Food Quality and Preference 84 (2020) 103938

Contents lists available at ScienceDirect

Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual

Self-esteem and visual attention in relation to congruent and non-congruent images: A study of the choice of organic and transgenic products using eye tracking

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ARTICLE INFO

Keywords:
Image congruence
Eye tracking
Self-esteem
Organics
Visual attention

ABSTRACT

This study proposes a new model for understanding the behavior of consumers of organic products, using the theory of self-esteem and the congruence among images containing organic and transgenic attributes. The study employed image visualization metrics based on experiments using the eye tracking instrument. The methodological part was divided into two stages. The first was based on a Discrete Choice model, obtaining the following probabilities of the consumer choosing the product: +2.52%, −8.5%, +4.3%, −2.43%, and −5.2% for an increase in self-esteem, for the male gender, for the presence of an organic seal, for the presence of a transgenic seal, and for the presence of a seal that represents a large property, respectively. The second stage was based on hypothesis tests, as a complementary methodology to the first stage. In this context, the time metrics "total fixation of look" on the product and time of "first fixation" on the product for the organic vs. transgenic seals did not differ for individuals classified as having low self-esteem and in individuals of the male gender. As for women and for individuals with high self-esteem, these metrics were lower in the visualizations of an organic seal compared to the transgenic ones. We conclude that visual attention is influenced by the self-esteem and the congruency of the image in food decision. It is suggested that other studies should delve more deeply into applying the model to other behaviors and products.

1. Introduction

Image congruence (IC) was defined by Paul and Bhakar (2017) as a similarity between the image of a celebrity, public figure, sports personality, or other endorser, and the image of the brand that is being endorsed. In this study, the endorser is represented by organics consumers, and the brand image is represented by the image of organic products; therefore, congruence is defined here as being when the attributes of organic products (organic seal, small farmer figure) are consistent with all the benefits (healthiness, nutritional aspects, food safety, and health) (Subrtová, 2016) identified by the consumer through the packaging and symbols.

From a self-esteem viewpoint, consumers are motivated to buy a product with positive value for a positive self-image (positive self-congruence condition) or to improve their image and come closer to obtaining an ideal image (self-consistency). On the other hand, it is foreseen that consumers will be motivated to pursue a product with a (positive or negative) image that is congruent with their self-image belief (Sirgy, 1982). The hypothesis that the effects of self-confidence and ideal congruence on purchase motivation are confirmatory has been tested using the theory of self-esteem and self-consistency (Sirgy, 1985).

Self-esteem is a relevant part of an individual's perception in relation to products that they acquire or use. It is undeniably one of the most important attitudes that an individual has, and has been at the forefront of research topics in the area of psychology for more than a century. The study of self-esteem has generated a vast amount of international literature in recent decades and the Rosenburg Self-Esteem Scale (Rosenberg, Schooler, & Schoenbach, 1989) has been one of the most widely used instruments (Blascovich & Tomaka, 1991; Heatherton & Wyland, 2003), conceptualized as a one-dimensional instrument capable of classifying self-esteem levels into low, medium, and high.

In Brazil, this instrument was originally adapted and validated for research by Hutz (2000) and that version has been used by various researchers (Hutz & Zanon, 2011). Similarly, with the aim of forming a scale that was sensitive to fluctuations in self-esteem, Heatherton and

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https://doi.org/10.1016/j.foodqual.2020.103938
Received 6 November 2019; Received in revised form 27 February 2020; Accepted 17 March 2020
Available online 30 March 2020
0950-3293/

Polivy (1991) developed the State Self-Esteem Scale (SSES). To measure self-esteem and relate it with other constructs such as congruence and preference for organic products, this study used the SSES measurement scale. From this perspective, there are three main components: performance self-esteem, social self-esteem, and physical self-esteem.

In the last two decades, a new type of consumer has emerged, who has expressed more and more concern about the environment and social sustainability, thus leading to the potential for differentiation, which can generate choices and preferences (Padua, Schlindwein, & Rode, 2011; Vermeir & Verbeke, 2006). Nowadays, food consumption patterns are rapidly changing as a result of development and sustainability issues, considerations related to nutritional aspects, and health-related questions.

In light of this context, one market that has presented expressive growth in the last few years and that still has major potential for expansion is that of organic foods. This is a relatively new market in Brazil and actions to add value enable the needs and desires of these new consumers, who are generally more demanding and informed, to be met. This market has grown significantly since 2012, due to the regulations introduced in 2011 for the production and sale of these products in Brazil. Investments in the sector lead it to be believed that organic production in Brazil could reach R$ 2 billion in turnover (Universal Institute of Marketing in Agribusiness, 2017) (Coti-Zelati, Miniussi, de Araújo, & de Queiroz, 2018).

One of the most important objectives of marketing is to understand the decision-making process of consumers. Yet, the traditional tools (surveys, personal interviews, and observations) are often inadequately used in marketing research to analyze and study consumer behavior. Since people's decisions are influenced by various unconscious mental processes, consumers often do not wish or are unable to explain their choices (Lindstrom, 2016; Morin, 2011). These conventional methods have sought to understand consumer behavior for decades, aiming to explain and predict the effectiveness of advertising campaigns. For the most part, however, the conventional techniques have failed miserably, as it can be observed that the research on consumer behavior carried out using conventional methods is unable to capture the entirety of what goes on in the consumer's mind (Lindstrom, 2016; Morin, 2011).

One of the main gaps in the current studies on consumer behavior is perceived here, related to how the tools are used in the traditional market research carried out through questions, group discussions, or participation in internet panels (Lindstrom, 2016; Morin, 2011). In this sense, in marketing studies, neuroscience and its diagnostic techniques are filling the gaps in the understanding of consumer behavior, not as a definitive solution, but as a new and promising research tool that should be taken into account to understand what goes on in the consumer's mind (De Camargo, 2013; Javor, Koller, Lee, Chamberlain, & Ransmayr, 2013; Shigaki, Gonçalves, & Santos, 2017).

