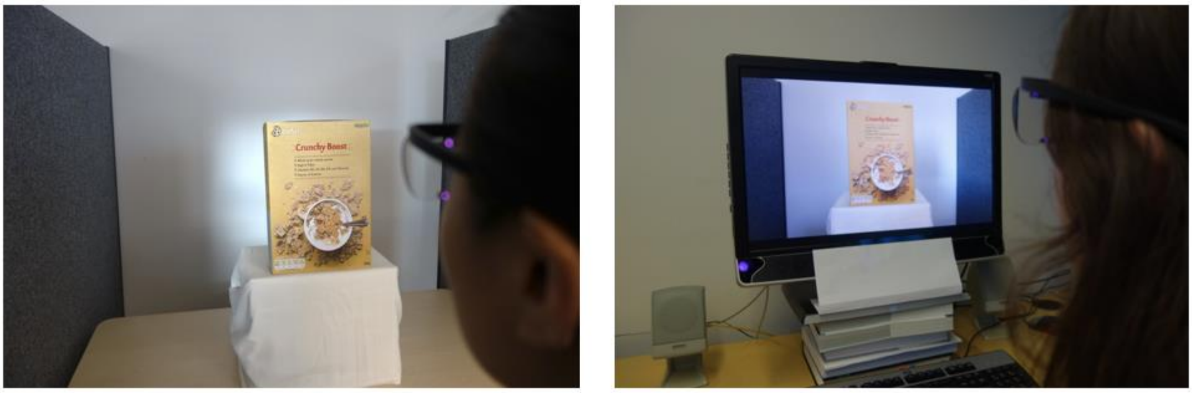


Figure 3: set-up - real-life viewing of the physical product compared to screen viewing of the product (picture taken from the real-life physical product). Authors' own pictures.

When displaying cereal packages on-screen, during the 7-seconds gap a white slide was shown. The reason behind this stood in recreating the most similar setting to the one in real life viewing condition. In fact, when stimuli were presented in a physical and tangible way, each package was placed in a certain position, i.e in the same spot which was defined with tape and an X on the stool, at a specific eye level and distance from the participant. In between each package, a white cardboard was placed between the participant and the object to mask the substitution of the packages, so that each cereal package could be removed and the next one could be placed without the participant noticing the transition happening behind the white cardboard. Thus, when the cardboard was removed so that the participant could directly and solely see the subsequent package. By replicating the same scene as in real life viewing, the white cardboard was translated into white slides in between each package in screen-based viewing. Moreover, the stimuli shown on-screen were represented by pictures of the cereal packages taken in front of the real set-up at roughly the same distance and eye level of the sitting position of the participants in real-life condition. However, when displaying packages on the screen, the pictures were zoomed in so that the packages appeared in the same proportions and dimensions as when they were exhibited in real life to participants sitting in front of the physical objects. Lastly, in order to keep the same setup in both conditions the participants in real-life viewing were also exposed to each cereal package for 8 seconds with an interval of 7 seconds between each stimulus.

5.7. Set-up of experiment and equipment

The neuroscience labs at Copenhagen Business School were used to perform the experiment in both viewing conditions in order to control for any confounding variables. One of the labs was used only for screen-viewing while the other lab was used only for real-life viewing. The research was conducted in a laboratory set-up in order to allow for higher control of the variables compared to a field experiment. This enabled us to avoid external sources of distraction and noise that could have compromised the results. Moreover, it allowed ut to produce a study that could be easily replicated by others. We randomly assigned participants to either the real-life viewing or the screen-based viewing condition and all groups in both viewing conditions were exposed to stimuli under free-viewing and task-viewing. Random assignment of participants allowed for greater confidence that any measurable change that might have occurred after the study manipulation would have been caused by the treatment under study and not the characteristics of the groups being compared. All the participants were first given verbal instruction about the experiment including why we were doing the study, what kind of equipment was used in the study, explanation of the calibration procedure and its relevance as well as the necessary distance between the participants and the stimuli in order to get the most accurate data.

The participants were then verbally instructed about sitting and in particular keeping their head still during the study as it was fundamental to collect stable data. Thereafter, they were asked to read and sign a consent form before starting the study (Appendix 3). They were then verbally informed that they were presented with written instructions twice during the study, once at the beginning of the study and one halfway through the experiment. Therefore, they had to read the instructions which were handed to them on a A4 paper to be held upright at eye height.

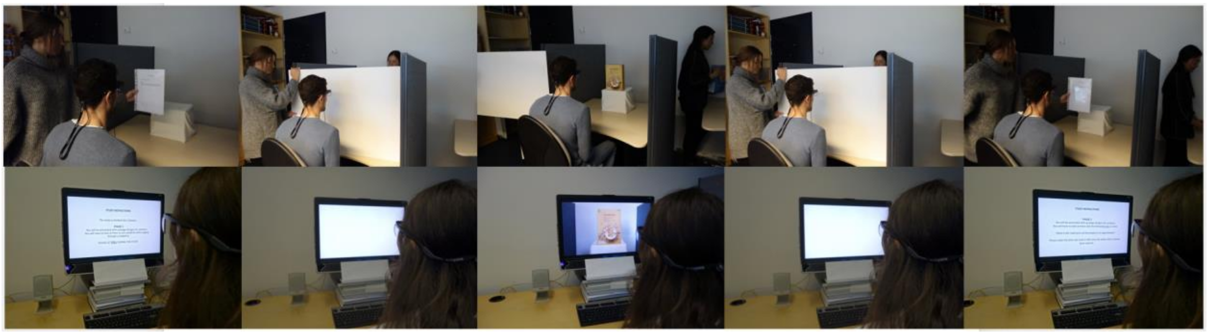


Figure 4: Differences in stimuli exposure in the two viewing conditions. Authors' own pictures.

In order to track the participants natural viewing behavior, Tobii 2 Pro eye-tracking glasses were used in both viewing conditions. Prior to starting the experiment, a calibration procedure on the glasses was followed for each participant (Tobii, 2016, p. 33) in order to make sure that the eye-tracking equipment worked properly in recording and catching the participants eye movements. The two main components of the glasses used to run the experiment were: a pair of wearable eye-tracking glasses (head unit) and a recording unit. The glasses were composed of multiple parts such as full high definition angle scene camera, microphone, eye-tracking sensors that detected the direction of eye movements, IR illuminators that projected infrared light on the eye to assist the sensors to identify the pupil and a micro HDMI cable that connected the eye-trackers to the recording unit. The latter recorded and saved all the data collected through the glasses, including sound and video, on an SD memory card, allowing for an easy transfer of data to a computer (Tobii, 2018). The portable Tobii Pro 2 eye-trackers functioned as a measuring device of fixations and saccades and were capable of gathering uncontrolled attention data, recording 25 pictures per second, identifying the precise position of the eye every 40ms and collecting information at a rate of 50Hz (Clement et al., 2013; Meyerding and Merz, 2018; Tobii, 2016; Tobii, 2017).

To achieve the best data accuracy, according to Tobii, the recommended distance between the viewer and the stimulus is 62cm (Tobii, 2017, p. 6-7). Therefore, in respect to that recommendation the same distance was kept in this study. Since the screen viewing condition used stimuli consisting of pictures of the real-life cereal packages, a camera was needed. For this purpose, a 12MP camera was used to photograph the stimuli whose dimensions were kept as similar as possible. For this reason, the camera was held frontally at eye height as the participant would have viewed the cereal packages. Consequently, the lightning of the room, the height the stimulus and angle of the shoot were kept as constant and analogous as possible to the experiment setup of real-life viewing condition. As aforementioned, in between the stimuli a white blank visual gimmick was adopted. In the real-life condition a cardboard of 70 cm in height and 100 cm in length was used to block participants' view. Whereas, in the screen-based condition the stimuli were spaced out by a white screen given by the white slide.

To assure the most similar conditions between screen based and real-life viewing, the stimuli were manipulated to generate the most comparable results. The cereal packages were individually placed on a couple of cereal boxes stacked one on top of the other functioning as a stool where stimuli can be put at eye height of the participant, in the same spot and angle orientation. The *stool* was wrapped in a white cloth and positioned on a table where the participant was seated at a precise distance of 62cm from the stimulus. Whereas, the surroundings were hidden by two grey dividing walls, one on each side of the table.

The software used to collect and process data was iMotions biometric research platform version 8.0, which allowed to determine fixations from the raw data provided by the recordings using the Tobii I-VT Fixation filter as classification algorithm. The basic objective of this filter was to classify eye movements according to the "*velocity of the directional shifts of the eye"* (Tobii, 2016, p. 53). If the velocity of eye movements was below a certain value (threshold), then the eye movements were defined as part of a fixation (Tobii, 2016). Likewise, if the velocity was above the threshold, then the eye movements were categorized as saccades. The I-VT filter applied a threshold on each data point. The default velocity threshold value was 30°/s and was set based on Tobii internal testing and review of eye-tracking literature. Whereas, the default minimum fixation duration value was 60ms, implying that all fixations under that value were excluded (Laski, Brunault, Schmidt and Ryu, 2018; Tobii, 2016). Data analysis was conducted using JMP 14 Statistics software.

High spatial and temporal resolution eye-trackers like Tobii Pro Glasses 2 are sufficiently accurate to be applied in the field of marketing for both academic and commercial purposes (Wedel and Pieters, 2008). Laski et al. (2018) and Meyerding & Mertz (2018) provided further support for the use of Tobii eye-trackers as they used the Tobii device (Tobii Pro Glasses 2) and software (Tobii I-VT filter) to capture and quantify the eye movements in their experiments. This gave validation to the methodological approach engaged in our study.

The study setup and how analysis of data was performed through data comparisons is visualized and explained in the following Table 3 and Table 4. It is essential to point out that the whole analysis covers two types of comparisons both having the two different viewing conditions (screen-viewing and real-life viewing) based on two phases (free-viewing and task performance) as main elements which are explained in detail in the following sections.

Viewing condition	Sample size	Sample Group	Free viewing 1^{st} phase	Task viewing 2^{nd} phase
On-screen	37	Group 1	Block 1 A B C D E F G	Block 2 H I J K L M N
		Group 2	Block 2 H I J K L M N	Block 1 A B C D E F G
Real life	37	Group 3	Block 1 A B C D E F G	Block 2 H I J K L M N
		Group 4	Block 2 H I J K L M N	Block 1 A B C D E F G

Table 3: visualization of study set-up comparisons (first comparison). Authors' own depiction.

The difference between the two analyses (as illustrated in tables 3 and 4) can be found in the way the data was compared. As table 3 illustrates the first comparison of the data was made ***between subjects (2 groups - investigating the viewing condition between the groups)*** meaning that under the free-viewing we compared stimuli of the same block in the two viewing conditions. This implies that stimuli A, B, C...G (screen condition) were compared with stimuli A, B, C...G (real-life condition) and stimuli H, I, J...N (screen condition) were compared with stimuli H, I, J...N (real-life condition). This *between-subjects* comparison was carried out in order to investigate whether the stimulus presentation method had an impact on the participants visual attention when participants are engaged in free-viewing. In the same manner, under the task-viewing we compared stimuli of the same block in the two viewing conditions in order to investigate whether the method of stimulus presentation had an impact on the participants visual attention when participants are engaged in a task.

Viewing condition	Sample size	Sample Group	Free viewing 1st phase	Task viewing 2nd phase
On-screen	37	Group 1	Block 1 A B C D E F G	Block 2 H I J K L M N
		Group 2	Block 2 H I J K L M N	Block 1 A B C D E F G
Real life	37	Group 3	Block 1 A B C D E F G	Block 2 H I J K L M N
		Group 4	Block 2 H I J K L M N	Block 1 A B C D E F G

Table 4: Visualization of study setup comparisons (second comparison). Authors' own depiction.

Table 4 illustrates how the second comparison was made namely the comparison of the data was made ***within subjects*** **(*TASK and AOIs - investigating the different viewing goals and various AOIs on the same subject, therefore within each group*)** meaning that the data was compared within the screen based viewing condition and within the real-life viewing condition. More specifically, we compared on-screen stimuli from the same block between the two viewing goals, meaning that on-screen stimuli A, B, C... G (under free viewing) were compared with on-screen stimuli A, B, C... G (under task-viewing). Likewise, on-screen stimuli H, I, J... N (under free viewing) were compared with on-screen stimuli H, I, J... N (under task viewing). Furthermore, we compared real-life stimuli from the same block between the two viewing goals. This implies that real-life stimuli A, B, C... G (under free viewing) were compared with real-life stimuli A, B, C... G (under task-viewing). The same method was followed for the real-life stimuli H, I, J... N. This *within-subjects* comparison was made to establish whether participants changed their eye movements and visual attention towards specific AOIs when they had a task in mind compared to when they had not a task in mind within the same viewing condition. Balancing the viewing condition with either free exploration or task exploration of the stimuli created a total of four groups to be analyzed.

In order to grasp the idea of the two phases and the way stimuli were presented, the following paragraphs provide details into each phase and group. In the first phase of screen-viewing condition group 1 saw the first block of stimuli for 8 seconds with an interval of 7 seconds between each stimulus. Similarly, group 2 saw the second block of stimuli for 8 seconds with an interval of 7 seconds between each stimulus. The second phase starts after 15 seconds of showing a white slide, with the introduction of the task. Group 1 saw the second block of stimuli for 8 seconds and similarly group 2 saw the first block of stimuli for 8 seconds, both with an interval of 7 seconds between each stimulus.

In the first phase of real-life viewing condition group 3 saw the first block of stimuli for 8 seconds with an interval of 7 seconds between each stimulus. Similarly, group 4 saw the second block of stimuli for 8 seconds with an interval of 7 seconds between each stimulus. The second phase started after 15 seconds of showing a white slide, with the introduction of the task. Group 3 saw the second block of stimuli for 8 seconds and similarly group 4 saw the first block of stimuli for 8 seconds, both with an interval of 7 seconds between each stimulus. All participants were exposed to the stimuli by wearing (mobile) eye tracking glasses in both viewing conditions. Each session had a duration of 5-10 minutes.

Furthermore, in the first phase of the experiment the participants in each group were not given a specific task, allowing us to gain insights into unconstrained fixation selection. In the second phase of the experiment the participants in each group were given a task as previously mentioned, i.e. subject are asked the open-ended question following the Jun, MacInnis, and Park's (2005) approach: "*What is the retail price of this product in a supermarket*?" (Orth et al., 2010). Therefore, phase 1 was when top-down factors were not controlled for (but they were most likely present - see visual attention section 2.3) and phase 2 was when top-down factors were controlled for.

To sum up, we controlled for the visualized dimensions of the stimuli by manipulating object positioning and on-screen object size, defining the precise view distance between the participant and the object, as well as viewing conditions. At the end of the experiment the subject were awarded some biscuits, candy, chocolate and soda for their participation and asked some post-experimental questions followed by a short briefing about the aims of the study.

5.8. Pilot study

The thesis included a pre-study piloting phase before conducting the actual experiment. The purpose of the pilot study was to identify possible problems within each experiment set-up. For this reason, 2 participants were recruited as test persons of the experiment, making sure that the set-ups and all the related elements such as exposure time, stimuli presentation, participants position etc. were correctly followed and appropriate. Hence, the pilot study allowed to verify the set-ups and give the possibility to adjust the experiment with all the necessary changes. In terms of the real-life condition we learned that participants should have the instructions shown in front of them to read them at eye-height as placing the instruction on the table caused a recalibration. In addition, we noticed that participants were confused about the instructions for phase 2 (task viewing) as they did not know in which currency to say the price and if it was a just guess or the real retail prices. Therefore, this information was later added to the instructions used for both viewing conditions in the actual experiment. In on-screen viewing we noticed that the participants were distracted by the reflections of the computer sensors which appeared purple. To overcome this issue, a white paper is placed in front of the sensors in the actual experiment. Both pilot studies illustrated people's inability to sit still during the experiment which ranged from 5-10 minutes depending on the calibration procedure. In addition, they made us aware of the fact that we had to add "*please sit still during the experiment"* in the instructions for phase 1 and give the participants verbal reminders of the importance of sitting and keeping their head still throughout the experiment. Besides all the issues just mentioned, the pilot study for each viewing condition functioned as a necessary and useful exercise in preparation of the actual experiment. More specifically, it ensured that a certain coordination and flow were followed throughout the experiment.

