**Attentional capture and importance of package attributes for consumers' perceived similarities and differences among products: A case study with breakfast cereal packages**

**Paula Varela1,2, Lucía Antúnez3, Rafael Silva Cadena3, Ana Giménez3,4, Gastón Ares3,4**

1 Nofima AS, P.O. Box 210, 1431 Ås, Norway

2Former affiliation: Instituto de Agroquímica y Tecnología de Alimentos (CSIC), Agustín Escardino, 7, 46980 Paterna, Valencia, Spain.

3 Departamento de Ciencia y Tecnología de Alimentos. Facultad de Química. Universidad de la República. Gral. Flores 2124. CP 11800. Montevideo, Uruguay.

4 Centro de Investigación Básica en Psicología. Facultad de Psicología. Universidad de la República. Tristán Narvaja 1674. CP 11200. Montevideo, Uruguay.

Corresponding author: Paula Varela

Telephone: +47 45426026

Fax: +47 64943314

E-mail: [paula.varela.tomasco@nofima.no](mailto:pvarela@iata.csic.es); [pvarelatomasco@gmail.com](mailto:pvarelatomasco@gmail.com)

**Abstract**

The present work studied attentional capture and importance of package attributes for consumers' perception of similarities and differences among products through a combination of eye-tracking and projective mapping. As case study, fifty consumers performed a projective mapping task with ten breakfast cereal packages while wearing a mobile eye-tracker. The combination of mobile eye-tracking and projective mapping enabled a more comprehensive analysis of the importance of package attributes for consumer perception. Eye tracking allowed the identification of the most relevant package features for perceived similarity and differences among products and spotted attributes that were attended to but were not relevant, as well as package features that were relevant for categorization but were not largely attended to. Results suggest that studying attentional capture could contribute to better understanding attribute importance for consumer perception. Irrespectively of the saliency, most consumers looked at same key information, mainly located on the front-of-pack. Few consumers read the nutritional label and ingredients list (a much lower proportion than in previous static eye tracker studies). Results suggested that mobile eye-tracking has a great potential for assessing consumers' evaluation of packages in ecological settings. However, several disadvantages and limitations of the technique should be taken into account.

***Keywords:*** *eye-tracking; packaging; food labels; projective mapping; napping; sensory profiling*

**1. Introduction**

Packaging has become a key marketing strategy and plays an important role in attracting consumers’ attention (Clement, 2007; Rettie & Brewer, 2000; Moskowitz, Reiser, Lawlor, & Deliza, 2009; Silayoi & Speece, 2007). Package design strongly affects consumers' attention, sets up sensory and hedonic expectations and can even modulate future product experiences (Ares & Deliza, 2010; Becker, van Rompay, Shifferstein, Galetzka, 2011; Deliza & MacFie, 1996; Schifferstein, Kole, & Mojet, 1999). Packages are important sources of information since they communicate the products' main characteristics, allowing consumers to make inferences about them (Carneiro, Minim, Deliza, Silva, Carneiro, & Leão, 2005; Silayoi & Speece, 2007; Steenkamp, 1990). Also, the increasing need to differentiate products in the marketplace has led to include information about credence attributes, such as health claims (Lähteenmäki, 2013), environmental sustainability (Leire & Thidell, 2005) or quality (Jahn, Schramm, & Spiller, 2005).

Thus, understanding how consumers evaluate food packages when making their purchase decisions and identifying important package attributes for consumer perception are relevant inputs for package design and communication strategies.

The importance of package attributes is a multidimensional construct composed of three main dimensions: salience, relevance and determinance (Van Ittersum, Pennings, Wansink, & van Trijp, 2007). Salience measures the availability of an attribute in memory, which, for any reason, stands out from the rest, and would affect the order of verbalization of the attributes if prompted to enumerate them. Relevance, on the other hand, can be regarded as the extent to which the attribute provides benefits related to consumers' values and desires (Myers & Alpert, 1977). In other words, a piece of information is relevant to an individual when it connects with background information he/she has available to yield conclusions that matter to him/her (Wilson & Sperber; 2004). Meanwhile, attribute determinance is related to its importance in judgment and choice (Van Ittersum et al., 2007). Determinance goes beyond relevance; an attribute can be extremely relevant (e.g., safety of automobiles) but it can have no real effect on choice if all products are perceived to be equal for this attribute (Myers & Alpert, 1977).

Several methodologies can be used for estimating the importance of package attributes. Categorization within a category is one of the commonly used methodologies during new product development. It enables to identify the key elements within a food category and to identify product opportunities (Ahmad & Richard, 2014).

The evaluation of similarities and differences among products relies on an overall representation of the products, which is achieved through a process of synthesis, that determines the relative importance of the different characteristics (Jaeger, Wakeling, & MacFie, 2000). Distinct cognitive processes are involved in this evaluation. Consumers usually base their evaluation on cognitive schemas related to their knowledge about the food category or considering specific features of the products (Wadhera & Capaldi, 2012).