This study proposes a new model for understanding organics and transgenics consumer behavior, seeking the relationship between the theory of self-esteem and the congruence between images and attributes of organics and the consumer's preference based on experiments using the eye tracking instrument. Complementarily, parametric hypotheses tests were used to evaluate the equality of the fixation metrics between both genders (female and male); these tests were also applied to evaluate the equality of these metrics within the group of respondents with high self-esteem and with low self-esteem.

This paper is structured in five sections besides this introduction. In the next section the concepts of self-esteem and congruence of attitudes and images are presented. The third section presents the description of the research method employed. The fourth section describes the analytical model and the fifth presents the results found, as well as the discussions and conclusions.

2. Literature review

Ideally, congruence means isomorphism (uniformity of form), as in geometry. Thus, it either exists or does not, and not as something more or less; numbers can or cannot be exactly superimposed. Congruence in this sense can only exist in geometric abstraction. The geometric concept, however, is derived from a more common, but inexact and perfectly appropriate use of the term: congruence as a condition of broadly corresponding to something or being essentially consistent with it (Eckstein, 1997).

Although organic attributes represent a specific mode of production, in practice consumers associate organic products with benefits that go way beyond this definition, such as nutritional, food safety, and health aspects (Subrtová, 2016). Thus, congruent attributes are those attributes that present all these benefits, identified by the consumer through packaging, symbols, and communication. Plassmann, Ramsøy, and Milosavljevic (2012) introduced a conceptual model to better understand consumer behavior, based on a number of processes such as: 1) representation and attention, 2) prediction of value, 3) experience of value, and 4) memory of value.

Attention represents one of the basic aspects of consumer psychology and conduct (Ramsøy, 2015), and is presented in two ways. On one hand there is bottom-up attention, where the mind attunes to the events that occur inside and outside the body. It is a process in which the attention is automatically led to stimuli, and it happens when the person is dominated by their senses. Another form of attention occurs top down, in which the person actively focuses on particular aspects of the world, such as in situations in which they seek some specific type of information; in this sense, the user controls their senses (Ramsøy, 2015).

The attention paid by consumers to product stimuli is selective, and it is driven from the bottom up (given by the stimulus) and from the top down. Once the information is addressed, the perceptive process can begin. Through eye tracking, it is possible to determine what the visual stimuli were of a particular website, advert, video, or app, among others, which had the longest fixation time, the path taken by the eye, what was observed first, the fixation time, the percentage of areas fixated on, the quantity of fixations, and in analyses that require user action, the quantity of clicks can even be analyzed (Sousa, 2016). Eye tracking technology enables an individual's eye movements in relation to a stimulus to be recorded, registering the path of visual exploration up to the act of choosing a product or packaging (Kytö, Järveläinen, & Mustonen, 2018). Eye tracking is generally used to track parameters such as fixations and saccades, using an infrared corneal reflection methodology, measuring the angle of the distance of the reflection of infrared light from the center of the pupil. While fixations describe the period during which the eye remains relatively immobile, saccades refer to eye movements. Fixations are characterized in terms of the length of fixation, referred to as the fixation duration, and the number of fixations per second, defined as the fixation frequency (Kytö, Ens, Piumsomboon, Lee, & Billinghurst, 2018; Murias et al., 2018).

Eye fixations serve to provide a precise measure for evaluating the attention of consumers, since attention determines where the eye goes. Fixations are analyzed in relation to areas of interest (AOIs), defined by the researcher. Although the information is not acquired during saccades, these are useful for revealing elements of the consumer's visual search, such as trade-offs, and the order seen in the area of interest. One of the first tasks in an investigation that collects information using eye tracking consists of defining AOIs (by the evaluator and team) of each interface and determining whether they are visible to the participants. These areas seek the identification of perceptible elements or series of elements, such as a unit or group (Kytö et al., 2018; Murias et al., 2018).

Next, an analysis is carried out of the basic eye movement measures: the fixations. Fixations are related to the moment in which the eyes are relatively fixed, assimilating or "decodifying" what is being informed. They can be interpreted as a codification task, that is, a high frequency of fixation on a particular area can indicate greater interest in the destination (Kytö et al., 2018; Murias et al., 2018).

Some of the most important metrics used in this study are:

- *Time of the first fixation:* the time that passes until the first fixation. The shorter this time until the user fixates for the first time on an area of interest, the greater the capacity will be for the graphic properties of the area to attract visual attention. It is a useful measure when a specific target is being studied (Barreto, 2012).
- *Fixation duration:* the cumulative duration and average spatial location of a series of consecutive fixations within an area of interest. The fixation duration may include various fixations and a shorter quantity of time of short saccades between fixations. The fixation that occurs outside the area of interest will mark the end of the fixation (Barreto, 2012).
- *Number of fixations on an area of interest (visits):* a greater number of fixations will show greater importance for the user. This metric relates to the fixation duration, which serves as a basis for studying the number of fixations in total variable duration tasks. The number of fixations on an element in itself shows that element's level of importance (Kytö et al., 2018; Murias et al., 2018).

Thus, by examining the behaviors of consumers, researchers can determine the information and the resulting data can be statistically analyzed, demonstrating evidence of specific visual patterns. From a self-esteem viewpoint, consumers will be motivated to buy a product with a positive value for a positive self-image (positive self-congruence condition) or to improve their image and come closer to obtaining an ideal image (self-consistency). On the other hand, it is predicted that consumers will be motivated to pursue a product with a (positive or negative) image that is congruent with their self-image belief (Sirgy, 1982). The hypothesis that the effects of self-confidence and ideal congruence on purchase motivation are confirmatory was tested using the theory of self-esteem and self-consistency.

3. Methodology

3.1. Data collection

The experimental research covered two phases. The first phase covered the use of the eye tracking instrument. In the second phase, the research was carried out without the instrument. A breakdown of the data collection phases can be seen in Fig. 1 below.