6. ANALYSIS AND RESULTS

According to what has been discussed in the methodology (section 5) two specific and rather distinctive approaches were followed to compare and analyze our data. Since previous eye-tracking studies have found that there is a difference in viewing behaviour between screen-based and real-life settings. This study aimed to verify the existence of a clear difference in attention allocation between viewing conditions as well as cognitive goals.

6.1. Independent and dependent variable

This study has two different setups to test the different relations between the variables. As a result, the independent variables are 'VIEWING CONDITION' referring to the screen based versus real life (here defined as physical) stimuli display method, 'COGNITIVE GOAL' referring to the two phases where the first is free-viewing meaning looking at the stimuli without any explicitly defined task in mind and task-viewing meaning looking at the stimuli based on the given cognitive goal or task in mind and lastly 'AOI' referring to the (1) pictorial (2) product name (3) text (including the subgroups) and (4) brand and/or logo. The variable 'VIEWING CONDITION' is a between-subject variable as the comparison is made between two groups. Both the 'COGNITIVE GOAL' and 'AOI' are within-subject variables as the comparisons are made within the same groups and same people being exposed to various cognitive goals and AOIs (go to section 5 for detailed explanation). The dependent variables are 'TOTAL FIXATION DURATION' (TFD) and 'TIME TO FIRST FIXATION' (TTFF) which refer to the variables that we apply to measure visual attention allocation in order to investigate whether there is any influence or effect caused by the independent variables on these specific dependent variables.

6.2. Data extraction

After collecting data on iMotions biometric research platform version 8.0 and before extracting data, fixations were extracted using Velocity-Threshold Identification (I-VT) algorithm for both the screen and real-life condition. Consequently, the same algorithm with 30°/sec velocity threshold was used for both conditions as they both involved mobile eye-trackers. Areas corresponding to each AOI were manually outlined on the different cereal packages which were then gaze mapped automatically in iMotions by the software. Eye-tracking data consisted of videos recorded by the eye-trackers where gaze points were projected on video recordings. Static images of the cereal packages were then uploaded on iMotions and gaze points in the videos were reflected onto the static images. Thereafter, gaze mapping was reviewed by comparing videos and static images to ensure that fixations were captured by the software and correctly mapped on the cereal packages in the pictures. In case of missed or incorrectly placed fixations, gaze mapping was conducted manually. Finally, data was extracted in a text file and transported onto an excel sheet which was cleaned and sorted to ensure relevant information was comparable and analysed in the most appropriate way. Data was then imported into JMP to proceed with the statistical analysis which was carried out after excluding irrelevant data.

6.3. Analysis based on TFD

We ran a generalized linear mixed effect model (GLMM) for repeated measures with "VIEWING CONDITION" as the study's between-subject variable and "COGNITIVE GOALS" and "AOI" as within-subject variables. The distribution of the TFD variable showed some skewness, but because the residuals of the test were normally distributed, the model was considered valid and no transformation was applied to the data. In our study, we investigated the impact of the viewing condition (Physical/3D and screen/2D) and viewing goal (free-viewing/task-viewing) on the visual attention allocated to different AOIs measured based on TFD. This implied that we had to approach it as a three-way interaction between: **Condition*Viewing goal*AOI** (Appendix 4). More specifically, a three-way interaction can be thought of as testing for whether the simple two-way Viewing Goal*AOI interactions (within subject) are different for the different groups of conditions (between subject). It is important to notice that since these two-way interactions are part of a larger three-way mixed analysis they are defined as simple two-way interactions. This can be best visualized in the table below:

Fixed Effect Tests

	Source	Nparm	DF	DFDen	F Ratio	Prob > F
	Condition	1	1	71,15	13,661	0.0004*
	ViewingGoal	1	1	69,75	26,318	<,0001*
	4xAOI	3	3	216,3	184,4256	<,0001*
(1)	Condition*ViewingGoal	1	1	69,75	1,3905	0,2423
(2)	Condition*4xAOI	3	3	216,3	3,8965	0,0097*
(3)	ViewingGoal*4xAOI	3	3	215,3	17,4894	<,0001*
	Condition*ViewingGoal*4xAOI	3	3	215,3	1,8478	0,1395

*Table 5: TFD - Fixed Effect Tests of the three-way interaction Condition*Viewing Goal*AOI.*

Table 5 presents the three-way interaction which includes two within-subjects variables and one between-subject variable. In order to determine whether we had a statistically significant three-way interaction we looked at the "Prob > F." column, which contained the statistical significance value (i.e., *p*-value ~ $p < 0.05$) of the test. As the Fixed Effect Tests revealed, there was no statistically significant three-way interaction between **Condition*Viewing Goal*AOI**, $F(3, 215.3)=1.8478$, $p=0.1395$.

Since the data did not reveal any statistically significant three-way interaction, we investigated whether there was any statistically significant two-way interaction. As before the Fixed Effect Tests revealed whether a significant two-way interaction existed.

For example, consider the following two-way interactions, as highlighted in table 5:

(1) **Viewing Goal*Condition** interaction

(2) **AOI*Condition** interaction

(3) **Viewing Goal*AOI** interaction

As shown in table 5, the two-way interaction between **Viewing Goal*Condition** was not statistically significant, F(1, 69.75)=1.3905, p=0.2423. However, the table shows that there was a statistically significant two-way interaction between **AOI*Condition**, F(3, 216.3)=3.8965, p=0.0097 and table shows statistically significant two-way interaction between **Viewing Goal*AOI**, F(3, 215.3)=17.4894, p<0.0001.

6.3.1. Condition*AOI

6.3.1.1. Free viewing

The simple two-way interaction effect revealed that the simple two-way **Condition*AOI** interaction effect for free viewing was statistically significant (table 6). In variable terms, when the viewing goal is *free-viewing*, the AOI effect on TFD did depend on the condition, meaning the condition had an effect on how long the participants viewed different AOIs. Therefore, there was a statistically significant simple two-way interaction between AOI and condition for free-viewing F(2, 215.7)=4.2475, p=0.0061.

Response Mean (TFD)

Fixes Effect Tests

Source	Nparm	DF	DFDen	F Ratio	Prob > F
Condition	1	1	71,12	14,5548	0,0003*
4xAOI	3	3	215,7	120,157	<0,0001*
Condition*4xAOI	3	3	215,7	4,2475	0,0061*

*Table 6: TFD - Fixed Effect Tests of two-way interaction Condition*AOI for free-viewing.*

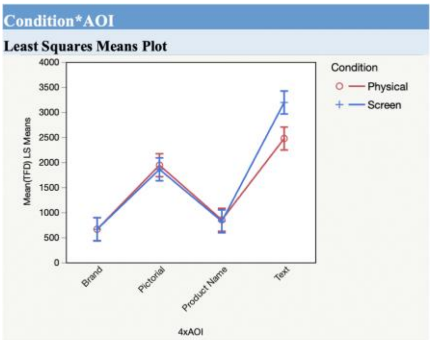


*Figure 5: TFD - Least Squares Means Plot two-way interaction Condition*AOI for free viewing.*

To establish a clearer picture of the simple main effects of these significant interactions, we ran multiple pairwise tests. Therefore, it was necessary to apply a correction, so all pairwise comparisons were run using Tukey HSD method (Demšar, 2006) that adjusted the degrees of freedom for multiple comparisons (Appendix 5). The pairwise comparisons revealed that in free-viewing the AOI Text was viewed significantly shorter (in terms of TFD) in the real-life/physical condition (M=2472.5, 95% CI 2243.8 to 2701.3ms) compared to the screen viewing (M=3191.1, 95% CI 2962.4 to 3419.8ms), t = -4.38, p=0.0005 (figure 5).

This study did not find any significant differences but just a slight one in viewing time for the pictorial element for free-viewing as it revealed TFD to be slightly greater in the real-life condition (M=1939.6, 95% CI 1710.8

to 2168.3ms) compared to the screen condition (M=1856.9, 95% CI 1628.2 to 2085.7ms) but as revealed by the Tukey HSD pairwise comparisons this was not a significant difference between the two t=0.50, p=0.9996. As for the AOIs Brand and Product name we did not find a statistically significant difference in viewing time in the two viewing conditions under free viewing. An overview of the relevant tables and graphs with results is shown in Appendix 5.

6.3.1.2. Task-viewing

The simple two-way **Condition*AOI** interaction effect for task-viewing was not statistically significant. In variable terms, when the viewing goal was *task viewing*, AOI effect on TFD did not necessarily depend on the condition meaning the condition did not have an effect on how long the participants viewed different AOIs. Therefore, there was no statistically significant simple two-way interaction between AOI and condition for task-viewing F(3, 214.1)=1.1862, p=0.3159.

Response Mean (TFD)

Fixes Effect Tests

Source	Nparm	DF	DFDen	F Ratio	Prob > F
Condition	1	1	70,41	5,3652	0,0235*
4xAOI	3	3	214,1	153,5755	<0,0001*
Condition*4xAOI	3	3	214,1	1,1862	0,3159

*Table 7: TFD - Fixed Effect Tests of two-way interaction Condition*AOI for task viewing.*

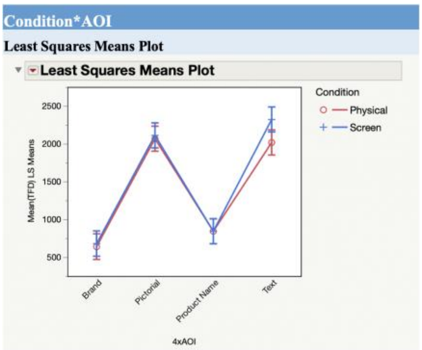


*Figure 6: TFD - Least Squares Means Plot two-way interaction Condition*AOI for task viewing.*

To establish a clearer picture of the simple main effects of this non-significant interaction effect between **Condition*AOI**, we ran multiple pairwise tests (Appendix 6). Even though the interaction effect was not significant, table 7 shows that individually both variables were significant under task-viewing. The pairwise comparisons applying Tukey's HSD method revealed that in the task-viewing the AOI Text was still viewed shorter (in terms of TFD) in the real-life/physical condition (M=2015.6, 95% CI 1850.4 to 2180.8ms) but not significantly compared to screen viewing (M=2320.2, 95% CI 21550336 to 2484.4ms), t= -2.57, p=0.1737).

Still this study did not find any significant difference but just a slight one in viewing time for the AOI Pictorial under task-viewing. The results revealed TFD to be slightly shorter in the real condition (M=2066.1, 95% CI 1900.8 to 2231.3ms) compared to the screen condition (M=2109.9, 95% CI 1944.6 to 2275.1ms) but as revealed by the Tukey HSD pairwise comparisons there was not a significant difference between the two t= -0.37, p=1,0000 (figure 6). As for the AOIs Brand and Product name we did not find any statistically significant difference in viewing time in the two viewing conditions under task-viewing. An overview of the relevant tables and graphs with results is shown in Appendix 6.

The results highlighted an important trait in the participants viewing behavior which is also somehow surprising. The participants had the tendency to fixate longer on the AOI Text in the screen condition compared to the physical one during free viewing. This could indicate prior experience or knowledge in reading when having something presented on a screen compared to when something is present in its physical form. However, the data already showed that this significant difference between viewing time of the AOI Text was changing to non-significant when the viewing goal changed to task-viewing (physical condition).

In conclusion, hypothesis H1a was partially rejected since a partial statically significant difference was found in terms of TFD in the two-way interaction between Condition and AOI. More specifically, the statistically significant results only held true for the free viewing but not for the task viewing. One (Text) out of the four AOIs showed a statistically significant difference in terms of TFD between physical and screen condition with p-value of <0.0001 for free viewing. More specifically, under free viewing, the mean TFD for AOI Text was higher when viewed in screen condition (3,2s) than in physical condition (2,5s). However, under task viewing, no statically significant difference was found for any of the AOIs between the two conditions.

Response Mean (TFD)				
Multiple Comparisons for Condition*AOI				
		Physical	Screen	
Viewing Goal	4xAOI	Estimate	Estimate	Prob>|t|
FV	Text	2472,5547	3191,0979	<,0001*
	Pictorial	1939,5614	1856,9335	0,9996
	Brand	661,4037	661,0357	1,0000
	Product Name	849,9891	820,6108	1,0000
Task Viewing	Text	2015,5681	2320,2391	0,1737
	Pictorial	2066,0692	2109,848	1,0000
	Brand	638,9037	679,1856	1,0000
	Product Name	842,522	841,7429	1,0000

Table 8: Multiple comparisons. Authors' own depiction.

6.3.2. Viewing Goal*AOI

6.3.2.1. Physical Condition

The simple two-way interaction between AOI and Viewing goal was significant for both conditions (physical and screen condition). The simple two-way **Viewing Goal*AOI** interaction effect for the physical condition was statistically significant (table 9). In variable terms, in the physical condition AOI effect on TFD did depend on the Viewing Goal meaning the Viewing Goal had an effect on how long the participants viewed different AOIs. Thus, there was a statically significant simple two-way **AOI*Viewing Goal** interaction for *physical condition*, $F(3, 107.2)=3.8874$, $p=0.0111$.

Response Mean (TFD)					
Fixes Effect Tests					
Source	Nparm	DF	DFDen	F Ratio	Prob > F
4xAOI	3	3	108,2	80,6234	<0,0001*
Viewing Goal	1	1	34,26	5,8158	0,0214*
4xAOI*Viewing Goal	3	3	107,2	3,8874	0,0111*

*Table 9: TFD - Fixed Effect Tests of two-way interaction Viewing Goal*AOI for physical condition.*

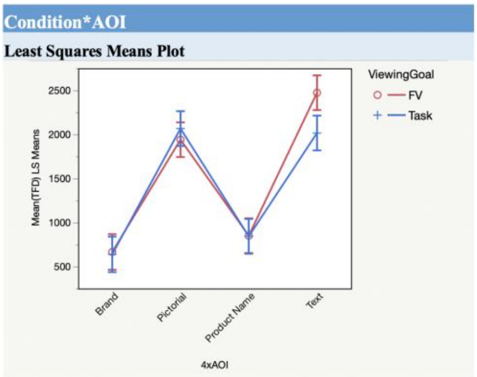


*Figure 7: TFD - Least Squares Means Plot two-way interaction Viewing Goal*AOI for physical condition.*

To establish a clearer picture of the simple main effects of this significant interaction effect between **AOI*Viewing Goal** we ran multiple pairwise tests (Appendix 7). The pairwise comparisons applying Tukey's HSD method revealed that the AOI Text was viewed significantly longer in the physical condition (in terms of TFD) when viewing goal was free-viewing (M=2472.5 95% CI 2275.2 to 2669.9ms) compared to when the viewing goal was task-viewing (M=2015.6, 95% CI 1818.3 to 2212.9ms), t=3.90, p=0.0041 (figure 7).

This study did not find any significant differences but a rather slim one in viewing time for the AOI Pictorial in the physical condition as the mean TFD revealed only slightly smaller viewing time when the viewing goal was free-viewing (M=1939.6, 95% CI 1742.2 to 2136.9ms) compared to viewing time when the viewing goal was task-viewing (M=2066.1, 95% CI 1868,7 to 2263.4ms) but the difference was not statistically significant, t= -1.8, p=0.9598. As for the AOIs Brand and Product name we did not find a statistically significant difference in viewing time for different viewing goals in the physical condition. An overview of the relevant tables and graphs with results is shown in Appendix 7.

6.3.2.2. Screen Condition

The simple two-way **Viewing Goal*AOI** interaction effect for the screen condition was statistically significant (table 10). In variable terms, in the screen condition AOI effect on TFD did depend on the Viewing Goal meaning the Viewing Goal has an effect on how long the participants viewed different AOIs. Thus, the simple two-way interaction between AOI and Viewing Goal for *screen condition* was statically significant, F(3, 108.3)=15.8428, p<0.0001.