Holistic methodologies, such as projective mapping, can be used to study the main package attributes underlying consumers’ perception of similarities and differences among products methodology (Risvik, McEwan, Colwill, Rogers, & Lyon 1994). Projective mappinghas been increasingly applied for sensory product characterization of food products with consumers (Varela & Ares, 2012), ( This methodology has also been applied for characterizing packages (Carrillo, Varela & Fiszman, 2012a) and to get an insight into how information on the pack influences hedonic or other perceptions (Carrillo, Varela & Fiszman, 2012b).

One of the limitations of projective mapping is that it does not allow to conclude if some package features are not relevant for the categorization or if they did not catch consumers ‘attention, and therefore they were not processed. Thus, the use of mobile eye-trackers while consumers perform a projective mapping task could contribute to a better estimation of the determinance dimension of attribute importance.

In the few seconds consumers usually invest evaluating food products, they do not attend to all the information included on food packages (Milosavljevic & Cerf, 2008). Therefore, attentional mechanisms select part of the information for further processing, while the rest of the information is not processed and consumers do not become aware that it is there (Pieters, 2008). Attention, defined as the degree to which consumers focus on a stimuli within their range of exposure is a pre-requisite for information processing and therefore key step in consumer decision making process. Both bottom-up and top-down processes mediate consumers’ attention towards the different elements of a food package. Bottom-up attention is a rapid and automatic form of attentional capture that depends on the characteristics of the stimulus (e.g., its color, size, shape, saliency of the element from the background in which it is included) and occurs even when the consumer is not specifically searching for it (Wolfe, 1998). On the other hand, top-down attentional capture depends on consumers' interest and motivations when evaluating the stimulus and requires consumers to voluntarily search for specific information (Koch, 2004). Thus, if a certain package element does not automatically catch consumers' attention (bottom-up process), they would not use it for making their choices unless it is relevant for them and they would specifically try to find it on the package (Greenwald & Leavitt, 1984).

Despite the role of attentional capture, little research has been found reporting the cognitive process that mediates consumers’ evaluation of food packages. Most research has been based on the estimation of the importance of different package characteristics after they have captured consumers’ attention (Ares & Deliza, 2010;; Deliza & MacFie, 1996; Lange, Issanchou, & Combris, 2000; Moskowitz et al., 2009; Carrillo, Varela & Fiszman, 2012a; 2012b). In this context, studying attentional capture can contribute to the study of attribute importance and could be a relevant area of research for people working in sensory and consumer science, marketing, and graphic and package design.

Eye-tracking techniques have a great potential for objectively assessing consumers’ perception of visual stimuli (Pieters, 2008) and are being increasingly used in sensory and consumer science (Ares, Giménez, Bruzzone, Vidal, Antúnez, Maiche, & Ares, 2013; Piqueras-Fiszman, Velasco, Salgado-Montejo, & Spence, 2013; Soederberg Miller & Cassady, 2012; Mitterer-Daltoé, Queiroz, Fiszman & Varela, 2014). Most of these studies use static eye-trackers, which involve the presentation of visual stimuli on a monitor and recording the participants' gaze patterns. However, when dealing with food packages, this type of approach could potentially increase the salience of the information which is usually presented on the sides and back of the packages. In this sense, mobile or head mounted eye-trackers could have several advantages to study consumers' perception of real packages and labels in more ecological situations, as participants can move around and evaluate real products, as they would normally do in a real-life situation.

The present work aimed at studying attentional capture and attribute importance of package features for consumers' perceived similarities and differences among products of a food category through a combination of projective mapping and eye-tracking, using breakfast cereals as case study.

**2. Materials and methods**

**2.1. Stimuli**

Breakfast cereal packages were chosen as stimuli as they usually contain diverse extrinsic attributes, which made them good candidates for this methodological study. Ten commercial breakfast cereal samples were selected as stimuli. Samples were selected to get a wide range of products in terms of type of product, brand, nutritional characteristics, and nutritional and health claims on the packages. Samples represented the main characteristics of the products available in the Uruguayan market and included the four main brands (brand A was the most relevant). They were purchased from various Uruguayan supermarket chain stores located in Montevideo. For interpretation purposes they were named as follows: sugar added flakes (S1, S2, S3), honey-added flakes (H), high fibre (F1, F2, F3), whole cereal (W) and muesli (M1, M2). These names represent the main characteristic of the samples, but more detailed information could be seen in Table 1. Also, four examples of the front of packages are shown in Figure 1. Commercial samples were used in the experiment so there was no experimental design involved. The idea was to cover a wide range/combination of extrinsic factors. In this sense, it is important to stress that the samples were similar and different in many characteristics that were not included in the name chosen for interpretation. For example, sample H corresponded to a “Cornflakes with honey” product, but samples M1 and M2 also contained honey. Also, samples r F1-F3 were names as “high in fibre”, but there were other samples that were also formulated with whole cereals (H, S3, W) or that contained oats (F2, F3, M1, M2).