To better understand the size of the sample of observations, some points should be highlighted:

Regarding the respondents:

- *Phase 1:* in this research, the sample initially had 20 respondents. With the aim of complementing the sample, six months later (September 2019) another data collection was carried out at the Higher School of Advertising and Marketing (ESPM). In this phase, the sample had another 10 respondents. In both data collections, the sample was composed of consumers and non-consumers of organics, totaling 30 respondents.
- *Phase 2:* information obtained from 102 individuals. The data collection was carried out in the month of November 2019, in the laboratory of Mackenzie Presbyterian University, with a sample of consumers and non-consumers of organics.

In both phases, to avoid bias, the participants were oriented to only choose between the products presented in the Eye Tracking screen. No attributes were described. The participants were volunteers that study or work at the university campus. Thus, we could not generalize the results. We ask if they usually buy or not organic products.

By adding together the individuals from the 2 phases, 132 respondents (30 + 102) were obtained; this sample features 51.5% male individuals, 54.4% declare themselves to be consumers of organic products, and the age of the respondents varies between 18 and 30 years old. With the aim of measuring the self-esteem of organics consumers, in both phases, the data collection was carried out using questionnaires and the Heatherton-Polivy Self-Esteem Scale (Heatherton & Polivy, 1991) (point I, Fig. 1). The sample included consumers and non-consumers of organics and the selection criterion was based on consumers of organic and non-organic products. The sentences were laid out in a seven-point Likert format, varying from "I totally agree" to "I totally disagree" (Sbicigo, Bandeira, & Dell'Aglio, 2010, Page 396).

Self-esteem has been measured around the world using the Rosenberg Self-Esteem Scale (RSS) (Rosenberg, 1965), conceptualized as a one-dimensional instrument capable of classifying self-esteem levels into low, medium, and high. In Brazil, this instrument was originally adapted and validated for research by Hutz (2000) and that version has been used by various researchers (Hutz & Zanon, 2011). Similarly, with the aim of forming a scale that was sensitive to fluctuations in self-esteem, Heatherton and Polivy (1991) developed the State Self-Esteem Scale (SSES). To measure self-esteem and relate it with other constructs such as congruence and preference for organic products, this study used the SSES measurement scale.

Self-esteem can also be conceptualized as a hierarchical construct that can be divided into its constituent parts. From this perspective, there are three main components: performance self-esteem, social self-esteem, and physical self-esteem (Heatherton & Polivy, 1991). The scale was composed of twenty items focusing on the three subcomponents. Performance self-esteem refers to the sense of general competence and

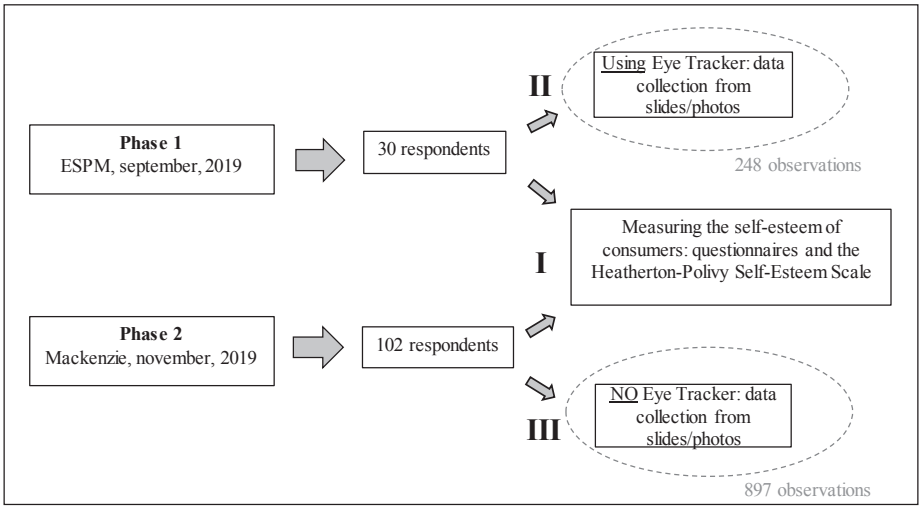

Fig. 1. Data collection phases of the research. *Source:* research data.

includes intellectual capacities, school performance, self-regulating capacity, self-confidence, effectiveness, and agency, and measures up to what point individuals consider their performance to be desirable. Individuals with high performance believe that they are more intelligent and capable.

The social self-esteem subscale measures up to what point people are more concerned about their image; it refers to how people believe others perceive them. It is highly related with the perception of others, especially whether others attribute significant value to them and value and respect them. In this case, they will be experiencing high social self-esteem. Finally, the appearance scale refers to a self-assessment regarding the individual's physical characteristics. This is how people see their bodies, and includes items such as athletic abilities, physical attractiveness, body image, as well as physical stigmas and feelings about race and ethnicity (Heatherton & Wyland, 2003). It is observed, however, that the subcomponents of self-esteem are related with overall self-esteem, since they represent the sum of the specific components of self-esteem, each of which is weighted by its importance to self-concept.

After this stage occurred in both phases, the same individuals were exposed to the experiment to collect information through exposure to photos/slides (points II and III, Fig. 2). The participants indicate their choice for a product (A or B) or neither one. It was an orthogonal design based on all the possible combination. Each individual observed 8 slides; the time for evaluating each slide was at least 10 s. Each slide contained 2 products (with different presentations of seals): one on the left of the slide and another on the right of the slide, as illustrated in Fig. 2. This figure presents a sample of these slides with all the attributes evaluated. On each slide a different combination of these attributes was used. When shown this, the individual had the option of choosing between the two products (A and B) on the slide or not choosing these alternatives. When they chose one, the value 1 was recorded on a spreadsheet and when they did not choose one, the value 0 was considered. These values composed the dependent variable data used in the logit model (main method), described in the item below.

In all the slides combinations the products/attributes appear in the right and in the left sides. The combination was in the slide 1: Product 1 (left side) versus Product 2 (right side). In slide 2 Product 2 (left side) versus Product 3 (right side) and so on. Than all the products are shown to the participants in both right and left sides. There is no significant statistical difference in the eye tracking metrics when the attributes were in the right or left sides.