Response Mean (TFD)					
Fixes Effect Tests					
Source	**Nparm**	**DF**	**DFDen**	**F Ratio**	**Prob > F**
4xAOI	3	3	108,1	105,6980	<0,0001*
Viewing Goal	1	1	36,28	29,3220	<0,0001*
4xAOI*Viewing Goal	3	3	108,3	15,8428	<0,0001*

*Table 10: TFD - Fixed Effect Tests of two-way interaction Viewing Goal*AOI for screen condition.*

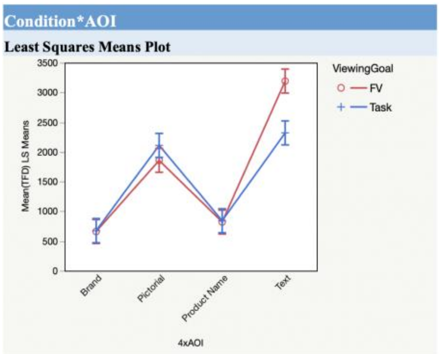


*Figure 8: TFD - Least Squares Means Plot two-way interaction Viewing Goal*AOI for screen condition.*

To establish a clearer picture of the simple main effects of this significant interaction effect between **AOI*Viewing Goal** we ran multiple pairwise tests (Appendix 8). The pairwise comparisons applying Tukey's HSD method revealed that the AOI Text was viewed significantly longer in the screen condition (in terms of TFD) when viewing goal was free-viewing (M=3191.1, 95% CI 2989.2 to 3392.9ms) compared to when the viewing goal was task-viewing (M=2320.2, 95% CI 2118.3 to 2522.1306ms), t=7.83, p<0.0001 (figure 8).

This study did not find any significant differences but a rather slim one in viewing time for the AOI Pictorial in the screen condition as the mean TFD revealed only slightly smaller viewing time when the viewing goal was free-viewing (M=1856.9, 95% CI 1655.0 to 2058.8ms) compared to viewing time when the viewing goal was task-viewing (M=2109.9, 95% CI 1907.9 to 2311.7ms) but the difference was not a statistically significant, t= -2.28, p=0.3170. As for the AOIs Brand and Product name we did not find a statistically significant difference in viewing time for different viewing goals in the screen condition. An overview of the relevant tables and graphs with results is shown in Appendix 8.

In conclusion, hypothesis H1b was rejected as statistically significant difference was found in terms of TFD in the two-way interaction Viewing Goal and AOI.

More specifically, one (Text) out of the four AOIs showed a statistically significant difference in terms of TFD between free viewing and task viewing with p-value of 0,0041 and <,001 for physical and screen condition respectively. In fact, for physical condition, the mean TFD for AOI Text was higher when viewed under free viewing (2,5s) than under task viewing (2,0s). Likewise, for screen condition, the mean TFD for AOI Text was higher when viewed under free viewing (3,2s) than under task viewing (2,3s).

Response Mean (TFD)				
Multiple Comparisons for Viewing Goal*AOI				
		Free viewing	**Task viewing**	
Condition	**4xAOI**	**Estimate**	**Estimate**	**Prob>|t|**
Physical condition	Text	2472,5447	2015,5681	0,0041*
	Pictorial	1939,5614	2066,0692	0,9598
	Brand	665,435	638,3597	1,0000
	Product Name	849,9891	842,522	1,0000
Screen condition	Text	3191,0979	2320,2391	<,0001*
	Pictorial	1856,9335	2109,848	0,3170
	Brand	661,0357	675,6863	1,0000
	Product Name	820,6108	841,7429	1,0000

Table 11: Multiple comparisons. Authors' own depiction.

6.3.3. Conclusion

A three-way mixed ANOVA was run to understand the effects of condition, viewing goal and AOI.

There was no statistically significant three-way interaction between AOI, Viewing Goal and Condition, F(3, 215.3)=1.8478, p=0.1395. Statistical significance of a simple two-way interaction was accepted for **Condition*AOI**, F(3, 216.3)=3.8965, p=0.0097 and **Viewing Goal*AOI**, F(3, 215.3)=17.4894, p<0001 but not for **Viewing Goal*Condition**, F(1, 69.75)=1.3905, p=0.2423. There were statistically significant simple two-way interactions of AOI and Condition for free-viewing F(3, 215.7)=4.2475, p=0.0061 but not for task-viewing, F(3, 214.1)=1.1862, p=0.3159. Moreover, there were statistically significant simple two-way interactions of Viewing Goal and AOI for physical condition F(3, 107.2)=3.8874, p=0.0111, as well as for screen condition, F(3, 108.3)=15.8428, p<0001.

6.4. Analysis based on TTFF

Similarly to the previous analysis, we ran a general linear mixed effect model (GLMM) for repeated measures with "CONDITION" as the study's between-subject variable and "VIEWING GOALS" and "AOI" as within-subject variables. The distribution of the TTFF variable also showed some skewness, but because the residuals of the test were again normally distributed, the model was considered valid and no log transformation was applied or needed. In this analysis we investigated the impact of the viewing condition (Physical/3D and screen/2D) and viewing goal (free-viewing/task-viewing) on the "initial" visual attention allocated to different AOIs based on how fast participants fixated on each AOI. This implied that we had to approach it as a three-way interaction between: **Condition*Viewing Goal*AOI** (Appendix 9).

The data revealed that the three-way interaction between **Condition*Viewing Goal*AOI** was on the border of significance, F(3, 211.1)=2.6092, p=0.05 (approximated from 0.0525). As the next step, we additionally ran analyses to investigate the two-way interactions. It appeared that the simple two-way interactions between viewing goal and AOI did differ between the groups of condition.

Fixed Effect Tests

	Source	Nparm	DF	DFDen	F Ratio	Prob > F
	Condition	1	1	71,68	0,1344	0,7150
	4xAOI	3	3	212,5	192,1662	<,0001*
	ViewingGoal	1	1	71,82	42,2397	<,0001*
(1)	Condition*4xAOI	3	3	212,5	1,4969	0,2164
(2)	Condition*ViewingGoal	1	1	71,82	2,011	0,1605
(3)	4xAOI*ViewingGoal	3	3	211,1	9,4816	<,0001*
	Condition*4xAOI*ViewingGoal	3	3	211,1	2,6092	0,0525

*Table 12: TTFF - Fixed Effect Tests of the three-way interaction Condition*Viewing Goal*AOI.*

Since the data did in fact present a slight statistically significant three-way interaction, the presence of statistical significance was investigated between two-way interactions, which are exhibited in table 12.

- (1) Two-way **Condition*AOI** interaction
- (2) Two-way **Condition*Viewing Goal** interaction
- (3) Two-way **Viewing Goal*AOI** interaction

As shown in table 12 the two-way interaction between **Condition*Viewing Goal** was not statistically significant, F(1, 71.82) = 2.0110, p=0.1605. Similarly, table 12 reveals that there was no statistically significance two-way interaction between **Condition*AOI**, F(3, 212.5)=1.4969, p=0.2164.
However, the two-way interaction between **Viewing Goal*AOI** was found to be statistically significant, F(3, 211.1)=9.4616, p<0001.

6.4.1. Viewing Goal*AOI

6.4.1.1. Physical Condition

The simple two-way **Viewing Goal*AOI** interaction effect for the *physical condition* was statistically significant (table 13). In variable terms, in the physical condition AOI effect on TTFF did depend on the viewing goal meaning the viewing goal had an effect on how fast the participants looked at the different AOIs. Thus, there was a statically significant simple two-way **AOI*Viewing Goal** interaction for *physical condition*, F(3, 103.2)=2.9124, p=0.0380.

Response Mean (TTFF)
Fixes Effect Tests

Source	Nparm	DF	DFDen	F Ratio	Prob > F
4xAOI	3	3	104,1	115,8158	<0,0001*
ViewingGoal	1	1	35,95	11,5529	0,0017*
4xAOI*ViewingGoal	3	3	103,2	2,9124	0,0380*

*Table 13: TTFF - Fixed Effect Tests of two-way interaction Viewing Goal*AOI for physical condition.*

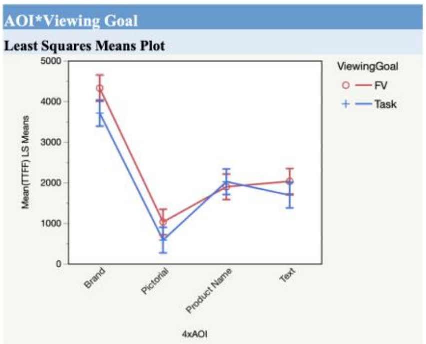


*Figure 9: TTFF - Least Squares Means Plot two-way interaction Viewing Goal*AOI for physical condition*

To establish a clearer picture of the simple main effects of this significant interaction effect between **AOI*Viewing Goal** we ran multiple pairwise tests (Appendix 10). The pairwise comparisons applying Tukey's HSD method revealed that the AOI Brand was fixated significantly faster in the physical condition (terms of TTFF) when viewing goal was task-viewing (M=3708.9, 95% CI 3386.0 to 4031.9ms) compared to when the viewing goal was free-viewing (M=4322.5, 95% CI 3999.6 to 4645.4ms), t=3.22, p=0.0354 (figure 9). The AOI Pictorial was fixated faster in the physical condition (in terms of TTFF) when viewing goal was task-viewing (M=581.1, 95% CI 266.6 to 895.5ms) compared to when the viewing goal was free-viewing (M=1026.1, 95% CI 711.6 to 1340.5ms) but this difference was not statistically significant, t=2.41, p=0.2460.

The AOI Text was fixated faster in the physical condition (in terms of TTFF) when viewing goal was task-viewing (M=1687.3918, 95% CI 1372.9448 to 2001.8388ms) compared to when the viewing goal was free-viewing (M=2029.3, 95% CI 1714.8 to 2343.7ms) but this difference was not statistically significant either, t=1.85, p=0.5850. The AOI Product Name was the only AOI that was not fixated faster in the physical condition (in terms of TTFF) when viewing goal was task-viewing (M=2019.2, 95% CI 1704.7 to 2333.6ms) compared to when the viewing goal was free-viewing (M=1893.3, 95% CI 1578.8 to 2207.7ms), so there was no statistically significant difference, t= -0.68, p=0.9973. An overview of the relevant tables and graphs with results is shown in Appendix 10.

6.4.1.2 Screen Condition

The simple two-way **Viewing Goal*AOI** interaction effect for the *screen condition* was statistically significant (table 14). In variable terms, in the screen condition AOI effect on TTFF did depend on the viewing goal meaning the viewing goal had an effect on how fast the participants view different AOIs. Thus, the simple two-way interaction between AOI and viewing goal for screen condition was statically significant, F(3, 107.4)=9.2263, p<0.0001.

Response Mean (TTFF)
Fixes Effect Tests

Source	Nparm	DF	DFDen	F Ratio	Prob > F
4xAOI	3	3	107,7	83,5721	<0,0001*
ViewingGoal	1	1	35,9	36,0501	<0,0001*
4xAOI*ViewingGoal	3	3	107,4	9,2263	<0,0001*

*Table 14: TTFF - Fixed Effect Tests of two-way interaction Viewing Goal*AOI for screen condition.*

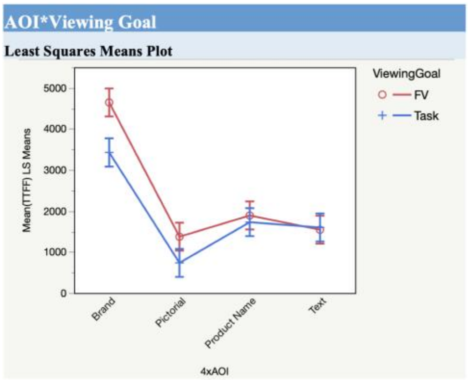


*Figure 10: TTFF - Least Squares Means Plot two-way interaction Viewing Goal*AOI for screen condition.*

To establish a clearer picture of the simple main effects of this significant interaction effect between **AOI*Viewing Goal** we ran multiple pairwise tests (Appendix 11). The pairwise comparisons applying Tukey’s HSD method revealed the AOI Brand was fixated significantly faster in the screen condition (terms of TTFF) when viewing goal was task-viewing (M=3426.9, 95% CI 3082.4 to 3771.6ms) compared to when the viewing goal was free-viewing (M=4645.2, 95% CI 4304.4 to 4985.9ms), t=6.71, p<0.0001 (figure 10).

The AOI Pictorial was fixated statistically significant faster in the screen condition (in terms of TTFF) when viewing goal was task-viewing (M=737.0, 95% CI 396.2 to 1077.8ms) compared to when the viewing goal was free-viewing (M=1373.8, 95% CI 1033.1 to 1714.6ms), t=3.55, p=0.0131.

The AOI Text was fixated almost as fast in the screen condition (in terms of TTFF) when viewing goal was task-viewing (M=1599.3, 95% CI 1258.5 to 1940.1ms) as when the viewing goal was free-viewing (M=1544.2, 95% CI 1203.4 to 1884.9ms), so there was no statistically significant difference, t= -0.31, p=1.000. The AOI Product Name was not fixated faster in the screen condition (in terms of TTFF) when viewing goal was task-viewing (M=1728.0, 95% CI 1387.2 to 2068.8ms) compared to when the viewing goal was free-viewing (M=1891.4, 95% CI 1550.7 to 2232.2ms), so there was no statistically significant difference, t=0.91, p=0.9845. An overview of the relevant tables and graphs with results is shown in Appendix 11.

In conclusion, H2a was confirmed as no statically significant difference was found in terms of TTFF in the two-way interaction between Condition and AOI. The H2b hypothesis was rejected as a statistically significant difference was found in terms of TTFF in the two-way interaction between Viewing Goal and AOI. More specifically, for physical condition one (Brand) out of the four AOIs showed a statistically significant difference in terms of TTFF between free viewing and task viewing with p-value of 0.0354. In fact, the mean TTFF for AOI Brand was higher when viewed under free viewing (4.3s) than under task viewing (3.7s). Likewise, for screen condition, two (Pictorial and Brand) out of the four AOIs showed a statistically significant difference in terms of TTFF between free viewing and task viewing with p-value of 0.0131 and <0.0001 for AOI Pictorial and Brand respectively. In fact, the mean TTFF for AOI Pictorial was higher when viewed under free viewing (1.4s) than under task viewing (0.7s). Similarly, the mean TTFF for AOI Brand was higher when viewed under free viewing (4.6s) than under task viewing (3.4s)

Response Mean (TTFF)				
Multiple Comparisons for Viewing Goal*AOI				
		Free viewing	Task viewing	
Condition	4xAOI	Estimate	Estimate	Prob>|t|
Physical condition	Text	2029,2722	1687,3918	0,5850
	Pictorial	1026,0875	581,0911	0,2460
	Brand	4322,5208	3708,9503	0,0354*
	Product Name	1893,2341	2019,1512	0,9973
Screen condition	Text	1544,1472	1599,2702	1,0000
	Pictorial	1373,8443	737,006	0,0131*
	Brand	4645,1679	3426,9691	<,0001*
	Product Name	1891,4394	1728,0224	0,9845

Table 15: Multiple comparisons. Authors' own depiction.

6.4.2 Conclusion on TTFF

A three-way mixed ANOVA was run to understand the effects of condition, viewing goal and AOI.

The three-way interaction between AOI, Viewing Goal and Condition, F(3, 211.1)=2.6092, p=0.0525 is on the border of significance. Moreover, statistical significance of a simple two-way interaction was accepted for **Viewing Goal*AOI**, F(3, 211.1)=9.4816, p<0.0001 but not for **Viewing Goal*Condition**, F(1, 71.82)=2.0110, p=0.1605 nor **AOI*Condition**, F(3, 212.5)=1.4969, p=0.2164. There were statistically significant simple two-way interactions of AOI and Viewing Goal for physical condition F(3, 103.2)=2.9124, p=0.0380, as well as for screen condition, F(3, 107.4)=9.2263, p<0.0001.

7. DISCUSSION

7.1. Discussion of analysis results

The purpose of the analysis was to investigate the research question, i.e. whether consumers' allocation of visual attention to stimuli differs when they are exposed to screen images (2D) from when they are exposed to physical products (3D). It is relevant to study the two viewing conditions since a difference would have a significant impact on the validity of the results, when an eye-tracking methodology is used for studying product design and/or in-store promotions. It has been assumed both in academic and commercial research that viewing a marketing stimulus on a screen has none or low influence on visual allocation of attention. Hypotheses were formulated to challenge this along with the assumption that the results of studies conducted on screen in a laboratory are generalizable to real-life settings.

The first analysis based on TFD showed that participants spent more time gazing the text on the product packages when presented on the computer screen compared to when they were presented in physical form. One explanation to this phenomenon may be that text received more attention due to top-down mechanism related to prior knowledge, experience or expectations causing these processes to be more engaged. It may have been triggered either by the participants' tendency to associate a screen with reading or by their anticipation of follow up questions related to what they have viewed, thereby collecting as much information as possible.