Insert Table 1 around here

The boxes included product name, brand, product description, net weight on the front of the package, as well as an image and up to three claims. For instance, in Figure 1d, Product name would be “Zucosos”, product description would be “hojuelas de maíz cubiertas con azúcar (*corn flakes with added sugar*)”, and one of the claims included on the front of pack: “made with whole cereal”. Diverse information was included on the laterals and the back of the packages: nutritional information, ingredients, claims (the same and other than those included on the front of the package), further images, usage instructions, and detailed nutritional benefits of eating cereals, of the product in particular, or of healthy life in general. All the information (verbal and non-verbal) varied in position and saliency (shape, size, colour, design) among samples, as shown in Figure 1.

Insert Figure 1 around here

**2.2. Consumers**

The study was carried out with 50 consumers, recruited from the University campus (Universidad de la República, Montevideo, Uruguay) based on their availability and interest to participate (ages ranging from 21 to 61, 40% male and 60% female). Candidates with vision problems or those that would need glasses for completing the task were excluded. All participants signed an informed consent agreement and received a small gift for their participation.

Unlike consumer acceptability studies or other quantitative consumer studies, the number of participants in eye-tracking studies is usually low because of the individual and time consuming nature of the task. Previous studies with desktop mounted eye-tracking systems have included 10-60 consumers (Bialkova & Trijp, 2010; 2011; Soederberg Miller & Cassady, 2012; Ares et al., 2013; Mitterer-Daltoe et al., 2014). In particular, with the use of mobile eye-tracker systems, previous studies have used 6 to 20 participants (Baschnagel, 2013; Franchak, Kretch, Soska, Babcock, & Adolph, 2010; Mello-Thoms et al., 2006)

**2.3. Procedure**

**2.3.1. Consumers’ testing procedure**

Evaluations were held individually, during one week, in a room equipped with shelves, tables and chairs. The total duration of the session was around 30 minutes per consumer. Consumers were untrained and they were briefed about the procedure at the beginning of the test on an individual basis.

The shelving unit was used to get a supermarket-like setting, where the cereal packages were all placed in one of the shelves. All samples were placed one next to each other, side by side, at the same (sight) level, so that consumers did not have to look too far down or too high up while performing the task. Samples were re-organized in a different order after each evaluation, following a balanced random block design (William's Latin square).

Consumers had to perform a projective mapping task while wearing a mobile eye tracker system (Tobii glasses). The projective mapping task was performed on a 140 x 75 cm table which acted as the “nap”, because of the size of the stimuli. Before mapping the samples consumers could look at the packages naturally, get hold of them, move them, and flip them, as they would normally do when shopping. Consumers were explained that they had to place the samples on the table according to their similarities and differences, taking into account that samples that were placed close to each other were similar and those that were far from each other were different. After they had completed the task they were asked to describe the products or groups of products with the use of “post-it” notes.

Participants only had contact with the packages and did not see or taste the cereals. All the information on the outside of the package was considered for this evaluation, since consumers were free to flip the boxes or not according to their own criteria, as they were not instructed one way or the other.

After the projective mapping task, participants were asked to fill in some exit questions, including personal data.

**2.3.2. Mobile eye-tracker operation**

A Tobii Glasses Eye Tracker (Tobii Technology, Stockholm, Sweden) was used to study the attentional capture of package features when consumers estimated similarities and differences among products.

The glasses have an infrared (IR) camera which records the gaze coordinates of the participant's right eye and a scene camera, which records the visual field. Gaze coordinates were recorded at a sampling rate of 30 Hz. The glasses are connected to a small device (recording assistant) that records the data. The record assistant is attached to the participants’ clothes or put inside their pockets during the test.

Each participant was asked to put the glasses on like he/she would normally do and to adjust them with the strap to a secure but comfortable fit, to avoid the movement of the device around the head while performing the task. Before starting the projective mapping each participant followed the system-guided calibration procedure of Tobii Glasses with the aid of an infrared (IR) marker. The participant was standing facing a white wall, 1 meter away from it, and followed the IR marker moved by the experimenter while keeping the head still during the entire process. After calibration the recording started and they could normally move around the room to evaluate samples and do the projective mapping task.

Before running the actual experiments various pilot studies were conducted to detect potential issues with the test design or test environment and to define sample placement, calibration procedure and the general settings to prevent the eye tracker from losing track of the subject’s gaze. Tobii Studio Professional version 2.3 (Tobii Technology, Stockholm, Sweden) was used to download the recordings.

**2.4 Data collection and analysis**

Projecting mapping data were collected as the X and Y coordinate values for the samples on each consumer's individual map by directly measuring the position on the table, considering the left down corner as the origin of the coordinate system. All the words provided by participants in the description phase were qualitatively analysed. A Multiple Factor Analysis (MFA) was performed considering the X and Y coordinate values for the samples on each consumer's individual map as a group of variables (Pagès, 2005). Confidence ellipses were constructed as suggested by Dehlholm, Brockhoff, & Bredie (2012).