In Phase 1 (point II, Fig. 1), the data collection was carried out by means of the eye tracking instrument, where the aim was to measure the visual attention of organics consumers and their congruence based on images and attributes of organics, as well as identifying the purchase preference of these consumers. The experimental research was carried out using the eye tracking instrument, a piece of biometric research equipment with eye monitoring technology (Jacob & Karn, 2003; Just & Carpenter, 1976; Peruzzo, 2018; Sousa, 2016), which enables an individual's eye movements to be measured and recorded during the sampling of a stimulus in a real or controlled environment. The eye tracker model used was the Tobii T120 with integrated 17″ monitor (refresh rate: 60 Hz, response time: 4 ms). This eye tracker captures eye movements at 120 Hz (or every 8.3 ms) and operates at a distance of 50–80 cm from the eyes and can follow the movements of the head within a 30 × 22 cm window (at 70 cm of the screen).

The volunteers were exposed to a set of images: organic and non-organic products. Simultaneously, the images of organic products presented characteristics and attributes of these products that were already identified in the literature, such as healthiness, ecological, small farmers, no fertilizers, etc. (Fig. 2). The form of visual report used was the AOI (Areas of Interest). This type of data representation enables statistical data to be generated regarding the behavior of participants in any area of the stimulus, relating visual fixation with the set of previously mentioned metrics (Barreto, 2012).

Each volunteer observed a set of different types of information laid out on 8 slides, using the eye tracker equipment, where the slides contained congruent and non-congruent attributes. Each slide was analyzed by the participant for 10 s. During the experiment, the individual answered their choice (A, B or neither one) for each slide shown, indicating their purchase intention in relation to the two types of foods displayed on each one of them. The result of the evaluations was elaborated and analyzed by a professional from the area who has been handling the equipment for some time, thus providing the authors with the necessary data to conclude the results.

In Phase 2 (point III, Fig. 1): in this stage, the aim was to measure the respondents' self-esteem as well as identifying the congruence of attributes and images of organics, based on the same slides and procedures used in Phase 1, (point I, Fig. 1), but without using the eye tracking instrument.

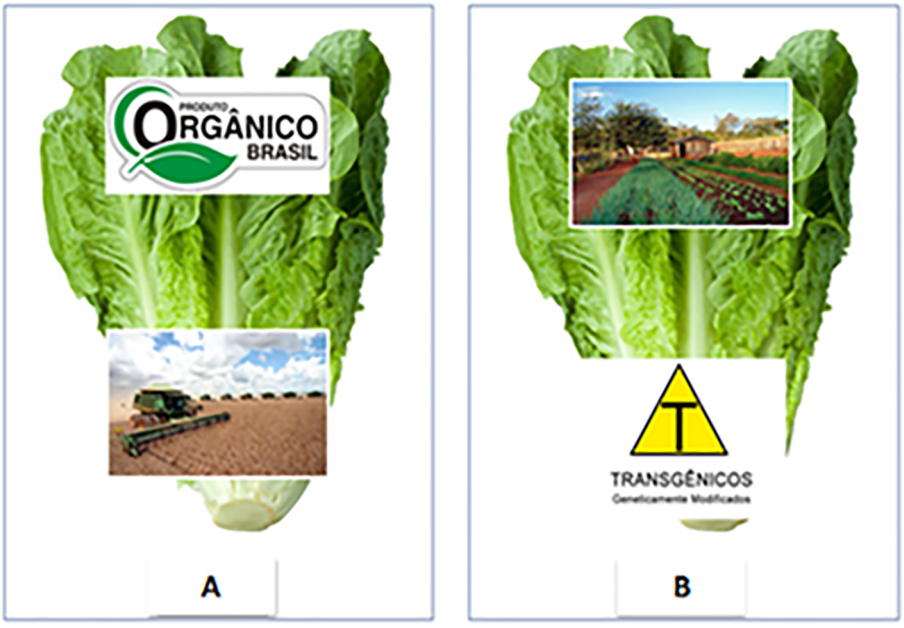

Fig. 2. Sample of a slide that represents all the attributes presented to the individuals during the collection of information by the eye tracking instrument.

In short, regarding the information obtained from the respondents (points II and III, respectively, Fig. 1), we have:

- *Phase 1:* when observing a slide, in the case of one of the products (A or B) being chosen, the value 1 was recorded on the spreadsheet; in the case of neither being chosen, the value 0 was recorded. In the latter case, duplicate information was considered, denoting that not choosing implies the non-choice of A and non-choice of B. The number of informational items (lines) on the spreadsheet was: 30 respondents × 8 slides = 240 observations (lines on the spreadsheet). Note that 8 cases were observed where the individual's response corresponded to 0 (not choosing). Thus, there was duplication of these 8 observations, resulting in 248 observations (240 observations + 8 observations).
- *Phase 2:* following the same logic, 102 respondents were obtained, exposed to 8 slides. Thus: 102 respondents × 8 slides = 816 informational items (lines on the spreadsheet). Of that total, 81 informational items correspond to the zero value (non-choice). So, by duplicating this value, a total of 897 observations are obtained from Phase 2 (816 informational items + 81 duplicate non-choice informational items).

By adding together the information from both phases, we obtain 1145 data items (248 from Phase 1 + 897 from Phase 2). In this case, 89 non-choice informational items were observed (8 in Phase 1 and 81 in Phase 2, including the duplications). In this stage, the Discrete Choice model method was used (for the 1145 observations). This model is used in marketing research for modeling decision makers' choices between alternative products and services. The decision makers can be people, families, companies, and so on, and the alternatives can be products, services, actions, or any other options or items about which choices should be made (Train, 2009). The collection of alternatives that are available for decision makers is called the set of options.

Based on this model, it was possible to attribute weights to the congruent and non-congruent attributes identified for each one of the slides; and for the purchase preferences. Based on the data collection, the organics and non-organics consumers were identified as well as their level of self-esteem based on a calculation of the mean and standard deviation. It was inferred that from a mean of (and including) five upward, the user has high self-esteem; below this number, their self-esteem is considered to be low.