In fact, the findings for AOI Text revealed that the mean fixation duration for screen images was 3191.1 ms and 2320.2 ms under free viewing and task viewing respectively, while regarding physical packages it was 2472.5 ms and 2015.6 ms respectively. When considering the effect of cognitive goals in the viewing pattern of consumers, the results showed that in both situations where the stimuli were presented on the computer display and in real-life, text was the element participants fixated the longest among the AOIs and more specifically the mean fixation duration was longer under free viewing, as opposed to task viewing.

What is important to notice and also surprising is that overall text was found to be viewed a lot shorter (in terms of mean TFD) in both conditions under task-viewing compared to free-viewing and data revealed that there was a rather uniform distribution between the AOIs under task-viewing. Thus, when the text received less attention, more attention was distributed to the other elements. This was especially true for the AOI Pictorial which attracted more attention (in terms of TFD) under task viewing compared to free viewing in both conditions. It caused some of the attention which was previously devoted to the AOI Text to then be transferred to the AOI Pictorial under task viewing. Thus, the attention allocated to the AOIs appeared more evenly distributed when the task was introduced.

The finding was relevant considering the results of the previous study from Suurmets et al. (2019) which discovered a significant difference between the two viewing conditions in regard to the AOI Pictorial. However, such significant difference was not found in this study. In fact, the data collected in this study did not show that people had a clear tendency to look at the picture significantly longer in real-life condition in contrast to on-screen condition, even though the TFD was slightly higher in the real-life condition (3D). The reason behind the significant difference found in the previous study can be associated with the fact that the visual stimuli were different products with different AOIs (i.e. cereal packages and tea packages), while in this study the focus was solely on cereal packages, presenting rather similar AOIs.

In broad terms the results of this study may have indicated that in free-viewing condition, participants processed the information on the product packages following more the peripheral route based on their low involvement, thus involving little cognitive effort from the participant. This was expressed in slower pace of screening the package elements while being more focused on one or few of those elements. Therefore, the viewer relied on the bottom-up cues that were easy to process and based more on the attractiveness of the elements in the visual field. At the same time, findings may had largely indicated that participants processed the information on product packages via the central route when task viewing is considered, since task viewing required the viewer to generate a response to the question: “What is the retail price of this product?”. To answer this question a higher involvement level was required from the participant as the given task demanded considerably greater cognitive effort and more focused or systematic processing of the information on the packages, opposed to when participants could freely view the products.

By using the central route, participants deliberately attended to the packages, carefully processed the elements and its information, in particular those they believed were relevant or important for a meaningful and logical evaluation of the product, and generated a response based on their own judgment of the quality or price of the product. This was expressed in faster pace of screening the package elements (lower TTFF values) and more uniform distribution of attention to different package elements. The results of this study indicated the use of central route to generate a price expectation, and therefore a response to the task although this is just one possible explanation and it only partially supports the theory. Generally, price expectations can be generated through both routes depending on whether people use quality inference like in our case or whether they use attractiveness judgment to form a price expectation (Kitchen et al., 2014; Orth et al., 2010; Te’eni-harari et al., 2007). Our results can possibly be explained by that fact that we would have not anticipated participants to generate price expectations in free viewing. Given that this would have required them to have their own top-down influence or agenda to determine the price, it may have been highly unlikely for viewers to engage peripheral route for price evaluation in this study. In fact, under free viewing, even though consumers possessed their own internal goals and tasks when looking at a product, we would expect them to view the product as a combination of salience and semantic significance of the elements in order generate an evaluation based on its attractiveness and personal liking, rather than price. Although we cannot say for sure whether these claims are correct, therefore the routes proposed by the ELM framework and our interpretations of the results are merely one possible explanation or pure speculation.

Also, it is very likely that our participants did not all create a price expectation for each viewed product in the same way. This study discovered some interesting findings which support the study of Orth et al., (2010). Our study included a few post-experiment questions where one of them was consisted of the price estimation. What we saw was that participants had a tendency to increase their price (from their baseline) when they considered the package to be of higher quality. When asked the reason why they attributed a higher price to a specific package the answers were related to e.g. what the vitamin levels and types were, whether it was gluten free, how the brand looked (green/natural) or it was all natural ingredients. As a result, this study is to some extent supporting what has previously been found since quality operated as a mediator for the price evaluation meaning that the assumed higher quality of the package led the participant to give a higher estimated price. More specifically, this was the case for the products that appeared to be "natural" as well as the products that were considered more attractive, namely the packages that were better developed and more professional design according to participants. Hence, a link between attractiveness and quality of the products can also be traced, thereby making attractiveness another factor that can influence consumers price expectations (Orth et al., 2010). Nonetheless, these post experimental questions were not presented or drawn up as a formal questionnaire, so the reliability and validity of the answers are not strong enough to be considered an actual result of the study even though the findings are interesting. This creates an opportunity for further research to investigate this further by conducting a post-experimental survey that focuses on the price estimations.

The second analysis based on TTFF showed that the element which was looked at the fastest was the AOI Pictorial for screen condition, especially under task viewing when participants viewed it faster than under free viewing. In fact, the findings revealed that the mean time to first fixation for AOI Pictorial for screen images was 737 ms and 1373.8 ms for free viewing and task viewing respectively, presenting a statistically significant difference. Whereas, findings revealed that the mean time to first fixation for AOI Pictorial for physical products was 2472.5 ms and 2015.6 ms respectively, but the difference was not statistically significant. The analysis further showed that participants looked at the brand significantly faster when they were given a task compared to when they were freely looking at the stimuli both when stimuli were presented on screen and when they were shown as physical products. Consequently, the AOI brand was viewed significantly faster when participants were given a task compared to when they were free viewing the stimuli. This significant difference was found in both conditions. In fact, the findings revealed that the mean time to first fixation for AOI Brand for screen images was 4645.17 ms and 3427 ms for free viewing and task viewing respectively, while regarding physical packages it was 4322.52 ms and 3709 ms respectively.

As stated above, an important and interesting finding revealed in this study was that when people evaluated packages they looked at the brand element significantly faster when they were given a task compared to when they were free to view the product, implying that under free viewing brand was prioritized less. The brand has been defined as a set of mental associations and added perceptions, held by the consumer with reference to a product or service (Kapferer, 2008). Moreover, the brand has the power to influence buyers thanks to the representations and relationships it evokes in the consumer. The importance of the brand is related to its ability to reduce perceived risk, which is especially present in specific industries like the food one e.g. coffee, tea, cereal, fresh pasta (ibid). Thus, a certain level of intrinsic risk requires higher involvement for the consumer in choosing the product and can especially be experienced in relation to opaque products, i.e. product whose inner qualities are to be discovered only after purchasing and consuming the product. As many consumers are reluctant to buy opaque products, it becomes essential for the external cues to highlight the internal qualities of the products. Hence, a brand is an efficient sign (ibid) of the superiority of some valued benefits or hidden qualities, which could be leveraged by consumers to gather information about the product as well as its qualities, allowing them to determine its value.

The informative function of the brand extends to its role of recognized symbol that can facilitate choice and gain time (ibid). This study confirmed that when people had to define the value of the product, in comparison to when they were not required to follow a specific task when looking at the product, brand was prioritized and thus, viewers directed their attention to the brand element much faster. This is supported by the fact that the subjects of this study relied on brand as a source of information and signal of its qualities in order to define the value, namely the price, of the product. During task-viewing a top-down influence was induced which led the participant to use prior knowledge and experience (top-down) in regard to the informativeness of a brand and its symbolic value. Therefore, this supports that top-down attention was generated and driven to fixation points that were high in semantic information and cognitive relevance (i.e. brand) based on the viewer's task (Ballard and Hayhoe, 2009).

Brand is acknowledged as a name that has the power of influencing buyers which is confirmed by our findings. Even though in this study all the brands on the product packages were fictional, they still significantly influenced how consumers distributed attention to the products, in particular when they were given the task of assessing the value the products in terms of price. Therefore, brands are seen as source of information, supporting the general tendency (prior knowledge) of consumers to rely on brand elements as sign of qualities, values and benefits of the product, regardless of the amount of brand awareness. In general, this implies that under task-viewing participants engaged in faster scanning of elements and more rapid information acquisition.

The results of both analysis (TFD and TTFF) were aligned with the few previous studies and findings which discussed the difference in visual attention between viewing conditions. The difference in visual attention between the two viewing conditions was most noticeable under free viewing. This study did not find a significant difference under task-viewing. It was confirmed that the presence of task and its level of detail can influence how viewers allocate their attention and thus their fixations (Hayhoe et al., 2003; Land et al., 1999). Furthermore, the results of the study demonstrated that the purpose of viewing differed when participants looked at images of the product packages and when they looked at the product packages in real life.

This was supported by Tatler et al. (2011) and in addition it showed that during a task like guessing the price of a product the purpose of the vision became collecting visual information and was guided by the desire of completing the task (this was seen as the participants got more uniform distribution on all elements in order to answer the question or estimate the price of the product). Therefore, there was clear proof of the existence of different principles driving gaze and fixations targets. Following the Yarbus implication, the level of informativeness of an object is tightly related to specific processing goals and the eye movements are a reflection of it. It was proved by Pieters and Wedel (2007) in relation to attention of ad objects as they found that specific processing goals (tasks) influenced the attention allocated to specific ad objects. Hence, the task is what determines the fixation points on an object. These points will vary based on the character of the information that the participant needs, given that different items of information are usually located in different parts of an object. The results presented in this study support these findings as a clear difference was found in relation to attention to the elements depending on the cognitive goal (free viewing vs. task viewing).

Moreover, the level of informativeness of a specific element was dependent on a precise goal, i.e. determine the price, rather than being solely linked to the element. Therefore, this specific finding from Pieters and Wedel (2007) could possibly be extended and applied outside of advertisement (ad objects) and applied to other product packaging (elements on packages) and packaging literature. Lastly, the findings of this study provide further support to the existing literature that attention is the result of the combination of bottom-up (stimuli presentation method and AOI) and top-down (cognitive goals) features or mechanisms, as it is the integration of salience and informativeness of the different AOIs (Milosavljevic and Cerf, 2008; Pieters and Wedel, 2007).

On one hand, this study shows that visual attention was guided bottom-up across product packages by the stimuli presentation methods itself and salience of the attended elements based on features like colour, contrast, size etc. of the elements. On the other hand, participants' attention was allocated top-down by the extent of informativeness of each element according to a specific goal, involving both the viewers' personal goal or agenda and the given task of estimating the price of the products. Therefore, it results that it was not possible to separate bottom-up and top-down processes.

Previous studies have proposed and advocated that salient bottom-up factors (e.g. shape, color, contrast, size etc.) control initial attention (Clement et al., 2013), whereas the more semantic top-down factors (text, picture and brand in relation to the associated meaning and value) have more relevance later on during an evaluation of the stimuli (Mehmedovic et al, 2017; Pieters and Wedel, 2004). More specifically, some authors define bottom-up features as more dominant determinants of fixations points early after the onset of the stimulus (Carmi and Itti, 2006; Nyström and Holmqvist, 2008; Parkhurst et al., 2002). However, other authors instead claim that bottom-up features control visual attention over time in a rather uniform way, while top-down features become more influential with the increase of viewing time (Nyström and Holmqvist, 2008). Consequently, it is possible that the significant influence that bottom-up factors exert on visual attention and fixation points soon after the stimulus is presented is later overridden by top-down factors making it impossible to separate the two (Mehmedovic et al., 2017). Therefore, it demonstrates that visual attention is and should be considered reflective of both visual features of a scene and contextual cues (Suurmets et al., 2019).

7.2. Discussion of implications

The discussion of our results highlights the problems related to the external validity of previous screen-based eye tracking studies especially those using free viewing. Consequently, this section should be of special concern to both practitioners and academics, as it section will discuss the implications of the findings for managers and academics.

7.2.1. Managerial implications

According to the literature, product packaging is an important marketing tool that communicates the product characteristic and benefits, as well as brand values. From a managerial perspective, our results provide managers with valuable insights in terms of how consumers attend package designs in different conditions. Thus, they provide alternative possibilities to overcome certain marketing problems. The design of packages is important not only for cereals or FMCG but all consumer goods, as it allows products to stay relevant. Therefore, the results from this thesis provide a wide range of managers with insights in how consumers attend packages and use different attributes to estimate the value of the product. These insights can be used for e-commerce and/or for brick and mortar based on how consumers allocate their visual attention. The first phase (free viewing) of the experiments conducted in this study provides us with enough evidence to confirm that screen based eye tracking results are not entirely generalizable to how consumers attend to products in real life. Hence, screen results would only be suitable for screen scenarios and setups.

As a result, it is important to notice that the difference in visual attention between viewing conditions is only really noticeable under free viewing. This implies that managers who use a screen to evaluate their new ads or product packages or rely on screen results from existing literature can end up with misleading results if they are to use these results to sell their products in physical stores. Consequently, managers would have to make the evaluation based on physical products unless they plan on distributing their product online where this would not be a problem. If the consumers are given a defined cognitive task (such as evaluating the price), however, the role played by the stimulus method appears to decrease, implying that screen-based setup may still be suited for investigating some research questions.

An example of how our results can be applied by managers can be found in regard to the AOI Text. In fact, the statistically significant difference between the two viewing conditions outlined that consumers gazed much longer at the text when shown on a computer display than when shown on physical products. This implied that the textual element drew more attention and therefore was prioritized more when viewing on-screen. Thus, managers can leverage these inputs and translate them in effective messages to the audience in accordance with the display method used. Leveraging the data of mean ms of the fixations can help managers determine if the duration of fixations on the text element are long enough to be read and understood. Since text was fixated significantly longer than any other AOI, companies should focus on text and define its structure based on whether it is meant to be displayed in real life settings or on a screen. Therefore, overall among all the elements on the product package the most informative and detailed core messages of the product should be embodied in the text in both physical and screen condition. Moreover, when designing packages addressed to online shoppers, companies could dedicate even more space and relevance to text, opposed to when packages are going to be displayed in brick and mortar.

Another example of how our results can be applied by managers can be *found* in regard to the AOI Brand. In fact, the statistically significant difference between the two viewing goals outlined that consumers gazed much faster at the brand when they were executing the task of defining the price compared to when they were not assigned a task. This implied that the brand element drew faster attention and therefore was prioritized more when viewing the product was guided by the evaluation task. The brand owners should build a strong brand identity, and the brand on the package should then be salient (easy to notice) and remind them of these brand values. In fact, Chandon et al. (2009) found that out-of-store factors influence visual attention but much less than in-store factors. It was shown in their study that in-store factors had powerful effects on attention that translated into small but reliable effects on brand evaluation. These small effects built up over time and contributed to individual-specific out-of-store factors (Chandon et al., 2009). Thus, managers can leverage these inputs and translate them into effective brand messages and symbols to the audience in accordance with the cognitive goal. Despite the AOI Brand not being the first element viewers looked at on a product package, companies should still make it relevant as consumers rely on it for its informative and symbolic value. This is supported by our findings which revealed that the brand was the only element with any statistically significant difference between viewing goals under both viewing conditions.

In terms of how fast attention is devoted to the AOI Pictorial, the results showed a statistically significant difference between the two viewing goals only when packages were shown on screen. In fact, consumers gazed significantly faster at the pictorial element when they were viewing the product on screen. This was particularly true when executing the task of defining the price compared to when they were not assigned a task. This implied that the pictorial element drew faster attention and therefore was prioritized more when viewing was guided by the evaluation task compared to free viewing, but only when stimuli were presented on screen. It may indicate that, to get an understanding of the scene, people first search for pictorial cues probably because it is faster to process pictures than to read words. In this case, managers can leverage these inputs and translate them in effective graphic and pictorial figures to the audience in accordance with the cognitive goal.