The terms elicited to describe each sample or group of samples were grouped by consensus between two researchers, considering synonymous and derived words. Terms mentioned by at least 5% of the consumers were retained for further analysis (Symoneaux, Galmarini, & Mehinagic, 2012). The frequency table containing terms generated by consumers and their frequency of mention was considered as a set of supplementary variables in the MFA of projective mapping data.

The eye-tracking software provided a video recording for each participant, in which the gaze coordinates were overlaid onto the scene video, which allowed identifying where participants were fixating their right eye at each moment. Fixations were defined by the software using the raw fixation filter. Considering that participants could move around and touch the packages and that the calibration of the glasses was performed at a fixed distance, parallax was corrected using the software by estimating the distance between the glasses and the packages.

The video recordings obtained with the eye-tracking glasses were analyzed by 3 independent coders and several data were extracted. The features of all the packages were identified as areas of interest (front of pack: brand, image, product name, product description, claims, net weight; sides & back of pack: product name, product description, nutritional label, ingredients, usage, benefits, claims). The occurrence of fixations for each consumer within each area were counted for each product by each coder. The number of fixations was counted as one when a consumer looked at a particular area of interest for each sample; irrespective of whether the same subject looked multiple times at the same area or not. A meeting was held for reaching consensus between results of the three coders.

Data were also analyzed at the individual level to determine the relationship between attentional capture and product description. For each area of interest the percentage of consumers who fixated their gaze and also considered the information included in that particular area for sample positioning in the projective mapping task was determined. Besides, the percentage of consumers who fixated their gaze on an area of interest and also used the information included on that particular area for describing samples was determined.

All statistical analyses were performed with R language (R Development Core Team, 2007) using FactoMineR (Lê, Josse, & Husson, 2008).

**3. Results**

**3.1. Projective mapping data**

Similarities and differences among packages were described using different criteria. Ten percent of the consumers described similarities and differences among products considering the design of the packages exclusively, taking into account their shape, size and colour. The rest of the participants based their descriptions on information available on the packages to different extents.

Consumers' descriptions of the samples were related to four main dimensions: *ingredients and composition*, *sensory and hedonics*, *nutritional aspects* and *usage and attitudes*. Table 2 shows the categories of terms mentioned by more than 5% of the consumers. The most frequently used categories for describing perceived similarities and differences among samples were related to product names and product description: *high fibre* (for samples F1, F2, F3), *bran* (sample F3) *honey* (samples H and M1); *muesli* (samples M1, M2); *sugar/sweetened* (samples S1, S2, S3). Aspects related to target consumers were also relevant for samples S1, S2 and S3, which were described using the category *for children/for teens.* Consumers' associations were also used for describing samples. Sample W was particularly highlighted as *whole* and *diet/light*. As shown in Table 2, consumers used the categories *natural* for describing samples F1, F2 and F3 and *healthy* for samples F1, F2, F3, M1, M2, and W.

Insert Table 2 around here

A consensus representation of the similarities and differences among samples was obtained using MFA. As shown in Figure 2a, cereals M1 and M2, the muesli products, appeared in the upper right quadrant, with their confidence ellipses almost totally overlapped. These samples were perceived by consumers as very similar and were described using the categories *muesli*, *healthy*, *complete*, *honey*, *yummy,* and *tempting.* Products F1, F2, and F3 were plotted in the lower right quadrant, with their confidence ellipses overlapped, being perceived as *natural* and with *high fibre*, and *bran* (Figure 2b). Samples S1, S2 and S3 were located in the lower left quadrant of the perceptual space and were described as *sugary, sweetened* and *for children and teens*. Product W appeared as intermediate between samples with high sugar and samples with high fibre, probably because it is made with whole cereal but its image was similar to those of sugar-added flakes. Sample H was located in an intermediate position between the S group and the M group, characterized by its *sweet flavour* and the added *honey* character (Figures 2a and 2b).

Insert Figure 2 around here

**3.2. Visual processing of the packages**

The mobile eye tracker recorded what consumers were looking at all stages of the projective mapping task, allowing further understanding of what underlies this profiling task. Figure 3 displays some exemplar shots of a video from one of the participants, showing how the gaze coordinates were overlaid onto the scene video, which allowed identifying where participants were fixating their right eye at each moment of the test. This particular subject flipped the packages to evaluate nutritional labelling, claims, and other information located on the sides or back of the packages.

Insert Figure 3 around here

The majority of the participants (66%) quickly skimmed through all the packages (glanced around) before starting to look at each particular package. Then, they went one by one through the packages, mostly from left to right on the shelf. The rest of the participants started directly by looking at one of the packages and went through all of them, from left to right. Around half of the consumers (26 out of 50) grabbed and turned or flipped the packages to look at the laterals or the back of the pack at some point, whereas the other half only looked at the front of the packages to evaluate their similarities and differences among products.

Table 3 displays the visual processing data extracted from the mobile eye-tracker data for all participants, for the selected areas of interest. The information presented on the front of pack showed the highest attentional capture during the projective mapping task, whereas the information displayed on the sides and the back of the packages showed a much lower attentional capture (Table 3).