The area of interest (AOI) covered on each one of the slides presented four well defined spaces, identified by congruent images of organic product (organic seal and a picture of a small farm) and by non-congruent images of non organic product (transgenic seal and a picture of a big farm). Visual attention was measured based on three metrics (first fixation, total fixation, and return visits). Also, each user's observation was measured in milliseconds, duly recorded by the eye tracker. Each metric indicated a value for each one of the spaces. This activity was repeated for each one of the twenty users.

Logistic regression or logit is used as non-linear models projected specifically for binary dependent variables. This regression enables the probability associated with the occurrence of a particular event to be estimated given a set of explanatory variables (Stock & Watson, 2004).

Faced with this database, two methods were adopted:

- *Principal method:* this was the logit model. The information obtained in both phases was considered, based on 132 respondents. Thus, the sample was composed of 1145 informational items. Here the variables relating to the visual metrics obtained with the eye tracking instrument were not used.
- *Complementary method:* as a way of the exploring analyses using the fixation metric variables, not used in the (main) logit model, parametric hypotheses tests (*f* test) were used. The data used here referred only to the data on the visual metric variables (obtained in Phase 1, referring to 248 observations).

3.2. Analytical model

To model the probability of occurrence of the product being chosen, the logit model was adopted, since the dependent variable (Y) can take the values 0 and 1. It was assumed that the chosen variables can influence the occurrence of the product being chosen or not. Thus, if the product is chosen by the consumer in the sample, Y (independent variable) takes the value 1; and 0 otherwise. So, in the binary logit model considered here, the response given by the individuals is a discontinuous and dichotomous variable. For example, if the individual answers "yes" to the question "do you choose any product from this slide?" then the dependent variable takes the value 1; if they answer "no", this variable takes the value zero.

This model is based on the (logistic) cumulative statistical probability function (Campbell, Mhlanga, & Lesschaeve, 2013):

$$P_i = \frac{1}{1 + e^{-X_i\beta}} \quad (1)$$

in which:

Pi represents the probability of occurrence of the product being chosen;
Xi is a vector of explanatory variables;
β is a vector of unknown parameters to be estimated.

According to Torres-Reyna (2014), the estimation of parameters β_0, $\beta_1 \cdots \beta_n$ is carried out based on the dataset, using the maximum likelihood method, in which a combination of coefficients is found that maximizes the probability of the sample having been observed. After the logit model estimation, the marginal effects of each attribute are calculated, finding the respective percentage in the variation in the individual's probability of choice.

In non-linear models, the estimated coefficient does not equal the marginal effect (MgE) of the dependent variable over the probability of the consumer making the choice, that is, $\partial P(Y = 1)/\partial X$ will not directly be β as in the linear regression (Wooldridge, 2000). So, according to Maddala (1986), the marginal effect will be given by:

$$\partial P(Y = 1)/\partial X = \beta \frac{e^{-X_i\beta}}{(1 + e^{-X_i\beta})^2} \quad (2)$$

that is, from multiplying the estimated coefficient β of each explanatory variable with the density function of the logistic distribution. The software used for the model adjustment was the R Program (Team, 2014).

The models estimated in this study presented the following as explanatory variables:

- GEN: refers to a binary variable, taking the value 1 for male consumers and 0 for females;
- CONSORG: refers to a binary variable, taking the value 1 for individuals who stated they were consumers of organic products and 0 otherwise;
- MSELFEST: continuous variable referring to the score that measures self-esteem (the higher the value of this variable, the higher the individual's self-esteem);
- CONGR1: refers to a binary variable, taking the value 1 in the presence of the "small property" seal on the product to be chosen and 0 otherwise (analysis carried out in relation to the product without the presence of any congruence seal);
- CONGR2: refers to a binary variable, taking the value 1 in the presence of the "organic" seal on the product to be chosen and 0 otherwise (analysis carried out in relation to the product without the presence of any congruence seal);
- NCONGR1: refers to a binary variable, taking the value 1 in the presence of the "transgenic" seal on the product to be chosen and 0 otherwise (analysis carried out in relation to the product without the

presence of any NON congruence seal);
- NCONGR2: refers to a binary variable, taking the value 1 in the presence of the "large property" seal on the product to be chosen and 0 otherwise (analysis carried out in relation to the product without the presence of any NON congruence seal).

As the dependent variable (Y), we have the individual's choice (Y = 1) and non-choice (Y = 0).

Note that in this study one model was estimated (as according to Eq. (1)) containing data from the two research phases. The final model presented the coefficients estimated for the variables highlighted above. The "AIC" and the "stepwise" methodology were considered as adjustment support. It should also be mentioned that the following were also initially considered as explanatory variables: total time (seconds) of the first fixation, total fixation time, and number of times the individual returns to the product with a fixation of look. That group of variables was excluded from this logit model as it did not present the respective significant estimated coefficients, as well as not contributing to the robustness of the final model.

In general, the TFF, TFD, and TVD categories are defined as time of the individual's first fixation on the product, total duration of fixation by the individual, and number of times the individual returns to the product with a fixation of look, respectively. As these variables were not considered in the logit model, a complementary methodology was used to test the hypotheses in order to explore and analyze these metrics. Thus, a hypotheses test was carried out, in order to compare whether the individuals' average time and number of visualizations for claims referring to organics and transgenics were equal, according to each one of these three categories (TFF, TVD, and TVD), considering individuals with high/low self-esteem and individuals of the male and female genders. So, the TFF, TFD, and TVD categories were analyzed using a hypotheses test, considering, for each one, the difference between two means for observations of the Organic (X_1) and Transgenic (X_2) seals.

There are two procedures to test the hypothesis that the difference between the means of two independent normal populations has a specified value, in the context of the variances of these populations being unknown:

- *Case 1:* the variances of these populations are unknown and supposedly equal.
- *Case 2:* the variances of these populations are unknown and supposedly different.