Overall, the AOI Pictorial was the element which viewers fixated on the fastest among all AOIs. Thus, the AOI Pictorial appeared to catch the attention the fastest, therefore it is important to make the pictures on the packages appealing or interesting in order to catch or maintain attention thereby increasing the likelihood of the product being selected. Increased attention to the package has been shown to correlate with increased likelihood of being chosen (Gidlöf et al., 2017). Consequently, companies should prioritize the pictorial element of product packages in order to draw consumers attention to the product. This mostly applies for e-commerce, but it would be wise to consider devoting more time and effort on illustrations also for brick and mortar, since the mean TTFF showed that AOI Pictorial was viewed much faster than other AOIs, even faster when compared to on-screen condition. However, no statistically significant difference was discovered for physical condition, and thus it is not possible to decisively conclude on the results of devoting more effort to the pictorial element when selling the products in physical stores.

Our results proved that the underlying assumption of generalizability of eye-tracking data from screen studies to real-life settings has to be questioned and challenged at least when applying the free-viewing paradigm. As a consequence, the related implications generate problems for companies conducting eye-tracking research. This especially applies when managers already allocated investment in eye-tracking and directly applied eye-tracking results from laboratory studies to draw on in-store consumer behavior. Moreover, issues can arise for companies which relied solely on eye-tracking data from on-screen studies in order to design products and product packages sold in physical stores, with no concerns towards the external validity of the data. It is important to emphasize that these conflicts are considered less relevant for managers applying task-viewing to evaluate their options as the difference between the viewing conditions is less influential in this case.

The rising relevance of eye-tracking has led to a rapid growth of adoption of eye-tracking technology in the commercial field (Wedel and Pieters, 2006). This is supported by the fact that the neuromarketing research has been recognised as a valuable opportunity for companies to survive the rising competition by understanding what attracts consumers' attention and guides their gaze. Deeper insight on eye movements allows companies to define which elements in the visual field consumers focuses the most on and which elements might influence their behaviour the most (Kumar et al., 2016). Therefore, the same method used in this study could possibly be applied to other FMCG or consumer goods category since these are expected to rely on most of the elements used in this study. Thereby, this information could provide consumer goods companies with a valuable opportunity to improve their own designs as well as adopting eye-tracking or neuromarketing research in a more valid and fruitful manner.

This is considered rather essential as 73% of consumers purchasing decision making takes place at the point-of-sale (Rettie and Brewer, 2000; Rundh, 2013). Therefore, packages can function as the main means to convey information about the product, determine consumers preferences and consequently influence purchasing behavior. The design of a product package is an important visual marketing tool (Mehmedovic et al., 2017), given its functional and communicative role, as well as its ability to achieve product differentiation and competitive advantage (Rundh, 2009; Rundh, 2013). Furthermore, this study provides advances in the packaging literature and research which manager can use by testing visual attention to different AOIs on cereal packages. It presents data regarding how attention differs between the AOIs, how task influences fixations and how attention is allocated on product packages when they are displayed on screen and when they are shown in physical form. The findings offer insights on which elements on the packages attract the longest fixation duration and which are looked at the fastest. Thus, this information could be used by companies in designing product packages as it increases the chances of the product to get noticed by consumers at the point of sale.

The communicative role of the packages was confirmed by our findings. In fact, participants had a tendency to fixate on all the elements on the package in order to gather information about the product based on their own self-interest and preference and also in order to determine the price of the product. The elements of the packages are key in defining the packages structure and role, meaning the way the information is conveyed. As a result, when applied to packaging, eye-tracking represents a way for companies to understand how consumers allocate their attention to the different elements of package designs and how these elements impact their purchasing decisions (Clement et al., 2013; Mehmedovic et al., 2017). Moreover, it allows companies to improve products and package design making the product, and therefore their brand, stand out, recognizable and considered in the set of choices of consumers (Rettie and Brewer, 2000), leading to a higher likelihood of the product to be purchased (Gidlöf et al., 2012; Rundh, 2009).

Therefore, in order to attract consumers visual attention, a specific product (package) and/or element needs to be sufficiently distinctive and deviating from what is commonly known in order to become visible from the competition (Gaber, 1995; Gaber et al., 2000). However, when the product and/or element becomes too distinctive then attention can just bounce back from the package. This can be explained by the fact that the increase in distinctiveness of a package design leads to higher attention only up to an optimal point after which any further increase causes attention to drop (Schoormans & Robben, 1997). In conclusion, companies should find the right balance when defining how to make their product visually stand out.

From a managerial perspective, this paper offers insight on product design and packaging and allows companies to gain knowledge about the amount of attention each packaging element attracts in a real-life setting (i.e. on shelf product) as well as virtual setting (i.e. online shop). Furthermore, this study provides firms with inputs which could be employed as insights that can help to optimize package designs and too define the company's visual identity by selecting the right place and space to allocate to each individual element on the packaging. On this account, companies can design product packages giving more or less emphasis on the different visual elements based on how much visual attention is dedicated to them by consumers. These insights can be beneficial for companies in the early stages of the product design and/or package design as well as branding or rebranding. In particular, applying eye-tracking studies to marketing purposes and package design can be especially useful for companies with low marketing budgets since it allows them to invest more efficiently and to use the results from this study as well as previous eye-tracking studies as benchmark to develop their own product packages, also considering if they are unable to perform their own neuromarketing study.

When firms apply the insights from this study to the design of their product packages they need to take into account the competitive landscape, how the products are currently perceived by consumers, how improved or new product packages could be perceived by their target audience and not just selling method (e-commerce or physical store). Changes to the visual elements of a product package need to be aligned with the brand identity along with the marketing goal in order to understand which packaging roles should be prioritized. The success of a product package stands in its ability to protect the product as well as capture attention and drive gaze to elements which deliver the relevant information about the product, create positive associations and trigger decision. Firms also need to take into account whether they are selling their product physically, through e-commerce or both as this would significantly influence how the results presented in this thesis can be applied and which results actually apply for the firm's specific selling methods. It is argued to be particularly challenging for managers and their firms that sell their products both offline and online since a clear trade-off is needed in order to optimally design a product package that fits both selling methods making this an important consideration for the managers.

Another implication for managers applying eye-tracking relates to the complexity of the technique and analysis of data. Eye-tracking requires a good understanding of how to handle the equipment, how to inform participant and protect their rights, how to collect and analyze data, how to interpret the results and how to apply the findings in real-life. Consequently, companies are required and encouraged to have background knowledge into neuromarketing, eye-tracking devices and techniques in order to get reliable and consistent data. A certain level of expertise is also necessary in order to avoid unspotted errors when conducting the study as well as when analyzing the data. Furthermore, given that cognitive processes are rather complex and there is still some lack of knowledge about them, companies without the required expertise can easily interpret their data as valid with no investigation of the errors or ambiguous results, as well as with no complete understanding.

Given the results of this study, the managerial implications developed in previous eye-tracking studies are challenged by the breaking of the assumption that findings of on-screen eye-tracking studies are generalizable to real-life consumer behavior. The analysis of data conducted in this study points out that there is a difference between how people allocate their attention to products when they are presented as pictures and as physical objects when participants are freely looking at the products. Consequently, studies conducted on-screen should be considered representative of on-screen consumer behavior only. This study's takeaways serve as valuable knowledge for businesses who invest in package design research, product design development and packaging production, as well as businesses which are interested in or already conducting eye-tracking studies on package design. Additionally, it serves to provide managers with valuable insights on how to optimize existing product packages or create new ones in order to break through the clutter. This is possible due to the better understanding of the attention devoted to each of the studied package features and their distinctive roles caused by the different stimuli display methods and cognitive goals. Thereby, the main takeaway from our study is to broaden the impact and scope of business research in order to provide managers with valid, fruitful and actionable results.

7.2.2. Academic implications

The main contribution in academic terms is that we challenged the assumption underlying most eye-tracking research and demonstrated that the assumption is only valid in some cases and under certain circumstances. In academic research it is a common practice to display stimuli on the screen (Mehmedovic et al., 2017), disregarding the differences in stimulus dimensions and/or stimuli presentation method (Chandon et al., 2009; Tonkin et al., 2011). This study tested the assumption underlying the generalizability of results from screen (2D) to real life (3D) and found that the commonly used methods may introduce biases. However, with a defined task the impact of the stimulus display method is smaller and this might also be the case with other tasks. Our study is among the first to directly analyze visual attention to marketing stimuli, more specifically packages, in the two viewing conditions and put them in contrast while keeping all variables constant, except for the stimulus presentation method. Furthermore, the research was extended to evaluate the impact of cognitive goals by including both free-viewing and task-viewing. Therefore, our study strengthens the understanding of visual attention and how the viewing condition impacts on consumers visual behavior. The results show that consumers' attention to product packages is different depending on whether they are viewed as pictures on a computer screen or as physical products in real life. Therefore, we provided evidence regarding the weakness of the generalizability of on-screen research to real life settings. Researchers should take into account the role of the screen in their study, as findings of studies conducted using a screen are not necessarily applicable to in-store consumer behavior.

Previous studies have researched the impact of the two different settings on consumers visual attention. In order to measure the difference, Tonkin and colleagues (2011) compared physical and virtual viewing environments by exposing participants to cereal packages showcased on a real-life shelf display and a snapshot of this same display projected onto a wall. Therefore, this can be considered the study which presents the most similarities to ours in regard to visual stimuli and test of the differences between viewing conditions. However, the setup in the Tonkin et al. (2011) study had some limitations, such as the poor fidelity and quality of the projected display compared to real-life shelf. In addition, instead of just using a search task we used two viewing motives (free-viewing and task-viewing) which could possibly be regarded as more informative from the perspective of consumer information processing.

Hence, the two viewing conditions are highly relevant. On one hand, free-viewing allowed to maximize the impact of the stimulus-driven attention. Participants were able to fixate on the AOIs that they deemed informative, interesting and/or standing out. On the other hand, task-viewing allowed to outline the impact of task-driven attention. Participants fixated on the AOIs that they deemed useful to make an evaluation of the product's value. Throughout the years a general consensus has emerged regarding eye-movements being a product of stimulus driven attention and goal driven attention. Therefore, our findings further supports the existing body of literature that suggests that attention is the results of the combination of bottom-up (viewing condition and AOIs) and top-down (cognitive goals) mechanisms where an integration of the salience and informativeness of each AOI happens (Milosavljevic and Cerf, 2008; Pieters and Wedel, 2007). This study expands the findings found in Tonkin et al. (2011) and suggests that consumer studies where products are presented in their physical form (Clement et al., 2013; Gidlöf et al., 2012) are likely to have higher external validity than those where products are presented and/or on a screen (Chandon et al., 2009; Huddleston et al., 2015).

Furthermore, there is a consensus in the branding literature that one of the functions of brand is to communicate brand values and to evoke certain associations and perceptions in the consumer's mind in relation to a product. It has been discussed that the informative and symbolic role of the brand can influence consumer behavior. Nevertheless, to the authors' knowledge, this is one of the first demonstrations of the relevance consumers give to the brand element as a result of the comparison between the viewing goals. Our findings show that the presence of task led participants to attend to the brand faster than under free-viewing. Thereby, the brand is used as a heuristic element to evaluate a product as it recognized as a sign of the qualities, values and benefits of the product. Some of the findings presented in this study could possibly be applied to advertising as they would have some of the same elements, although ads also include other or additional elements that were not included in this study. Hence, companies could tailor the ad to whether it will be a print ad or it will be used in an online campaign, meaning that a more thorough and descriptive message would be more suitable for an online ad as people spend more time looking at the text on-screen when they are viewing without a task. Since the concept of informativeness of ad objects which is strictly related to processing goals developed by Pieters and Wedel (2007) was confirmed in our study, it can be inferred that some of the insights drawn from this study could potentially be applied in advertising or offer a contribution to the advertising literature.

Another academic implication lies in the methodology of the study. The structure of the experimental design and stimuli exposure was defined to ensure that all participants were tested under the most similar conditions to generate the most comparable results. Even though the set-up structure was supported and applied by Belardinelli et al. (2016), it has not been used much in consumer research. However, it could provide a new and improved approach to study consumer reactions to products in their physical form.

The last implication is the positive influence studies like ours can have on the field of neuromarketing. Even though there is an increasing use of eye-tracking and neuromarketing is becoming more popular as more people are seeing the possibilities it can provide, there are still uncertainties associated with the field (Lim, 2018). The academic field and its discoveries are influenced by the trust and confidence of the society. Therefore, it becomes vital for researchers to showcase their best practices by striving for scientific rigor that ensures both reliability and validity. Proven reliability and validity of neuromarketing results are important in creating a positive perception and outlook on the discipline, which in turn are pivotal in gaining acceptance among other academics, practitioners and general public (Lim, 2018). It is possible that our study helps to shape a more positive perception of neuromarketing and the usefulness of the methods thanks to our findings. We expect our contribution to help researchers in determining the most appropriate way to display the marketing stimuli depending on the objective and/or selling method. Thereby, our study provides researchers with insights into how to structure their research in a way it ensures more reliable and valid data.

7.3. Quality evaluation: reliability, replicability, validity and ethics.

This section will cover an evaluation of the study based on the criteria proposed by Bryman and Bell (2011) in section 4.2. In addition, this section will also provide an evaluation of the ethical precautions taken as a demonstration of the ethical conduct of the study.

7.3.1. Reliability

Reliability deals with whether the study can generate consistent and stable results, meaning that if the study is performed again, it would generate the same results or results with very little variation.

In order to reach this level of consistency in the results, it is required that a high number of participants is tested as proof that significant findings of the study are not accidental nor generated by chance. We strived to recruit as many people as possible during the timeframe we had which resulted in 93 participants in total, although *only* 74 were used in the analysis. Even though there are no standard approaches to estimating the optimal size of the sample for eye-tracking studies, it is a relatively large sample, when compared to numerous previous published studies (Holmqvist et al., 2011). According to Holmqvist et al. (2011), the size of a study's sample depends on the design of the study and many of the published papers have less than 30 or 20 participants. Out of the 74 participants, half was assigned to the physical condition and half to the on-screen condition, in order to ensure that participants were evenly distributed among groups and no bias would occur because of unbalanced number of subjects within one condition. Therefore, the data of 19 participants was excluded from the study due to several problems that occurred during the experiment in order to guarantee that invalid data would not compromise the results of the study.

7.3.2. Replicability

Replicability deals with the possibility of others to replicating a study previously conducted. The specific details about this study are presented in sections 4 and 5 research design and methodology. Therefore, the reader can easily access information detailing the set-up and procedure of the experiment, visual stimuli description, variables selection, recruitment of participant, the eye-tracking equipment, data collection and extraction, data analysis and final results of the study. Structure and language of the information mentioned above allow the reader to easily grasp the necessary knowledge to replicate the study.

7.3.3. Validity

Validity deals with whether the results and conclusions obtained from a study have integrity.

Internal validity deals with whether the results and conclusions involving causality between variables are sound and valid. Aside from the dependent and independent variable selected and defined in the research design, all other variables were controlled in order to prevent them from influencing the results (e.g. lightning, exposure time to the stimuli, distance from the stimuli, body posture etc.). Lightning when taking pictures of the packages matched the lightning when participants were exposed to physical products. Participants were given the same amount of time when viewing a stimulus and when transitioning from one stimulus to the other with the white cardboard and white slide. Furthermore, participants were all seated 62cm from the stimuli and asked to maintain the same position throughout the whole study. Participants were also provided with the same instructions about the experiment and a particular emphasis was placed on informing the participant to keep still and especially their head throughout the whole experiment.

External validity deals with whether the results are generalizable outside of the concerned research context. We have previously discussed that the results may be applicable to other FMCG as well as to advertising, but further research could test and expand the findings to test if they can be used for other products than cereal packages and other contexts than package designs. In addition, as one of the purposes of this study was to question the assumption that eye-tracking studies conducted on-screen are generalizable to real-life settings, our findings have proved the vulnerability of this assumption. Therefore, this study brought new insights concerning the underlying assumption of the eye-tracking research.

7.3.4. Ethical considerations

In order to ensure a correct application of neuroscientific methods, this study followed the required ethical conduct. Thus, subjects were provided with sufficient protection as we guaranteed anonymity of test subjects, they had the right to withdraw from the experiment at any time and the only information recorded about the participant consisted of age and gender. Goals and risks of the study were disclosed prior to the experiment by informing the participants about the purpose of the study, eye-tracking equipment, the set-up and procedure of the experiment and the use of their data being limited to our thesis. Moreover, subjects gave their informed consent by reading and signing a consent form (Appendix 3) before starting the experiment. Following the quality evaluation of the study's reliability, replicability and validity, we are confident that we have both established and demonstrated scientific rigor which is needed for neuromarketing studies (Lim, 2018).