Although the packages differed in graphic design, and the location and conspicuity of the information were clearly different, the most observed information was in general the same for all samples. On the front of package almost all the consumers looked at product names of all samples. As shown in Table 3, brand was also looked at by a large proportion of consumers (between 72% and 98% of the participants, depending on the product), as well as the image (between 80 and 90% of the consumers).

Insert Table 3 around here

Claims and product description varied in their attentional capture among products. For samples F1 and F2 product description was attended to by a large proportion of participants. Meanwhile, attention to the various claims included on the packages was quite heterogeneous; some claims were looked at very frequently while others were almost disregarded. Net weight was observed by quite a low percentage of consumers for all the products (Table 3).

Consumers paid different level of attention to the information presented on sides and back of the boxes and in fact only few consumers actually read the information. The areas of interest attended to by the largest proportion of consumers were nutritional information (a maximum of 22% of the consumers for products F1 and M2) and the list of ingredients (a maximum of 18% of the consumers for product W). The claims located on the sides and back of packages were looked at by a much lower proportion of participants than those on the front of package. Benefits and usage instructions, both on the sides and the back of the pack, were also looked at by a very low percentage of consumers (Table 3).

**3.3. Relationship between attentional capture and perceived similarities and differences among samples**

Data were analyzed at the individual level to evaluate differences between attentional capture and importance of package attributes. As shown in Table 4, information about type of product and sugar content were the most determinant attributes of perceived similarities and differences among samples, showing a high attentional capture and being considered by a large proportion of consumers during sample positioning and the description phase.

Images on the front of pack were fixated at by an average of 84% of the consumers but only around 40% of them consider the conveyed message (mainly about target consumers) for categorizing products. The addition of honey and use of whole cereal also had a high attentional capture but influenced perceived similarities and differences only for a small proportion of consumers.

Brand was attended to by a large proportion of consumers, suggesting a high attentional capture. However, this package attribute was considered by a small percentage of consumers for estimating global similarities and differences among samples, as well as for describing those differences (Table 4). A similar trend was found for claims about nutritional composition, whereas nutritional information had a low attentional capture and was not considered for sample positioning by the consumers who fixated their gaze. Two consumers elicited terms related to the calorie content of the products in the description phase but they may have relied on previous knowledge or inferences based on the product name or description (e.g. including sugar or honey), rather than on the information provided on the packages.

Insert Table 4 around here

**4. Discussion**

**4.1. Attentional capture and importance of package attributes for consumer's perception of similarities and differences among products**

Consumers’ visual processing of packages was driven by both top-down and bottom-up attentional capture, i.e. consumers searched for specific information they considered necessary to complete the task and attended to areas of the packages that automatically caught their attention due to their saliency. Consumers mainly focused their attention on the information displayed on the front of the packages for completing the projective mapping task. However, they did not visually process all the information included in this area of the package to the same extent. As shown in Table 3, product name, image and brand were with the highest attentional capture. The percentage of consumers who attended to other information, such as claims or net weight was low (Table 3). It has to be pointed out that net weight could have been important to consumers in other situations; for example if the price of the package had been provided.

These results suggest that some of the information presented on the front of the packages was not noticed by the great majority of consumers because it was not considered relevant or because it did not catch consumers' attention. This suggests that the saliency of information should play a key role in the design food packages, particularly when dealing with characteristics that differentiate a product from their competitors. Studying bottom-up attentional capture of package features may be highly relevant when designing packages that include health claims or small logos (e.g. related to quality or environmental sustainability). In this same line, Graham, Orquin, & Visschers (2012) stated the need to further study the influence of label design on attentional capture and consumers' use of front-of-package nutrition labels.

Consumers mostly relied on information available on the packages for evaluating similarities and differences among samples. Product name, type of product and sugar content were the attributes that determined perceived similarities and differences among samples at the aggregate level (Figure 2) and for most consumers (Table 4). This information was included within the areas of the packages with the highest attentional capture, in agreement with several studies that report that consumers have a higher fixation likelihood on attributes that are more relevant for reaching a decision (Reisen, Hoffrage, & Mast 2008; Glöckner & Herbold, 2011; Su, Rao, Li, Wang, & Li, 2012).

Package features with low attentional capture, such as nutritional information, were not considered by a large proportion of consumers for evaluating similarities and differences among samples. However, it is interesting to highlight that some differences between attentional capture and attribute determinance were identified. As shown in Table 4, the great majority of the consumers who fixated their gaze on brand information did not use it to locate samples on the map or to describe similarities and differences among products. These results suggest that attentional and behavioral measures may be considered complementary when studying consumer perception of food packages.