For the decision regarding which CASE (1 or 2), an equality of variances test must be carried out, enabling it to be known whether the unknown variances of these populations (Organics and Transgenics) are supposedly equal (CASE 1) or not (CASE 2). The comparison of the variances of the two normal populations involves the use of the F distribution. Having identified which of these cases applies, the *t* test is then carried out. For details regarding the calculations of the test statistics, see Hoffmann (2006). For this, the equality of the means of the metric in question (TFF, TVD, or TFD) is tested, for organics vs. transgenics. Let μ_1 and μ_2 be the Organic and Transgenic population means, and so Ho: $\mu 1 - \mu 2 = 0$ is tested based on the two random independent samples X_1 and X_2, with n_1 and n_2 observations, respectively.

4. Results and discussion

Unfortunately the congruent and non-congruent image regarding the size of the farm were note significant. Other eye tracking metrics such as gazing behavior could capture these differences (Vu, Tu, & Duerrschmid, 2016).

First, Table 1 presents the descriptions of the explanatory variables considered and their respective descriptive statistics observed for the purposes of adjusting the logit model.

Analyzing the data for the binary variables (Table 1), it is observed that 54.24% of the sample is composed of individuals who state they are organics consumers and 52.53% are male. With relation to the presence of seals in the photos/slides of the products analyzed by the respondents, 38.1%, 35.37%, 18.95%, and 44.45% of the sample presents the small property, organic, transgenic, and large property seals, respectively. With relation to the continuous variable "MSELFEST", its mean value was 4.45 for the sample considered. Calculating its coefficient of variation (CV) we find an approximate value of 28%. The CV evaluates the relative variability of the data based on the ratio between the standard deviation and the mean (Hoffmann, 2006). This value enables an evaluation of the percentage of the variability of the data in relation to its mean. After studying the CV from various tests, Pimentel-Gomes (1987) proposed the following classification: low, when less than 10%; medium, between 10 and 30%; high, when greater than 30%

The results obtained based on the logit model adjustment are presented in Table 2. For the model, the coefficients presented signs corresponding to what was expected for the analysis in question, as well as being significant, at the 1% and 5% significance levels. Note that other models were estimated considering the presence of other variables. Using the stepwise method and with the help of the lowest AIC value, the most robust model was defined, as presented below.

For the model, it was observed that 8.56% corresponds to the reduction in the probability of the individual choosing the product if they are a man (in relation to the female gender). With relation to self-esteem, the model presented a 2.52% increase in the chance of choosing the product for each unit increase in the score relating to that variable. In the presence of an organic seal, the result of the model indicated a 4.37% increase in the probability of the product being chosen. On the other hand, in the presence of a transgenic seal and a seal referring to a large property, a 24.36% and 5.25% reduction was observed in the probability of the product being chosen, respectively. The variables referring to the "small property" seal (CONGR1) and the characterization of the consumer as being an "organics consumer" (CONSORG) did not present significant coefficients in the model and their exclusion ultimately improved the fit and robustness of the final model. These results show how important is to food policymakers to understand the differences between consumers. Increase in the self-esteem could bring a better food choice. Found also differences between consumers using eye-tracking metrics. They found two clusters that are differed by how they extracted and processed information.

4.1. Results for the complementary methodology

4.1.1. Within groups analysis

As mentioned above, the TFF, TFD, and TVD categories were analyzed using a hypotheses test, considering, for each one, the difference between two means for observations:

- of the Organic (X_1) vs Transgenic (X_2) seals for the male and female genders;
- of the Organic (X_1) vs Transgenic (X_2) seals for high and low self-esteem;
- of the Organic (X_1) vs Transgenic (X_2) seals for organics and non-organics consumers

Thus, first the test was carried out to know the equality of the variances; that is, whether the unknown population variances (Organics and Transgenics) are equal or different (Case 1 or 2).

4.1.1.1. Considering the total sample. Table 3 presents the results of the comparison of the variances between organics and transgenics, within each category (TFF, TFD, and TVD), for the total sample.

Only the TFD category presented non-rejection of the null hypothesis (Ho), indicating that the test of means to be conducted should be the one related to Case 1, where the variances are unknown, but supposedly equal. For the other categories (TFF and TVD), the case

Table 1
Description of the explanatory variables and respective descriptive statistics.

Variables	Description	Mean	Maximum	Minimum	Standard deviation
CONSORG	1 if the individual states they are an organics consumer	0.5424	1	0	0.498
MSELFEST	Mean of the scores (scale) of all the categories that characterize "self-esteem" in the questionnaire (point I, Fig. 1)	4.452	7	0.46	1.285
GEN	1 if the individual states they are male; 0 otherwise	0.5153	1	0	0.499
CONGR1	1 if there is a "small property" seal in the photo/slide; 0 otherwise	0.3817	1	0	0.486
CONGR2	1 if there is an "organic" seal in the photo/slide; 0 otherwise	0.3537	1	0	0.478
NCONGR1	1 if there is a "transgenic" seal in the photo/slide; 0 otherwise	0.1895	1	0	0.392
NCONGR2	1 if there is a "large property" seal in the photo/slide; 0 otherwise	0.4445	1	0	0.497

Source: research data (2019).

Table 2
Estimates of the coefficients of the logit model and respective marginal effect values.

Variables[++]	Coefficients	St. deviation (coeff)	MgE[#]	St. deviation (MgE)
Intercept	1.7911***	0.3650	–	–
MSELFEST	0.2633***	0.0739	0.0252	0.0069
GEN	−0.8889***	0.1954	−0.085	0.0183
CONGR2	0.4799**	0.2006	0.043	0.0173
NCONGR1	−1.7029***	0.2521	−0.243	0.0452
NCONGR2	−0.5321**	0.2373	−0.052	0.0238
N		1145		
AIC		821.39		

***, ** indicates significance at 1% and 5%, respectively.
[#]Marginal Effect (MgE). [++]GEN: gender.
[++]MSELFEST: self-esteem (the higher the value of this variable, the higher the individual's self-esteem).
[++]CONGR2: "organic" seal.
[++]NCONGR1: "transgenic" seal.
[++]NCONGR2: "large property" seal.

indicated was Case 2, where the variances are unknown, but supposedly different. Thus, applying the hypothesis test according to the cases indicated, the comparison of means was obtained between organics and transgenics within each category (TFF, TFD, and TVD). The results are presented in Table 4.