8. LIMITATIONS

Like any research paper, the choices we made and the results we got were subject to some limitations which are covered in this section. The first limitation was tied to the study set-up. The experiment took place in a laboratory setting for both viewing conditions and participants were informed that they were subject to an eye-tracking study. As a result, the awareness of being part of the experiment may have led to the Hawthorne Effect (Cherry, 2018), which suggests that participants may change their behavior, thereby the way they attend to visual stimuli, due to the attention they are receiving from researchers instead of the manipulation of independent variables (ibid). This implies that participants who are aware of the experiment behaved in a way that differ from their regular behavior (Bryman & Bell, 2011, p. 718). Therefore, the Hawthorne effect might have caused participants to attend to the visual stimuli differently than they would have if they were not being tested. Furthermore (due to technological considerations), it is impossible to conduct eye-tracking studies without participants' awareness of their eye-movements being recorded, so the same limitation applies to all eye-tracking studies. Thus, it is not possible to determine to what extent this has influenced the viewing behavior of the participants.

The laboratory-setting also presented our second limitation, as studies conducted in a laboratory do not account for visual context and other environmental cues, but test for a product isolated from its product category (Garber, 1995; Schoormans & Robben, 1997). The results from our real-life condition were not completely reflective of in-store behavior since they did not take account of the retail environment where people can evaluate products in a more sensorial way as they can touch products and turn around the package. In addition, products in-store are displayed on shelf surrounded by other products within the same product category and therefore they compete for attention with each other. Consequently, research and development of product packages need to be conducted considering the whole product category and the competing products (Mehmedovic et al., 2017). Packages need to be designed in a way that allows the product to be visible and steal attention from other objects. Even though conducting a study in a real-life setting in order to test the real-life condition would have allowed to avoid this limitation, it would have caused a set of other issues related to the type of study set-up.

For that matter, real-life setting presents concerns related to the accuracy of eye-tracking research. For example, products on a store shelf are placed one next to the other and as a result they are too close to each other to ensure an accurate measurement of the relevant AOIs tested in the study. It is important that the elements tested with the eye-trackers are clearly distinguished and thus, picture, brand, text and other attributes do not overlap or integrate one with the other. The reason for this stands in the fact that it might be hard or even impossible to understand whether the participant eyes were fixated on a specific AOI or another. Although, the creation of our own cereal packages with fictional designs would have allowed us to avoid this issue in a real-life setting.

A third limitation stood in the exposure time. Participants were given 8 seconds to view each visual stimulus but there is a possibility that this was not a true representation of how much time consumers actually spend viewing a product in a supermarket and make their decision. In fact, according to Clement et al. (2013) consumers usually make their decision in-store within a few seconds relying on simple visual elements and limited cognitive effort. Thus, in their study participants were given only 5 seconds to view the packages. However, an exposure time of 10s has been considered the proper time for viewing product packages at least under the free-viewing paradigm (Chandon et al., 2009; Mehmedovic et al., 2017). In addition, 10s has been argued to be the average exposure time in store (ibid). Therefore, it is complex to define whether 8 seconds was the optimal exposure time or if it was in fact way too long. Moreover, given that consumers have different personal agendas and purchasing behavior, it is hard to define whether they would spend more or less time viewing a product package.

Even though we tried to ensure that all participants from both viewing conditions were given the same transition time (non-exposure) between one stimulus and another, the white cardboard required few milliseconds more than the white slide and as it was slid in and out manually it was not possible to guarantee the same time precision as the slide on the computer display. Furthermore, once participants understood the mechanisms of the white cardboard, some of them had the tendency of following it with their eyes. Although it was a limitation of the study, it was not expected to have a major impact on the results, as we ensured that the viewing conditions were as similar as possible.

Another limitation was related to the product used to test participants' visual attention. As the experiment concerned only cereal packages, no actual definitive assumptions could be formulated on whether the same exact results are applicable to other products (other FMCG or consumer goods) as this was out of the scope of this study. All people have different associations, knowledge, goals and personal agendas when freely viewing a product. Moreover, when evaluating products that have higher price points and require higher involvement, people might engage in a different viewing behavior and focus their attention on different elements opposed to when they look at lower priced products. Lastly, this study focused on consumers visual attention and thereby their information processing. Despite several studies showing that higher visual attention leads to choice, we did not investigate how or whether visual attention to our packages would have led to a choice as it was out of the scope.

9. CONCLUSION

Firms worldwide experience increased competition which is particularly true for the FMCG industry where shelf space is at a premium and product features are becoming increasingly similar. Therefore, it has become imperative for firms operating within FMCG and consumer goods industry to understand what retains and attracts consumers attention in order to address their behavior and influence their purchasing decisions. This understanding has increasingly been sought out by eye-tracking studies that expose consumers to marketing stimuli on a screen and track their eye movements. Neuromarketing had been widely recognized as an approach into the mental processes and behavior performed by consumers when exposed to marketing stimuli. For this reason, academics and practitioners have been applying novel and innovative marketing research approaches such as neuroscience methods and technologies to investigate marketing related topics. Eye-tracking research has gained much more acceptance and has come into wider use as a consequence of understanding and recognizing the opportunities it offers in addressing important marketing questions. Moreover, the accessibility of eye-tracking systems has contributed to its increasing diffusion thanks to low-cost and easy-to-use equipment.

The literature review suggests that there is a clear difference in how consumers visually and cognitively process stimuli depending on the stimuli presentation method, i.e. on a computer monitor or in physical form. As a result, the validity of the assumption that screen-based results can be applied to real-life setting has been questioned. The review further reveals that people processes the same information differently and that visual attention has a great impact on this process and behavior as consumers heavily rely on visual inputs. Both information processing and visual attention are reflected in eye movements. This suggest that firms need to understand eye movements in order to understand consumers purchasing behavior given that decision making is influenced by information processing and visual attention.

A large part of studies on visual attention in marketing has focused on advertisements, leaving the literature on visual attention to product packages rather understudied compared to advertisements. Packages play a key role in attracting and retaining consumers attention through their format and its ability to communicate the values and benefits of the product. Therefore, studies on packaging provide valuable knowledge around consumers attention to a product and its communicative ability. The relevance of packaging in the consumers purchasing behavior is further supported by the fact that companies are increasing their investments and allocating larger budgets to package designs and packaging initiatives. Given its two distinctive roles (functional and communicative), packaging has become an integrative marketing tool and a new area for eye-tracking and visual attention research.

Therefore, in order to enrich the visual attention literature, in this study we used product packages as marketing stimuli. These marketing stimuli were used to investigate consumers visual attention to different package elements classified in distinctive areas of interest (AOIs) in order to test how attention differed in screen-based and real-life settings. Thus, investigation into the assumption that screen-based results could be generalized to real-life settings was undertaken in addition to the influence of cognitive goals on visual attention and how it impacted the generalizability of screen-based results. The assumption underlying most eye-tracking studies was proven to be weak by our findings. The analysis of TFD revealed statistically significant simple two-way interactions between AOI and Condition for free-viewing and between AOI and Viewing Goal for both conditions. Data showed that in free-viewing condition, the AOI Text was viewed significantly longer on-screen than in real-life. Furthermore, when stimuli were presented on-screen, AOI Text was fixated significantly longer under free-viewing compared to task-viewing.

The results revealed that overall text was viewed a significantly shorter in terms of mean TFD in both viewing conditions when task-viewing was compared to free-viewing. The viewing time varied less with task-viewing making it more evenly distributed across the different AOIs. Thus, the attention which was previously devoted to text was then distributed to the other elements. Therefore, hypothesis H1a was partially rejected as a statistically significant difference between viewing conditions was found under free-viewing but not under task-viewing. Whereas, hypothesis H1b was rejected as a statistically significant difference between cognitive goals was found during both viewing conditions.

The analysis of TTFF revealed statistically significant simple two-way interactions between AOI and Viewing Goal for both conditions. Data showed that in physical condition, the AOI Brand was viewed significantly faster under task-viewing compared to free viewing. Furthermore, when stimuli were presented on-screen, AOIs Brand and Pictorial were fixated significantly faster under task-viewing compared to free-viewing. The faster TTFF to the AOI Brand led to the inference that under task viewing brand was prioritized more compared to free viewing and thus when given the task of defining the value of the products participants relied on brand for its informative and symbolic role regarding the qualities of the packages. Therefore, hypotheses H2a was accepted as no statistically significant difference was found in terms of TTFF when viewing condition was considered. Whereas, hypothesis H2b was rejected as it was discovered that there was a statistically significant difference in terms of TTFF when cognitive goal was considered.

As a result of both analyses, it is possible to conclude that the patterns of eye movements changed across different viewing conditions, namely when people looked at pictures of the products and when they looked at the physical products. In addition, it has been shown that participants allocated their attention differently across different cognitive goals. Consequently, the findings of this study have resulted in several managerial and academic implications. The study provides new knowledge about the relative amount of attention given to each packaging element in a real-life setting (i.e. can be applied to shelf product) as well as virtual setting (i.e. can be applied to online shops), thereby offering insights into package design. This is one of main managerial implications of this study, as it provides firms with insights on designing or improving product packages by giving more or less emphasis on different visual elements depending on how much attention each element gets from the consumer. In fact, the study provides firms with the ability to better understand the attention devoted to each package feature and its distinctive role under different cognitive goals. The attention allocated to each element is influenced by the viewing conditions and cognitive goals therefore this is something that firms need to take into account as well as considering their competitive landscape in order to determine the most appropriate way to apply our results.

Moreover, since packaging design is highly relevant not only for cereals or FMCG, managers of consumer goods could benefit from the findings of this study and get better understanding on how consumer process packages through their viewing behavior and how their attention is allocated to the different elements of the package. Furthermore, managers could use the results of this study to better tailor their own research and package design based on whether they are present only online and/or in brick and mortar.

Application of this study's results is dependent on the selling method therefore the assumption underlying most eye-tracking research today may not hold under all circumstances. Herein lies the main academic contribution as the study provides evidence that it is arbitrary to generalize results from studies conducted on-screen to real-life behavior. However, this only applies when consumers are free to attend to the products as they wish (free-viewing) and the results are used to sell the products physically instead of virtually. It implies that the consumer studies that generalize their on-screen results to real-life or physically distributed products are likely to have a low external validity.

Besides expanding the findings of previous studies, other contributions of this study relate to the strengthening of the understanding of visual attention, the impact of cognitive goals and the impact of the viewing condition on consumers visual behavior. Furthermore, this study is among the first to demonstrate the relevance of brand as a heuristic element as a result of the investigation of consumers attention under two different viewing goals. It was shown that participants rely on the brand element in order to evaluate the product as it is recognized as source of information regarding the qualities, values and benefits of the product. Lastly, it also offers the possibility of shaping a more positive perception of neuromarketing and of the usefulness of its methods, and therefore leading to a higher likelihood of acceptance among other academics, practitioners and general public. Our contribution could help researchers and managers in defining the best way to display marketing stimuli in accordance with the objective and/or selling method.

10. FURTHER RESEARCH

It has been well established by now that most eye-tracking research is performed in laboratories (Clement et al., 2013) and mostly on computer screen. Given that the real world is considered much more dynamic compared to laboratories, our research could be extended by performing an experiment with the same visual stimuli in a real-life environment or physical store such as supermarkets. This further research would allow to test a more realistic setting by having the fictional products placed together on a supermarket shelf, thereby showing an entire shelf display populated with product packages instead of having only one product at a time. In order to keep a fair comparison between real-life and on-screen condition, a different stimuli exposure should be adopted accordingly. A picture of the shelf display, instead of individual product pictures, should be taken and projected onto a wall to keep exposure condition and stimuli dimensions constant between viewing conditions.

However, it should be taken into account that there are both advantages and disadvantages of real-life experiment compared to laboratory ones which are discussion in the limitations section 8. In addition, further research could extend the proposed experiment method by testing the influence of the dimensions of the visual stimuli. This can be implemented not only by displaying all the products on a shelf (instead of individual products) but also by changing the dimensions of the shelf, and therefore the products within the shelf, between the two viewing conditions. Thereafter, for screen condition a picture of the real-life shelf should be taken and displayed on a computer screen. However, in order to allow the viewer to see the full shelf the picture should be resized to fit the screen and therefore, stimuli will be displayed in much smaller dimensions than in real-life.

Other ways our study could be expanded in a relevant and interesting way is to add and analyze the variables that could potentially have an impact on the results, e.g. age/computer usage. Age could be an interesting variable that could be tested by grouping participants for each viewing condition into two age groups. One group would be defined as the "young group" and would include individuals who are used to being in front of a screen and frequently use the computer. Whereas, the other group would be the "old group" and would include individuals who are not used to being in front of a screen and therefore rarely use the computer. This could possibly provide interesting results regarding any specific age effect on the way participants look at the products across the two viewing conditions.

Given the relatively limited literature available on the impact of viewing conditions on consumers visual attention, further research could also include an exact replication of this study but with the use of other types of products, although still displaying one product at a time. Findings suggest that package features that affect attention are context-dependent and category specific and at the same time they are limited to the specific package type within the product category (Mehmedovic et al., 2017) (e.g. box in the cereal category, can in the beer category). Consequently, further research that investigate other products and product categories should take into account the type of visual stimulus according to the product category (ibid). Changing the visual stimuli to e.g. detergents, toilet paper etc. could help determine if the differences found in visual attention exist across different products or even across product categories. As with our own study, these other products or product categories could also be moved into a more realistic environment and thus be tested in a real-life setting. Moreover, further research could mimic online consumer behavior for on-screen condition by presenting pictures of the product with a white background as it is usually shown on e-retail websites. This could provide insights on whether this type of pictures, and thus a more online shopping experience, would emphasize the difference between viewing conditions and generate any other difference in consumer viewing behavior.

Even though there is plenty of research papers by now that investigate the importance and influence of tasks or goals on visual attention (Land and Tatler, 2009; Pieters and Wedel 2007; Tonkin et al., 2011), it has not been largely investigated how task can influence visual attention in conjunction with the viewing condition. This study found that the difference in visual attention across viewing conditions actually gets smaller or diminishes to a point where it is non-existent. Hence, it is important for further research to establish whether this diminishing difference is still present when participants engage in other cognitive tasks or have other cognitive goals than the one presented in this paper. The other goals could be search task (Tonkin et al., 2011), choice task (Gidlöf et al., 2012) or evaluation goal (Pieters and Wedel, 2007) such as the rating of usefulness or attractiveness of the stimulus.

In addition, our review of the literature (stimuli display method section 2.3.10) suggests that various studies that conduct an experiment on computer screens experience significant central fixation bias (‘t Hart et al., 2009; Foulsham and Underwood, 2008; Foulsham et al., 2011) According to Tatler (2007), there is always supposed to be central viewing bias for screen-viewing. Although some studies in natural settings also experience it but to a lesser extent (Gidlöf et al., 2012), there are studies where a central fixation bias is not present at all (Tonkin et al., 2011). Thus, the central fixation bias only appears to be present in some instances while in other it is less present or even non-existent. Since we did not actually investigate this phenomenon as it was out of our scope, further research could examine it in order to establish whether there is a central fixation bias in either one of our conditions, in both of them or none of them. Furthermore, researchers could inspect whether the bias is affected by cognitive goals (whether participants are free-viewing or viewing based on specific task). A question remains regarding whether the human brain is wired in a way that makes it gravitate toward the center to orient its attention when transitioning between different locations of a scene (Chandon et al., 2009) and whether this only happens when sitting in front of a screen. Therefore, this thesis suggests that an even more detailed study of this area is needed. In particular, this study calls for further research on the difference in visual attention across viewing conditions based on individually displayed products, shelf displayed products, multiple types of product, multiple product categories as well as the multiple stimuli dimensions and multiple tasks.