The description phase of projective mapping can be regarded as a step in which consumers “explain or justify” their categorization. As in any free word association or open-ended question, the most cited terms would be the most salient for consumers (Symoneaux et al., 2012; Van Ittersum et al., 2007; Vidal, Ares, & Giménez, 2013). Most of the elicited terms used were directly related to information available on the packages (Table 2). Consumers also used other terms related to sensory and hedonic expectations generated by the package (*yummy, tempting*, and with *sweet flavour*), as well as nutritional perception (*healthy*, *complete*, *natural*)*.*

In the present work eye-tracking provided information that enabled a more comprehensive analysis of attribute importance for consumers' perception of similarities and differences among samples. It allowed to differentiate package features according to their attentional capture and determinance for consumers' perceived similarities and differences. Type of product and sugar content could be identified as the main characteristics that determine differences among breakfast cereals available in the Uruguayan market. On the contrary, other package features were not determinant for perceived similarities and differences because they were attended to but not relevant in the categorization (e.g. brand information), whereas other package features were not used for the categorization but seemed to be not largely processed (e.g. nutritional information or health claims). Studying the interplay between attentional capture and attribute importance for different aspects of consumer perception is a promising area of research.

**4.2. Potentialities and limitations of mobile eye-tracking**

Although attentional capture is a pre-requisite for information processing, most approaches for studying consumer perception do not take into account how information is acquired. In fact, information is usually presented in a single plane using product cards or a computer monitor. This approach can modify attentional capture and increase the salience of the displayed information, which may lead to an overestimation of the influence of certain parameters on food choice. In contrast, this work presents a better understanding of attentional capture in a more ecological situation. In this sense, mobile eye-tracking showed a great potential for studying consumer behaviour under situations that simulate the way in which the information is presented on food packages. This technology allowed consumers to freely search for the information they needed for making their choices, while simultaneously evaluating automatic attentional capture of salient information. This approach could be particularly interesting when working with health claims (Lähteenmäki, 2013) and environmental sustainability (Leire & Thidell, 2005), which are increasingly used to differentiate food products in the marketplace.

Nevertheless, this work highlighted a number of inconveniences that should be taken into account when using mobile eye-tracking systems. Calibration was a challenge for some subjects even if they have normal sight. Sometimes it took 2-3 tries for being able to obtain good calibration parameters for some participants. In particular, the height of the consumer resulted on a challenge for the good performance of the attained calibration in relation with the recorded gaze during the test phase. Some consumers (too tall or too short) had to be dismissed if a good calibration was not possible. However height was not a problem for the data acquisition once a good calibration was attained.. Another problem arose when the glasses were not well adjusted or the subject moved them without noticing. Thus, the obtained gaze coordinates would be moved from the actual area of interest.

Data analysis showed to be quite complicated as subjects were free to move and hold the products in their hands. In these situations the areas of interest cannot be easily defined using the software and the number of participants who fixate their gaze within each area of interest should be done by hand, with the consequent limitation of which sort of data can be collected within realistic timeframes and effort. In addition, counting multiple fixations within the same area or measuring times of fixations cannot be done with accuracy and would not be recommended as it would take too long.

Furthermore, parallax correction can lead to some errors at the time of data analysis since the gaze is calibrated at a certain distance. Accurate data analysis when the participants are allowed to move requires correction by estimating the distance between the glasses and the object. It is also worth pinpointing that the test performed in this work was closer to real life in the way that consumers were free to move, pick the packs and flip them, but the number of samples was limited to ten and there was only one shelving unit. If respondents were allowed to freely move through a supermarket or real environment, the calibration problems would be most probably enhanced, becoming a major issue.

**5. Conclusions**

The combination of mobile eye-tracking and projective mapping showed to be a useful tool for studying consumers' visual processing of packages and to identify the information they relied on for evaluating similarities and differences among products. It allowed identifying the most relevant package features for performing the projective mapping task: some that were attended to but were not relevant and some relevant for categorization but not largely attended to. During the test, irrespectively of their saliency, most consumers looked at same key information, mainly in the front-of-pack. On the other hand, attention to the various claims included on the packages was heterogeneous. Only a few consumers actually read the nutritional label and ingredients list (much lower proportion than reported by previous static eye tracker studies). Benefits and usage instructions were almost disregarded.

Mobile eye-tracking technology has a great potential for assessing consumers' evaluation of packages in natural settings and to assess that the relevant messages are successfully conveyed when designing package and label design. Assuring that consumers perceive all the relevant information included on packages can contribute to the development of more successful products. Further research should be carried out with mobile eye-trackers evaluating consumers' perception of food packages when making purchase decisions. Research on bottom-up attentional capture of package features and its influence on consumer decision making processes would be a valuable contribution to the field and could contribute to the development of successful communication strategies.