According to the data in Table 4, there are indications of a difference between organics and transgenics, within all the categories studied (TFF, TFD, and TVD), when the total data sample is considered. These results are based on the rejection of the null hypothesis (Ho). Also, as the test considered here was one-tailed, the rejection of the null hypothesis implies that there is an indication that the mean of organics is different from and lower than the mean of transgenics for all the categories.

4.1.1.2. According to high and low self-esteem. From the results of the hypotheses tests, it is noted that when the organic and transgenic seals are compared for the TFF, TFD, and TVD categories, differences are observed in the means for time and for visualizations for the seals. This result is observed when the total sample is considered and when individuals with high self-esteem in this sample are considered. In individuals with low self-esteem, it is observed that only the TVD category presents a difference between the means for organics and transgenics (with that of organics being lower). What stands out in the results of these hypotheses tests is that the total TVD category was the only one that presented a statistical difference, for the sample considered here, in the comparison of the observations of the organic and transgenic seals, for high and low self-esteem. Thus, it could be suspected that this variable is more efficient than the others for the aim of characterizing the fixation of the types of consumer behaviors and profiles with the different image congruence stimuli.

Based on the results of the complementary methodology of hypotheses tests, it was observed that the number of visualizations (TVD) revealed low relevance given the classification of the individual's self-esteem; that is, when this is high or low, the mean number of visualizations was lower for organics when compared to transgenics. Perhaps non-congruent seals (transgenics in this case) may attract more attention, leading to a greater number of visualizations (independent of the individual's state/self-esteem).

4.1.1.3. According to male and female gender. The TFF and TVD categories present significantly different and smaller means in organics, when compared to transgenics for individuals of the male and female genders. Only individuals of the female gender presented a difference in the means of organics and transgenics (with that of organics being lower) for the TFD category.

Considering the male gender individuals, only the TFD category does not differ between organics and transgenics. For the other categories (TFF and TVD), there is evidence of differences in the means of the metrics between organics and transgenics (with that of organics

Table 3
Test analyzing the unknown variances between the two population samples (organics and transgenics).

Categories/Variables[++]	Organic (variance)	Transgenic (variance)	F statistic	Null hypothesis "Ho" (rejection)	Case
TFF	2.30	2.97	0.77**	Yes	2
TFD	0.58	0.59	0.98[#]	No	1
TVD	0.68	1.67	0.41*	Yes	2
Observations	248	248	–	–	–
Hypotheses	Ho: $\sigma^2_{organic} = \sigma^2_{transgenic}$; H_A: $\sigma^2_{organic} \neq \sigma^2_{transgenic}$				

***, **, * indicates significance at 1%, 5%, and 10%, respectively.
[#]Significance above 10% or non-significance.
[++]TFF: time first fixation.
[++]TFD: total duration of fixation by the individual.
[++]TVD: number of times the individual returns to the product with a fixation.

Table 4
Test for comparing the two means of the independent normal populations (organics and transgenics).

Categories/Variables[++]	Organic (variance)	Transgenic (variance)	F statistic	Null hypothesis "Ho" (rejection)
TFF	0.73	1.15	−2.86*	Yes
TFD	0.45	0.60	−2.07**	Yes
TVD	0.49	0.83	−3.42*	Yes
Observations	248	248	–	
Hypotheses	Ho: $\mu^2_{organic} = \mu^2_{transgenic}$; H_A: $\mu^2_{organic} < \mu^{o2}_{transgenic}$			

***, **, * indicates significance at 1%, 5%, and 10% respectively.
[#]Significance above 10% or non-significance.
[++]TFF: time first fixation.
[++]TFD: total duration of fixation by the individual.
[++]TVD: number of times the individual returns to the product with a fixation.

being higher). In general, for this study, with the sample considered, similarity was observed in the behavior of individuals of the female gender and individuals with high self-esteem, when comparing the means of the metrics (TFF, TFD, and TVD) for observation of organic and transgenic seals. Individuals of the male gender presented some similarity with individuals with low self-esteem. It warrants highlighting that this is only evidence found using one hypotheses test methodology. The study does not aim to affirm this evidence, but rather tests the water in order for future correlated studies to be conducted. In general, there is evidence that individuals of the female gender resemble individuals with high self-esteem and individuals of the male gender resemble individuals with low self-esteem, in relation to the behavior portrayed by means of the eye tracking metrics (TFF, TFD, and TVD), given observation of organic and transgenic seals.

4.1.1.4. According to consumers of organics and non-consumers of organics. Considering the organic consumers individuals, only the TFD category does not differ between organics and transgenics. For the other categories (TFF and TVD), there is evidence of differences in the means of the metrics between organics and transgenics (with that of transgenic being higher). In case of non-organic consumers, only TFF category does not differ between organics and transgenics. For the categories TFD and TVD there is evidence of differences in the means of the metrics between organics and transgenics (with that of transgenic being higher).

In a nutshell, in case of organic consumers, for the TFF category there is evidence of differences in the means of the metrics between organics and transgenics seals; in case of non-organic consumers, for the TFD category there is evidence of differences in the means of the metrics between organics and transgenics seals

4.1.2. Between groups analysis

The TFF, TFD, and TVD categories were analyzed using a hypotheses test, considering, for each one, the difference between two means for visualizations:

- of the Organic (X_1) seal for male vs female gender, for high and low self-esteem, and for consumers of organics and non-consumers of organics;
- of the Transgenics (X_2) seal for the male vs. female gender, for high and low self-esteem, and for those who state they are consumers of organics and non-organics;

As was carried out in the "within groups" analysis, before the hypotheses tests to compare the means, the hypothesis test was carried out to known the equality of the variances; that is, whether the unknown population variances of each group (male, female, high self-esteem, low self-esteem, organics consumers and non-organics consumers) are equal or different (Case 1 or 2).