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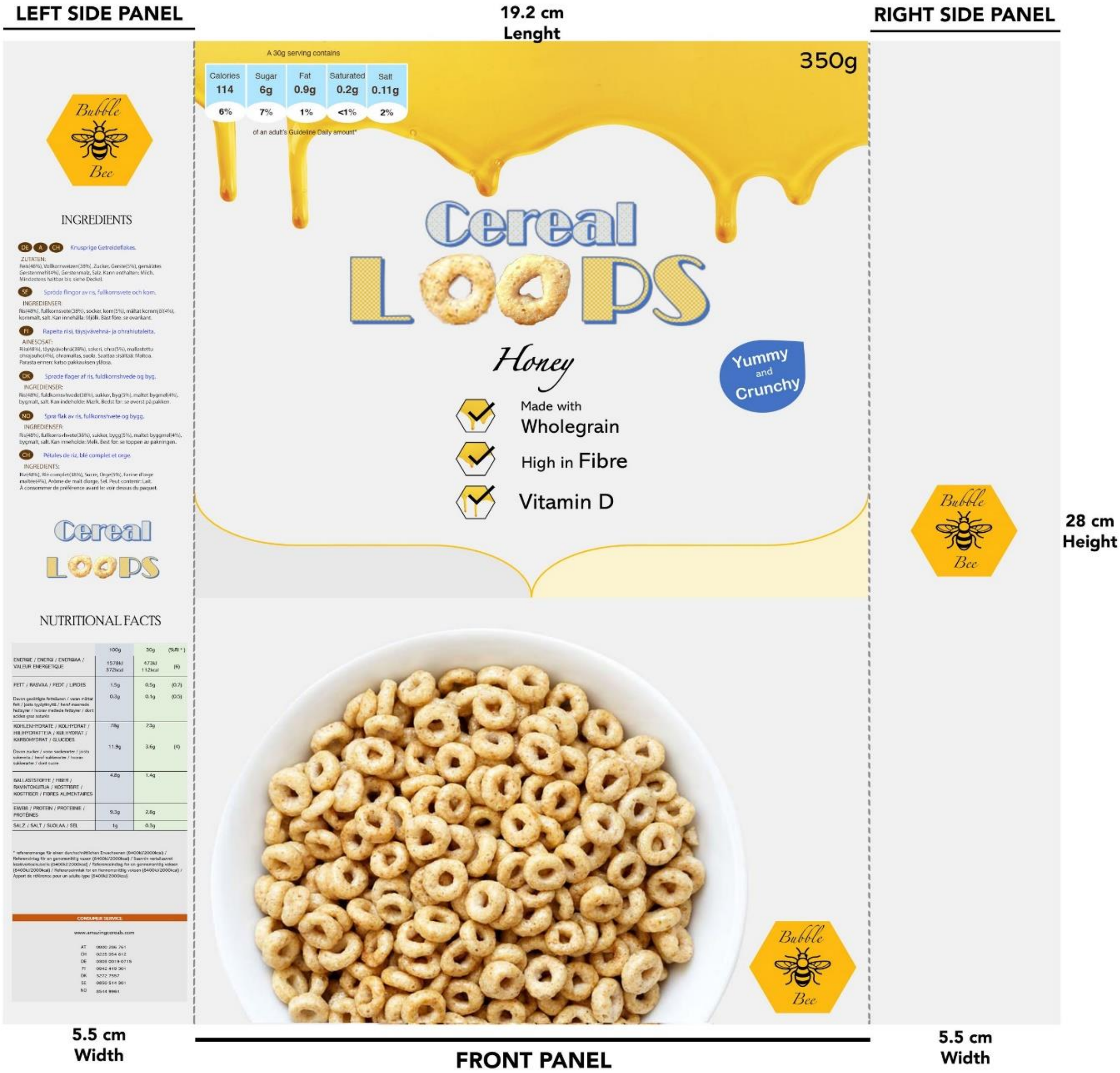
12. APPENDICES

APPENDIX 1 - Eye tracker types (monocular and binocular)

Eye-trackers can also be classified in monocular and binocular. The first refers to eye movement measuring system from only one eye, while the latter collects data and track gaze from both eyes. Most of eye-tracking research is based on a monocular approach because it is common belief that both eyes make the same movements and monocular eye-trackers have a lower cost. Binocular eye-trackers are operated depending on high-end or low-end eye tracking devices. On one hand, high-end eye-trackers pull out one stream of data from each eye. On the other hand, low-end eye-trackers output one unique data stream. Hence, binocularity is applied to extend data accuracy and precision when using a remote (low-end) eye-tracker, by comparing the data and using the one with higher quality or by calculating the averages among the data sets. Eye movements: When larger than about 15-20 min per arc (i.e. 1/60 of visual degree), shifts of gaze are needed to refocus attention given the decline in visual resolution. When smaller than 15’, they are defined microsaccades or fixational saccades and can improve performance of visual tasks when it is necessary to shift gaze between closely positioned details, similarly to the role of large saccades in wider visual field (ibid). Moreover, it is believed that microsaccades function as a signal of shifts of attention based on the idea that they can be used as overt indicators of those shifts what would otherwise be hidden (Kowler, 2011).

APPENDIX 2 - Example of cereal package design with dimensions (without AOI drawing)



APPENDIX 3 - Subject consent registration form

Subject consent registration form

Log-number ___________________

Date & Time ___________________

We want to thank you for participating in our master thesis study. It is very much appreciated.

The study requires us to use an eye-tracker that will track your eye-movements as we will present you with something to look at and a task to solve. By participating in this study, you are contributing to scientific advances.

As a participant in this study, you should know the following:

- The collected data will be anonymous and used for the purpose of research only
- You have the right to decline participation and to withdraw from the research before and during the test
- If you choose to withdraw from the study, it will have no consequences for you as a respondent.
- There are no foreseeable factors that are expected to influence your willingness to participate, such as potential risks, discomfort or adverse effects.

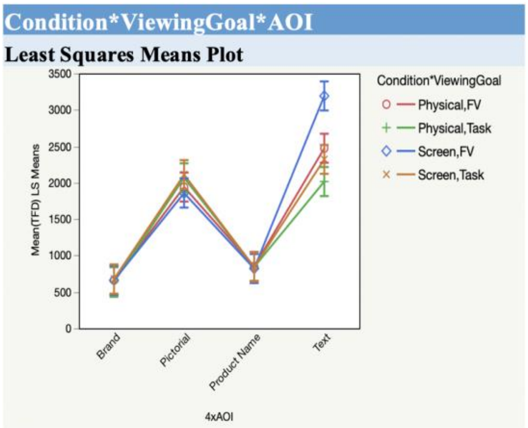
I have read and understood the statements above. I have received adequate or enough information about the research and the extent of the task. I accept participation in this study.

Subject Signature ___________________________________

APPENDIX 4 - TFD analysis (three-way interaction Condition*Viewing goal*AOI)

Summary of Fit

RSquare	0,642347
RSquare Adj	0,632952
Root Mean Square Error	544,6793
Mean of Response	1507,277
Observations (or Sum Wgts)	587



APPENDIX 5 - TFD analysis (two-way interaction Condition*AOI under free-viewing with Tukey HSD all pairwise comparisons)

Response Mean (TFD)

Multiple Comparisons for Condition*4xAOI

Least Squares Means Estimates

Condition	4xAOI	Estimate	Std Error	DF	Lower 95%	Upper 95%
Physical	Brand	661,4037	118,10148	247,05	428,7895	894,0179
Physical	Pictorial	1939,5614	116,11533	239,26	1710,8225	2168,3003
Physical	Product Name	849,9891	116,11533	239,26	621,2505	1078,728
Physical	Text	2472,5447	116,11533	239,26	2243,8058	2701,2836
Screen	Brand	661,0357	116,11533	239,26	432,2968	889,7746
Screen	Pictorial	1856,9335	116,11533	239,26	1628,1946	2085,6725
Screen	Product Name	820,6108	116,11533	239,26	591,8719	1049,3498
Screen	Text	3191,0979	116,11533	239,26	2962,3589	3419,8368

Tukey HSD All Pairwise Comparisons

All Pairwise Differences

Condition	4xAOI	-Condition	-4xAOI	Difference	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Physical	Brand	Physical	Pictorial	-1278,16	185,3488	-6,90	<,0001*	-1845,5	-710,82
Physical	Brand	Physical	Product Name	-188,59	185,3488	-1,02	0,9714	-755,93	378,75
Physical	Brand	Physical	Text	-1811,14	185,3488	-9,77	<,0001*	-2378,48	-1243,8
Physical	Brand	Screen	Brand	0,37	165,6223	0,00	1,0000	-506,59	507,33
Physical	Brand	Screen	Pictorial	-1195,53	165,6223	-7,22	<,0001*	-1702,49	-688,57
Physical	Brand	Screen	Product Name	-159,21	165,6223	-0,96	0,9792	-666,17	347,75
Physical	Brand	Screen	Text	-2529,69	165,6223	-15,27	<,0001*	-3036,65	-2022,74
Physical	Pictorial	Physical	Product Name	-1089,57	184,0896	5,92	<,0001*	526,09	1653,06
Physical	Pictorial	Physical	Text	-532,98	184,0896	-2,90	0,0786	-1096,47	30,50
Physical	Pictorial	Screen	Brand	1278,53	164,2119	7,79	<,0001*	775,88	1781,17
Physical	Pictorial	Screen	Pictorial	82,63	164,2119	0,50	0,9996	-420,01	582,27
Physical	Pictorial	Screen	Product Name	1118,95	164,2119	6,81	<,0001*	616,31	1621,59
Physical	Pictorial	Screen	Text	-1251,54	164,2119	-7,62	<,0001*	-1754,18	-748,90
Physical	Product Name	Physical	Text	-1622,56	184,0896	-8,81	<,0001*	-2186,04	-1059,07
Physical	Product Name	Screen	Brand	188,95	164,2119	1,15	0,9446	-313,69	691,59
Physical	Product Name	Screen	Pictorial	-1006,94	164,2119	-6,13	<,0001*	-1509,59	-504,30
Physical	Product Name	Screen	Product Name	29,38	164,2119	0,18	1,0000	-473,26	532,02
Physical	Product Name	Screen	Text	-2341,11	164,2119	-14,26	<,0001*	-2843,75	-1838,47
Physical	Text	Screen	Brand	1811,51	164,2119	11,03	<,0001*	1308,87	2314,15
Physical	Text	Screen	Pictorial	615,61	164,2119	3,75	<,0001*	112,97	1118,25
Physical	Text	Screen	Product Name	1651,93	164,2119	10,06	<,0001*	1149,29	2154,58
Physical	Text	Screen	Text	-718,55	164,2119	-4,38	<,0001*	-1221,19	-215,91
Screen	Brand	Screen	Pictorial	-1195,9	184,0896	-6,50	<,0001*	-1759,38	-632,41
Screen	Brand	Screen	Product Name	-159,58	184,0896	-0,87	0,9886	-723,06	403,91
Screen	Brand	Screen	Text	-2530,06	184,0896	-13,74	<,0001*	-3093,55	-1966,58
Screen	Pictorial	Screen	Product Name	1036,32	184,0896	5,63	<,0001*	472,84	1599,81
Screen	Pictorial	Screen	Text	-1334,16	184,0896	-7,25	<,0001*	-1897,65	-770,68
Screen	Product Name	Screen	Text	-2370,49	184,0896	-12,88	<,0001*	-2933,97	-1807,00

APPENDIX 6 -TFD analysis (two-way interaction Condition*AOI under task-viewing with Tukey HSD all pairwise comparisons)

Response Mean (TFD)							
Multiple Comparisons for Condition*4xAOI							
Least Squares Means Estimates							
Condition	4xAOI	Estimate	Std Error	DF		Lower 95%	Upper 95%
Physical	Brand	638,9037	85,994896		266,92	469,5891	808,2182
Physical	Pictorial	2066,0692	83,900790		262,04	1900,8636	2231,2747
Physical	Product Name	842,522	83,900790		262,04	677,3165	1007,7276
Physical	Text	2015,5681	83,900790		262,04	1850,3626	2180,7737
Screen	Brand	679,1856	84,925208		264,53	511,9702	846,401
Screen	Pictorial	2109,848	83,900790		262,04	1944,6424	2271,0535
Screen	Product Name	841,7429	83,900790		262,04	676,5374	1006,9485
Screen	Text	2320,2391	83,900790		262,04	2155,0336	2485,4447

Tukey HSD All Pairwise Comparisons									
All Pairwise Differences									
Condition	4xAOI	-Condition	-4xAOI	Difference	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Physical	Brand	Physical	Pictorial	-1427,17	129,7448	-11,00	<,0001*	-1824,34	-1030,00
Physical	Brand	Physical	Product Name	-203,62	129,7448	-1,57	0,768	-600,79	193,55
Physical	Brand	Physical	Text	-1376,66	129,7448	-10,61	<,0001*	-1773,83	-979,49
Physical	Brand	Screen	Brand	-40,28	120,8611	-0,33	1,0000	-410,26	329,69
Physical	Brand	Screen	Pictorial	-1470,94	120,1435	-12,24	<,0001*	-1838,72	-1103,17
Physical	Brand	Screen	Product Name	-202,84	120,1435	-1,69	0,6948	-570,62	164,94
Physical	Brand	Screen	Text	-1681,34	120,1435	-13,99	<,0001*	-2049,11	-1313,56
Physical	Pictorial	Physical	Product Name	1223,55	128,3664	9,53	<,0001*	830,6	1616,50
Physical	Pictorial	Physical	Text	50,50	128,3664	0,39	0,9999	-342,45	443,45
Physical	Pictorial	Screen	Brand	1386,88	119,3802	11,62	<,0001*	1021,44	1752,33
Physical	Pictorial	Screen	Pictorial	-43,78	118,6536	-0,37	1,0000	-407,00	319,44
Physical	Pictorial	Screen	Product Name	1224,33	118,6536	10,32	<,0001*	861,11	1587,54
Physical	Pictorial	Screen	Text	-254,17	118,6536	-2,14	0,3915	-617,39	109,05
Physical	Product Name	Physical	Text	-1173,05	128,3664	-9,14	<,0001*	-1566,00	-780,10
Physical	Product Name	Screen	Brand	163,34	119,3802	1,37	0,8706	-202,11	528,78
Physical	Product Name	Screen	Pictorial	-1267,33	118,6536	-10,08	<,0001*	-1630,54	-904,11
Physical	Product Name	Screen	Product Name	0,78	118,6536	0,01	1,0000	-362,44	364
Physical	Product Name	Screen	Text	-1477,72	118,6536	-12,45	<,0001*	-1840,94	-1114,5
Physical	Text	Screen	Brand	1336,38	119,3802	11,19	<,0001*	970,94	1701,82
Physical	Text	Screen	Pictorial	-94,28	118,6536	-0,79	0,9933	-457,50	268,94
Physical	Text	Screen	Product Name	1173,83	118,6536	9,89	<,0001*	810,761	1537,04
Physical	Text	Screen	Text	-304,67	118,6536	-2,57	0,1737	-667,89	58,55
Screen	Brand	Screen	Pictorial	-1403,66	129,0383	-11,09	<,0001*	-1825,67	-1035,65
Screen	Brand	Screen	Product Name	-162,56	129,0383	-1,26	0,9124	-557,56	232,45
Screen	Brand	Screen	Text	-1641,05	129,0383	-12,72	<,0001*	-2036,06	-1246,05
Screen	Pictorial	Screen	Product Name	1268,11	128,3664	9,88	<,0001*	875,15	1661,06
Screen	Pictorial	Screen	Text	-210,39	128,3664	-1,64	0,7261	-603,34	182,56
Screen	Product Name	Screen	Text	-1478,50	128,3664	-11,52	<,0001*	-1871,45	-1085,55

APPENDIX 7- TFD analysis (two-way interaction Viewing Goal*AOI under physical condition with Tukey HSD all pairwise comparisons)

Response Mean (TFD)

Multiple Comparisons for 4xAOI*Viewing Goal

Least Squares Means Estimates

4xAOI	Viewing Goal	Estimate	Std Error	DF	Lower 95%	Upper 95%
Brand	FV	665,435	102,39713	237,73	463,7134	867,1566
Brand	Task	638,3597	102,39713	237,73	436,6381	840,0814
Pictiorial	FV	1939,5614	100,148500	231,06	1742,2404	2136,8824
Pictiorial	Task	2066,0692	100,148500	231,06	1868,7482	2263,3902
Product Name	FV	849,9891	100,148500	231,06	652,6681	1047,3101
Product Name	Task	842,5220	100,148500	231,06	645,201	1039,843
Text	FV	2472,5447	100,148500	231,06	2275,2237	2669,8657
Text	Task	2015,5681	100,148500	231,06	1818,2472	2212,8891