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**Tables**

**Table 1.** Characteristics of the cereal package samples used as stimuli in the projective mapping task. Same letters in the column brand represent products of the same brand.

|  |  |  |
| --- | --- | --- |
| **Sample** | **Brand** | **Description** |
| F1 | A | Seed assortment (sesame, flax, sunflower) with soy protein |
| F2 | A | Oats bran, wheat bran, soy protein, wheat germ and honey |
| F3 | B | Oat bran |
| H | C | Corn flakes with honey, fortified with vitamins, iron and zinc. Made with whole cereal. |
| M1 | A | Muesli with honey. Assortment of rolled oat, raisins, corn flakes, coconut, sesame seeds, wheat germ, brown sugar and honey. |
| M2 | D | Muesli. Assortment of corn flakes, oat flakes, wheat bran, sugar, coconut and honey, fortified with vitamins, iron and zinc. |
| S1 | E | Corn flakes with sugar |
| S2 | D | Corn flakes with sugar, fortified with vitamins, iron and zinc |
| S3 | C | Corn flakes with sugar, fortified with vitamins and iron. Made with whole cereal. |
| W | C | Wheat, rice and corn-based extruded flakes, fortified with vitamins and iron. Made with whole cereal. |

Note: S1, S2, S3 sugar added flakes; H honey-added flakes, F1, F2, F3 high fibre, W whole cereal and M1, M2 muesli

**Table 2.** Main descriptors generated by the consumers in the description phase of the projective mapping task . Percentage of consumers who used each of the categories to describe each of the cereal packages.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Dimension** | **Category** | **F1** | **F2** | **F3** | **H** | **M1** | **M2** | **S1** | **S2** | **S3** | **W** |
| Ingredients and composition | Bran | 2 | 8 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Corn | 0 | 0 | 0 | 8 | 0 | 0 | 8 | 6 | 6 | 2 |
| Flakes | 0 | 0 | 0 | 6 | 2 | 2 | 8 | 8 | 6 | 6 |
| Grain | 12 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Muesli | 2 | 2 | 0 | 0 | 32 | 32 | 0 | 0 | 0 | 0 |
| High calories, energy | 2 | 2 | 2 | 4 | 4 | 6 | 0 | 0 | 2 | 0 |
| High fibre | 38 | 46 | 30 | 6 | 20 | 20 | 0 | 0 | 2 | 10 |
| Honey | 0 | 2 | 0 | 40 | 30 | 16 | 4 | 4 | 4 | 0 |
| Low calories | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 0 | 6 |
| Mix | 8 | 8 | 2 | 0 | 12 | 12 | 0 | 0 | 0 | 6 |
| No sugar, not sweet | 6 | 6 | 2 | 2 | 0 | 0 | 0 | 2 | 0 | 12 |
| Oats | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Protein, vitamins, minerals | 2 | 2 | 6 | 0 | 6 | 10 | 0 | 0 | 0 | 0 |
| Soy | 6 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sugar, sweetened | 0 | 0 | 0 | 16 | 0 | 0 | 60 | 54 | 52 | 2 |
| Whole | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 2 | 18 | 28 |
| Sensory and hedonics | Attractive, coloured | 4 | 4 | 6 | 6 | 6 | 2 | 0 | 2 | 2 | 4 |
| Crunchy | 0 | 0 | 0 | 4 | 0 | 0 | 6 | 6 | 6 | 2 |
| Do not like | 4 | 6 | 4 | 4 | 0 | 0 | 2 | 2 | 2 | 4 |
| Good pack design | 10 | 10 | 2 | 6 | 10 | 4 | 2 | 8 | 6 | 2 |
| Not attractive, coloured | 6 | 6 | 10 | 2 | 0 | 2 | 4 | 0 | 0 | 0 |
| Not tasty | 2 | 2 | 8 | 0 | 0 | 2 | 0 | 2 | 2 | 4 |
| Sweet flavour | 0 | 0 | 0 | 22 | 14 | 8 | 22 | 20 | 20 | 0 |
| Yummy, tempting | 8 | 8 | 6 | 16 | 22 | 24 | 10 | 14 | 12 | 4 |
| Nutrition | Diet, light | 0 | 0 | 4 | 0 | 2 | 4 | 0 | 0 | 0 | 20 |
| Nutritive, nutr. complement | 16 | 16 | 8 | 4 | 8 | 8 | 4 | 4 | 4 | 0 |
| Usage and attitudes | Breakfast | 0 | 0 | 2 | 4 | 2 | 4 | 4 | 6 | 6 | 2 |
| Classic, conventional | 0 | 0 | 2 | 0 | 2 | 0 | 2 | 4 | 2 | 6 |
| Complete, complex, varied | 8 | 6 | 2 | 2 | 12 | 6 | 0 | 0 | 0 | 0 |
| For adults | 4 | 6 | 4 | 6 | 6 | 6 | 0 | 0 | 0 | 10 |
| For children, for teens | 2 | 2 | 2 | 12 | 2 | 2 | 40 | 36 | 34 | 0 |
| For women | 12 | 4 | 2 | 0 | 4 | 4 | 0 | 0 | 0 | 2 |
| Healthy | 22 | 22 | 22 | 8 | 22 | 30 | 2 | 2 | 4 | 26 |
| Natural | 34 | 34 | 26 | 4 | 14 | 18 | 0 | 2 | 0 | 10 |
| To add in, to prepare | 2 | 2 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| With milk, with yoghurt | 0 | 0 | 0 | 6 | 2 | 2 | 8 | 10 | 10 | 2 |
| Would buy | 2 | 2 | 2 | 2 | 6 | 6 | 2 | 2 | 4 | 0 |

Only the categories mentioned by more than 5% of the participants are displayed.