4.1.2.1. According to high and low self-esteem. For the TFF, TFD e TVD categories, there is not evidence of differences in the means of the metrics between organic seal for individuals with high self-esteem and individuals with low self-esteem. Similarly, for these group of individuals, there is not evidence of differences in the means of the metrics in transgenic seal, for all categories (TFF, TFD and TVD).

4.1.2.2. According to male and female gender. For the male and female genders individuals, there is not evidence of differences in the means of the metrics between organic seal, for all categories. The same result applies to the observation of the transgenic seal.

4.1.2.3. According to consumers of organics and non-consumers of organics. For the TFF, TFD e TVD categories, there is not evidence of differences in the means of the metrics between organic seal for consumers of organics and non-consumers of organics.

For the transgenic seal, only for TFF category, there is evidence of differences in the means of the metrics between consumers of organics and non-consumers of organics (with that of consumers of organic products being higher).

For other categories, there is not evidence of differences in the means of the metrics between transgenic seal for consumers of organics and non-consumers of organics.

4.1.3. Summary of results

Briefly, all the results of the hypothesis tests are presented below (Tables 5–7).

Table 5
Summary of the test results, **TFF metric**.

Groups (TFF)	X_1	X_2	Conclusions
WITHIN			
Low self-esteem	Organics	Transgenics	$X_1 = X_2$
High self-esteem	Organics	Transgenics	$X_1 < X_2$
Male	Organics	Transgenics	$X_1 < X_2$
Female	Organics	Transgenics	$X_1 < X_2$
Organic consumer	Organics	Transgenics	$X_1 < X_2$
Non Organic Consumer	Organics	Transgenics	$X_1 = X_2$
BETWEEN			
Organics	Male	Female	$X_1 = X_2$
Transgenics	Male	Female	$X_1 = X_2$
Organics	Low self-esteem	High self-esteem	$X_1 = X_2$
Transgenics	Low self-esteem	High self-esteem	$X_1 = X_2$
Organics	Organic consumer	Non-Organic Consumer	$X_1 = X_2$
Transgenics	Organic consumer	Non-Organic Consumer	$X_1 < X_2$

Source: research data.

Table 6
Summary of the test results, **TFD metric**.

Groups (TFD)	X_1	X_2	Conclusions
WITHIN			
Low self-esteem	Organics	Transgenics	$X_1 = X_2$
High self-esteem	Organics	Transgenics	$X_1 < X_2$
Male	Organics	Transgenics	$X_1 = X_2$
Female	Organics	Transgenics	$X_1 < X_2$
Organic consumer	Organics	Transgenics	$X_1 = X_2$
Non Organic Consumer	Organics	Transgenics	$X_1 < X_2$
BETWEEN			
Organics	Male	Female	$X_1 = X_2$
Transgenics	Male	Female	$X_1 = X_2$
Organics	Low self-esteem	High self-esteem	$X_1 = X_2$
Transgenics	Low self-esteem	High self-esteem	$X_1 = X_2$
Organics	Organic consumer	Non-Organic Consumer	$X_1 = X_2$
Transgenics	Organic consumer	Non-Organic Consumer	$X_1 = X_2$

Source: research data.

Table 7
Summary of the test results, **TVD metric**.

Groups (TVD)	X_1	X_2	Conclusions
WITHIN			
Low self-esteem	Organics	Transgenics	$X_1 < X_2$
High self-esteem	Organics	Transgenics	$X_1 < X_2$
Male	Organics	Transgenics	$X_1 < X_2$
Female	Organics	Transgenics	$X_1 < X_2$
Organic consumer	Organics	Transgenics	$X_1 < X_2$
Non Organic Consumer	Organics	Transgenics	$X_1 < X_2$
BETWEEN			
Organics	Male	Female	$X_1 = X_2$
Transgenics	Male	Female	$X_1 = X_2$
Organics	Low self-esteem	High self-esteem	$X_1 = X_2$
Transgenics	Low self-esteem	High self-esteem	$X_1 = X_2$
Organics	Organic consumer	Non-Organic Consumer	$X_1 = X_2$
Transgenics	Organic consumer	Non-Organic Consumer	$X_1 = X_2$

Source: research data.

5. Conclusions

The general aim of this study is to propose a new model for understanding the behavior of organics and transgenics consumers, based on an understanding of the relationship between the theory of self-esteem and congruence between images and attributes of organics and the consumer's preference based on experiments using the eye tracking instrument. An analysis is also carried out regarding the equality in the eye tracking metrics for the organics and transgenics seals within the following classes: female gender, male gender, high self-esteem, and low self-esteem.

The use of non-congruent images let the consumer to increase the total time fixed and the use of congruent imagens let the consumer to take the first visual attention. This behavior is similar to the finding by Helmert, Symmank, Pannasch, and Rohm (2017) regarding the visual suboptimal foods in discarding decision. Other studies could test the best combination and the trade-offs between what provides most versus fast visual attention.

Also, the results found tend to corroborate the interdisciplinary character of the topic, and they are consistent with the affirmations of De Camargo (2013), Javor et al. (2013), Lindstrom (2016), Plassmann et al. (2012), Ramsøy (2015), and Morin (2011), that social and health sciences should include research in an integrative way, in order to provide convergent results between the neuro-scientific techniques and the traditional research.

As research limitations, it is observed that using eye tracking technology is not except from criticisms that should be taken into consideration in the planning of its application, such as the new interfaces of modern computers that offer even more challenges of a technical nature when studying eye fixations. However, there is a verified difficulty in comparing the various metrics to obtain effective results.

In addition, it is noted that self-esteem can present importance in the decision-making process (probability of choice) and visual attention. – according to the logit model results, this probability increases by around 2.5% as the self-esteem score increases.

Therefore, despite the use of eye tracking technology helping to determine where the participant is looking, it cannot be known what they are thinking, since the user's eye movements alone do not reflect the totality of information that may be contained in the individual's mind.

CRediT authorship contribution statement

Felix Aguero Dias Leona: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - review & editing, Writing - review & editing. **Eduardo Eugênio Spers:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing. **Lilian Maluf de Lima:** Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - review & editing.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2020.103938.

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