Tukey HSD All Pairwise Comparisons

All Pairwise Differences

4xAOI	Viewing Goal	-4xAOI	-Viewing Goal	Difference	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Brand	FV	Brand	Task	27,08	120,4614	0,22	1,0000	-345,35	399,50
Brand	FV	Pictorial	FV	-1274,13	156,6643	-8,13	<,0001*	-1758,48	-789,78
Brand	FV	Pictorial	Task	-1400,63	147,6778	-9,48	<,0001*	-1857,2	-944,07
Brand	FV	Product Name	FV	-184,55	156,6643	-1,18	0,9365	-668,9	299,80
Brand	FV	Product Name	Task	-177,09	147,6778	-1,20	0,9305	-633,65	279,48
Brand	FV	Text	FV	-1807,11	156,6643	-11,53	<,0001*	-2291,46	-1322,76
Brand	FV	Text	Task	-1350,13	147,6778	-9,14	<,0001*	-1806,70	-893,57
Brand	Task	Pictorial	FV	-1301,2	147,6778	-9,81	<,0001*	-1757,77	-844,63
Brand	Task	Pictorial	Task	-1427,71	156,6643	-9,11	<,0001*	-1912,06	-943,36
Brand	Task	Product Name	FV	-211,63	147,6778	-1,43	0,8399	-688,2	244,94
Brand	Task	Product Name	Task	-204,16	156,6643	-1,30	0,8958	-688,51	280,19
Brand	Task	Text	FV	-1834,18	147,6778	-12,42	<,0001*	-2290,75	-1377,62
Brand	Task	Text	Task	-1377,21	156,6643	-8,79	<,0001*	-1861,56	-892,86
Pictorial	FV	Pictorial	Task	-126,51	117,2143	-1,08	0,9598	-488,89	235,88
Pictorial	FV	Product Name	FV	1089,57	155,2039	7,02	<,0001*	609,74	1569,41
Pictorial	FV	Product Name	Task	1097,04	146,1276	7,51	<,0001*	645,26	1548,81
Pictorial	FV	Text	FV	-532,98	155,2039	-3,43	0,0185	-1012,82	-53,15
Pictorial	FV	Text	Task	-76,01	146,1276	-0,52	0,9995	-527,78	375,77
Pictorial	Task	Product Name	FV	1216,08	146,1276	8,32	<,0001*	764,31	1667,86
Pictorial	Task	Product Name	Task	1223,55	155,2039	7,88	<,0001*	743,71	1703,38
Pictorial	Task	Text	FV	-406,48	146,1276	-2,78	0,1106	-858,25	45,30
Pictorial	Task	Text	Task	50,5	155,2039	0,33	1,0000	-429,33	530,34
Product Name	FV	Product Name	Task	7,47	117,2143	0,06	1,0000	-354,92	369,85
Product Name	FV	Text	FV	-1622,56	155,2039	-10,45	<,0001*	-2102,39	-1142,72
Product Name	FV	Text	Task	-1126,58	146,1276	-7,98	<,0001*	-1617,35	-713,80
Product Name	Task	Text	FV	-1630,02	146,1276	-11,15	<,0001*	-2081,8	-1178,25
Product Name	Task	Text	Task	-1173,05	155,2039	-7,56	<,0001*	-1653,88	-693,21
Text	FV	Text	Task	456,98	117,2143	3,90	0,0041*	94,59	819,36

APPENDIX 8 TFD analysis (two-way interaction Viewing Goal*AOI under screen condition with Tukey HSD all pairwise comparisons)

Response Mean (TFD)
Multiple Comparisons for 4xAOI*Viewing Goal
Least Squares Means Estimates

4xAOI	Viewing Goal	Estimate	Std Error	DF	Lower 95%	Upper 95%
Brand	FV	661,0357	102,40550	207	459,1442	862,9272
Brand	Task	675,6863	103,15538	210,61	472,3369	879,0356
Pictiorial	FV	1856,9335	102,40550	207	1655,0421	2058,825
Pictiorial	Task	2109,8480	102,40550	207	1907,9565	2311,7394
Product Name	FV	820,6108	102,40550	207	618,7194	1022,5023
Product Name	Task	841,7429	102,40550	207	639,8514	1043,6344
Text	FV	3191,0979	102,40550	207	2989,2064	3392,9893
Text	Task	2320,2391	102,40550	207	2118,3477	2522,1306

Tukey HSD All Pairwise Comparisons
All Pairwise Differences

4xAOI	Viewing Goal	-4xAOI	-Viewing Goal	Difference	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Brand	FV	Brand	Task	-14,65	111,8615	-0,13	1,0000	-360,42	331,12
Brand	FV	Pictorial	FV	-1195,90	162,0364	-7,38	<,0001*	-1696,76	-695,04
Brand	FV	Pictorial	Task	-1448,81	151,9415	-9,54	<,0001*	-1918,47	-979,15
Brand	FV	Product Name	FV	-159,58	162,0364	-0,98	0,9757	-660,44	341,29
Brand	FV	Product Name	Task	-180,71	151,9415	-1,19	0,9334	-650,37	288,95
Brand	FV	Text	FV	-2530,06	162,0364	-15,61	<,0001*	-3030,92	-2029,20
Brand	FV	Text	Task	-1659,20	151,9415	-10,92	<,0001*	-2128,86	-1189,55
Brand	Task	Pictorial	FV	-1181,25	152,4479	-7,75	<,0001*	-1652,47	-710,02
Brand	Task	Pictorial	Task	-1434,16	162,5114	-8,82	<,0001*	-1936,49	-931,83
Brand	Task	Product Name	FV	-144,92	152,4479	-0,95	0,9801	-616,39	326,30
Brand	Task	Product Name	Task	-166,06	162,5114	-1,02	0,9702	-668,39	336,27
Brand	Task	Text	FV	-2515,41	111,1703	-16,50	<,0001*	-2986,63	-2044,19
Brand	Task	Text	Task	-1644,55	162,0364	-10,12	<,0001*	-2146,88	-1142,22
Pictorial	FV	Pictorial	Task	-252,91	151,9415	-2,28	0,3170	-596,55	90,72
Pictorial	FV	Product Name	FV	1036,32	162,0364	6,40	<,0001*	535,46	1537,18
Pictorial	FV	Product Name	Task	1015,19	151,9415	6,68	<,0001*	545,53	1484,85
Pictorial	FV	Text	FV	-1334,16	162,0364	-8,23	<,0001*	-1835,03	-833,30
Pictorial	FV	Text	Task	-463,31	151,9415	-3,05	0,056	-932,96	6,35
Pictorial	Task	Product Name	FV	1289,24	151,9415	8,49	<,0001*	819,58	1758,90
Pictorial	Task	Product Name	Task	1268,11	162,0364	7,83	<,0001*	767,24	1768,97
Pictorial	Task	Text	FV	-1081,25	151,9415	-7,12	<,0001*	-1550,91	-611,59
Pictorial	Task	Text	Task	-210,39	162,0364	-1,30	0,8976	-711,25	290,47
Product Name	FV	Product Name	Task	-21,13	111,1703	-0,19	1,0000	-364,76	322,50
Product Name	FV	Text	FV	-2370,49	162,0364	-14,63	<,0001*	-2871,35	-1869,63
Product Name	FV	Text	Task	-1499,63	151,9415	-9,87	<,0001*	-1969,29	-1029,97
Product Name	Task	Text	FV	-2349,35	151,9415	-15,46	<,0001*	-2819,01	-1879,70
Product Name	Task	Text	Task	-1478,5	162,0364	-9,12	<,0001*	-1979,36	-977,63
Text	FV	Text	Task	870,86	111,1703	7,83	<,0001*	527,23	1214,49

APPENDIX 9 - TTFF analysis (three-way interaction Condition*Viewing goal*AOI)

Summary of Fit	
RSquare	0,812219
RSquare Adj	0,807286
Root Mean Square Error	791,9523
Mean of Response	2122,149
Observations (or Sum Wgts)	587

APPENDIX 10 - TTFF analysis (two-way interaction Viewing Goal*AOI under physical condition with Tukey HSD all pairwise comparisons)

Response Mean (TTFF)
Multiple Comparisons for 4xAOI*Viewing Goal
Least Squares Means Estimates

4xAOI	Viewing Goal	Estimate	Std Error	DF	Lower 95%	Upper 95%
Brand	FV	4322,5208	163,95821	250,29	3999,6072	4645,4344
Brand	Task	3708,9503	163,95821	250,29	3386,0367	4031,8639
Pictional	FV	1026,0875	159,64800	246,69	711,6405	1340,5345
Pictional	Task	581,0911	159,64800	246,69	266,6441	895,5381
Product Name	FV	1893,2741	159,64800	246,69	1578,8271	2207,7210
Product Name	Task	2019,1512	159,64800	246,69	1704,7042	2333,5981
Text	FV	2029,2722	159,64800	246,69	1714,8252	2343,7192
Text	Task	1687,3918	159,64800	246,69	1372,9448	2001,8388

Tukey HSD All Pairwise Comparisons
All Pairwise Differences

4xAOI	Viewing Goal	-4xAOI	-Viewing Goal	Difference	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Brand	FV	Brand	Task	613,57	190,6463	3,22	0,0354*	23,70	1203,44
Brand	FV	Pictorial	FV	3296,43	220,1165	14,98	<,0001*	2615,38	3977,49
Brand	FV	Pictorial	Task	3741,43	220,5499	16,96	<,0001*	3059,03	4423,83
Brand	FV	Product Name	FV	2429,25	220,1165	11,04	<,0001*	1748,19	3110,30
Brand	FV	Product Name	Task	2303,37	220,5499	10,44	<,0001*	1620,97	2985,77
Brand	FV	Text	FV	2293,25	220,1165	10,42	<,0001*	1612,19	2974,30
Brand	FV	Text	Task	2635,13	220,5499	11,95	<,0001*	1952,73	3317,53
Brand	Task	Pictorial	FV	2682,86	220,5499	12,16	<,0001*	2000,47	3365,26
Brand	Task	Pictorial	Task	3127,86	220,1165	14,21	<,0001*	2446,80	3808,92
Brand	Task	Product Name	FV	1815,68	220,5499	8,23	<,0001*	1133,28	2498,07
Brand	Task	Product Name	Task	1689,80	220,1165	7,68	<,0001*	1008,74	2370,86
Brand	Task	Text	FV	1679,68	220,5499	7,62	<,0001*	997,28	2362,08
Brand	Task	Text	Task	2021,56	220,1165	9,18	<,0001*	1340,50	2702,61
Pictorial	FV	Pictorial	Task	445,00	184,372	2,41	0,2460	-125,46	1015,46
Pictorial	FV	Product Name	FV	-867,19	216,9250	-4,00	0,0029*	-1538,37	-196,01
Pictorial	FV	Product Name	Task	-993,06	217,3648	-4,57	0,0004*	-1656,61	-320,52
Pictorial	FV	Text	FV	-1003,18	216,9250	-4,62	0,0003*	-1647,37	-332,00
Pictorial	FV	Text	Task	-661,30	217,3648	-3,04	0,0575	-1333,85	11,24
Pictorial	Task	Product Name	FV	-1312,18	217,3648	-6,04	<,0001*	-1984,72	-639,64
Pictorial	Task	Product Name	Task	-1438,06	216,925	-6,63	<,0001*	-2109,24	-766,88
Pictorial	Task	Text	FV	-1448,18	217,3648	-6,66	<,0001*	-2120,72	-775,64
Pictorial	Task	Text	Task	-1106,30	216,9250	-5,10	<,0001*	-1777,48	-453,12
Product Name	FV	Product Name	Task	-125,88	184,3720	-0,68	0,9973	-696,34	444,58
Product Name	FV	Text	FV	-136,00	216,9250	-0,63	0,9984	-807,18	535,18
Product Name	FV	Text	Task	205,88	217,3648	0,95	0,9805	-466,66	878,42
Product Name	Task	Text	FV	-10,12	217,3648	-0,05	1,0000	-682,66	662,42
Product Name	Task	Text	Task	331,76	216,9250	1,53	0,7898	-339,42	1002,94
Text	FV	Text	Task	341,88	184,3720	1,85	0,5850	-228,58	912,34

APPENDIX 11 - TTFF analysis (two-way interaction Viewing Goal*AOI under screen condition with Tukey HSD all pairwise comparisons)

Response Mean (TTFF)						
Multiple Comparisons for 4xAOI*Viewing Goal						
Least Squares Means Estimates						
4xAOI	Viewing Goal	Estimate	Std Error	DF	Lower 95%	Upper 95%
Brand	FV	4645,1679	172,97552	233,25	4304,3739	4985,9619
Brand	Task	3426,9691	174,91253	236,92	3082,3867	3771,5516
Pictional	FV	1373,8443	172,97552	233,25	1033,0503	1714,6383
Pictional	Task	737,0060	172,97552	233,25	396,2119	1077,8000
Product Name	FV	1891,4394	172,97552	233,25	1550,6454	2232,2334
Product Name	Task	1728,0224	172,97552	233,25	1387,2284	2068,8164
Text	FV	1544,1472	172,97552	233,25	1203,3531	1884,9411
Text	Task	1599,2704	172,97552	233,25	1258,4764	1940,0644

Tukey HSD All Pairwise Comparisons									
All Pairwise Differences									
4xAOI	ViewingGoal	-4xAOI	-ViewingGoal	Difference	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Brand	FV	Brand	Task	1218,2	181,4681	6,71	<,0001*	657,18	1779,22
Brand	FV	Pictorial	FV	3271,32	241,5212	13,54	<,0001*	2524,65	4018,00
Brand	FV	Pictorial	Task	3908,16	237,5594	16,45	<,0001*	3173,74	4642,59
Brand	FV	Product Name	FV	2753,73	241,5212	11,40	<,0001*	2007,05	3500,40
Brand	FV	Product Name	Task	2917,15	237,5594	12,28	<,0001*	2182,72	3651,57
Brand	FV	Text	FV	3101,02	241,5212	12,84	<,0001*	2354,35	3847,69
Brand	FV	Text	Task	3045,90	237,5594	12,82	<,0001*	2311,47	3780,32
Brand	Task	Pictorial	FV	2053,12	238,9735	8,59	<,0001*	1314,33	2791,92
Brand	Task	Pictorial	Task	2689,96	242,9122	11,07	<,0001*	1938,99	3440,94
Brand	Task	Product Name	FV	1535,53	238,9735	6,43	<,0001*	796,73	2274,33
Brand	Task	Product Name	Task	1698,95	242,9122	6,99	<,0001*	947,97	2449,92
Brand	Task	Text	FV	1882,82	2.389.735	7,88	<,0001*	1144,02	2621,62
Brand	Task	Text	Task	1827,70	242,9122	7,52	<,0001*	1076,72	2578,67
Pictorial	FV	Pictorial	Task	636,84	179,6018	3,55	0,0131*	81,59	1192,09
Pictorial	FV	Product Name	FV	-517,60	241,5212	-2,14	0,3946	-1264,27	229,08
Pictorial	FV	Product Name	Task	-354,18	237,5594	-1,49	0,8107	-1088,60	380,25
Pictorial	FV	Text	FV	-170,30	241,5212	-0,71	0,9967	-916,98	576,37
Pictorial	FV	Text	Task	-225,43	237,5594	-0,95	0,9803	-959,85	509,00
Pictorial	Task	Product Name	FV	-1154,43	237,5594	-4,86	0,0001*	-1888,86	-420,01
Pictorial	Task	Product Name	Task	-991,02	241,5212	-4,10	0,0020*	-1737,69	-244,34
Pictorial	Task	Text	FV	-807,14	237,5594	-3,40	0,0207*	-1541,57	-72,72
Pictorial	Task	Text	Task	-862,26	241,5212	-3,57	0,0121*	-1608,94	-115,59
Product Name	FV	Product Name	Task	163,42	179,6018	0,91	0,9845	-391,38	718,66
Product Name	FV	Text	FV	347,29	241,5212	1,44	0,8375	-399,38	1093,97
Product Name	FV	Text	Task	292,17	237,5594	1,23	0,9212	-442,26	1026,60
Product Name	Task	Text	FV	183,88	237,5594	0,77	0,9941	-550,55	918,30
Product Name	Task	Text	Task	128,75	241,5212	0,53	0,9995	-612,92	875,43
Text	FV	Text	Task	-55,12	179,6018	-0,31	1,0000	-610,37	500,12