**Table 3.** Attentional capture data. Percentage of consumers that looked at the different areas of interest for the ten cereal packages.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sample** | **Front of package (\*)** | | | | | | | | **Sides** | | | | | **Back of package** | | | |
| Brand | Image | Product name | Product description | Claim 1 | Claim 2 | Claim 3 | Net weight | Nutritional label | Ingredients | Claims | Usage | Benefits | Ingredients | Claims | Usage | Benefits |
| F1 | 98 | 84 | 100 | 80 | 76 | 72 | 4 | 4 | 22 | n.a. | 30 | n.a. | n.a. | 16 | 6 | 2 | 10 |
| F2 | 96 | 90 | 100 | 72 | 72 | n.a. | 4 | 6 | 14 | n.a. | 26 | n.a. | n.a. | 22 | n.a | 6 | 14 |
| F3 | 88 | 90 | 98 | n.a. | 64 | n.a. | n.a. | 6 | 20 | n.a. | 2 | 0 | n.a. | n.a. | n.a. | n.a. | n.a. |
| H | 84 | 70 | 100 | 32 | 80 | 2 | n.a. | 14 | 18 | 10 | 0 | 0 | n.a. | n.a. | 8 | n.a. | 6 |
| M1 | 84 | 88 | 96 | n.a. | n.a. | 28 | 10 | 8 | 12 | n.a. | 20 | n.a. | n.a. | 18 | n.a. | 0 | 16 |
| M2 | 84 | 82 | 100 | 70 | 76 | 12 | n.a. | 4 | 22 | 16 | n.a. | 4 | 4 | 4 | 4 | 0 | 8 |
| S1 | 72 | 82 | 92 | 34 | 48 | n.a. | n.a. | 12 | 14 | 6 | 2 | n.a. | n.a. | n.a. | 2 | n.a. | n.a. |
| S2 | 86 | 86 | 96 | n.a. | 48 | 30 | n.a. | 16 | 14 | 14 | 0 | 4 | 4 | n.a. | n.a. | n.a. | 6 |
| S3 | 82 | 86 | 96 | 28 | 80 | 4 | n.a. | 16 | 10 | 4 | 4 | 6 | n.a. | n.a. | 6 | n.a. | n.a. |
| W | 86 | 80 | 92 | 22 | 76 | n.a. | n.a. | 14 | 18 | 18 | 12 | 8 | 8 | n.a. | 6 | n.a. | 12 |

n.a. information not available on the package

(\*) Claim 1 and 2 were not the same across products. There were a maximum of three claims per box and they were individually coded by product for data extracting, and grouped under these three labels in order to summarize the information. Those claims varied in saliency (size, colour, location) and type of message. However, claim 3 was the same for products F1, F2 and M1, from the same manufacturer (El Naranjo) and it was identical in location, size, and message conveyed (“No preservatives. No additives. 100% natural”, presented as a small sign close to the image).

**Table 4.** Attentional capture and importance of package attributes. Percentage of consumers who fixated their gaze at different types of information included on the labels, percentage of consumers who used the information for sample categorization and description.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type of information** | **Samples** | **Area of interest where the information was located** | **Average percentage of consumers who fixated their gaze (%)** | **Percentage of consumers who fixated their gaze and considered the information for sample positioning (%)** | **Percentage of consumers who fixated their gaze and used the information for describing samples (%)** |
| Type of product | All | Product name  Product description | 97%  48% | 84% | 84% |
| Sweetened with sugar | S1, S2, S3 | Product name  Product description Claim 1 (S1 and S2) | 95%  31%  48% | 72% | 72% |
| Target consumers (for kids, teenagers or women) | W, S1, S2, S3 | Image | 84% | 36% | 40% |
| Whole cereal | W, S3 | Claim 1 | 79% | 36% | 36% |
| Brand | All | Brand | 86% | 10% | 10% |
| Nutritional information | All | Nutritional information | 16% | 0% | 0% |
| Claims about nutritional composition | F1, F2, F3, H, M2, S2, S3 | Claim 1  Claim 2 | 66%  31% | 2% | 10% |
| Added honey | H, M1, M2 | Product name  Product description  Image | 99%  51%  80% | 46% | 48% |

**Figure captions**

**Figure 1.** Example of four of the cereal packages used as stimuli.

**Figure 2.** Results of the projective mapping task in the first and second dimensions of the Multiple Factor Analysis: **a)** sample configuration, **b)** projection of the categories used in the description phase.

**Figure 3.** Exemplar shots of the video of one of the consumers, recorded using the mobile eye-tracker during the projective mapping task. Red dots are the gaze coordinates overlaid onto the scene video.