International Journal of Consumer Studies

ORIENTATION RESPONSE IN LOW-FAT FOODS: DIFFERENCES BASED ON PRODUCT CATEGORY AND GENDER.

Journal:	*International Journal of Consumer Studies*
Manuscript ID	IJC-OA-2020-275.R2
Manuscript Type:	Original Article
Keywords:	food, gender, marketing, sensory, consum
File Designation:	

ORIENTATION RESPONSE IN LOW-FAT FOODS: DIFFERENCES BASED ON PRODUCT CATEGORY AND GENDER.

Abstract

Because most consistent findings from previous studies have found the inconsistency between consumers' statements and their behaviour, this paper analyses diverse young consumers' responses that can affect their low-fat food purchase intentions. The main objective is to evaluate the differences in the orientation response (OR) between two product categories ("juice 0%" and "sweet 0%") considering also the gender of the participant. To this end, responses from men and women towards two kind of product presentation (juice 0% vs. sweet 0%) were collected through Heart Rate Variability (HRV) and Electromyography (EMG) measures. We hypothesize that men would obtain different OR regarding women, and we explore possible different OR regarding product category. With a sample of young consumers (46 men and 51 women), our results show product category differences but not gender differences.

Keywords: orientation responses (OR); low-fat foods; gender differences; Heart Rate Variability (HRV) and Electromyography (EMG) measures

1. INTRODUCTION

Today, more and more consumers try to find foods that are safe and, additionally, positively promotes good health because they see food to improve their health and well-being (Gray, Armstrong & Farley, 2003). McKeown & Nelson (2018) state that for young consumers healthy eating and the consumption of an adequate quality diet is important for cognitive growth and wellbeing. In this context, functional foods have been launched in Europe since the mid-1990s (Menrad, 2003) and show a growing expansion (Özen, del Mar Bibiloni, Pons & Tur, 2014). The International Life Sciences Institute states that functional foods are those that incorporate a variety of relevant components to improve health status or reduce the risk (non-prevention) of the disease (Ashwell, 2004). These foods also must cause

benefits beyond those of basic nutrition. For example, foods that are low in fats and sugars, among others, are functional foods (Küster & Vidal, 2017).

In this context, it is interesting to be able to explain the behaviour of the consumer who chooses these products to succeed in the development of products and marketing strategies (Urala & Lähteenmäki, 2003). However, the most consistent findings from previous studies have found the inconsistency between consumers' statements and their behaviour – the so-called intention-behaviour or attitude-behaviour gap. (Chekima, Oswald, Wafa Syed & Chekima, 2017).

According to McKeown & Nelson (2018), adolescence is a period when individuals develop into independent active consumers that participate in food related decisions and it is important to analyse decisions that are made by adolescents in the selection and consumption of food when given free choice as to what they would like to eat. In this sense, Santeramo, Carlucci, De Devitiis, Seccia, Stasi, Viscecchia, & Nardone (2018) review several studies that have emphasized the relevance of consumers' opinions about awareness, preferences, attitudes, perception and purchase intentions towards functional foods considering various product categories such as dairy, meat, bakery, and beverages. In this vein, and as Poels & Dewitte (2006) review, many times, emotions (physiological responses) dominate cognition (verbal responses), and not always the best-evaluated product is the chosen one. In this sense, and according to Wansink (2004), most of the choices related to eating behavior, including food purchases, are unarticulated and unconscious. Even more, as Köster & Mojet (2015) have remarked, physiological reactions could be used without explicit awareness of the relation between the measurement and the food eaten although in most cases the subjects are aware of the relationship.

But not only from a consumers' perspective, from a firm's perspective, also, it is especially interesting the evaluation that a certain food can have on the consumer before being developed and launched on the market (Le Goff & Delarue 2017) because the development and launch of food products involves a large amount of investment for companies. And this is especially relevant when a company develops

low-fat functional foods which market forecasts more than $300 billion for 2020 (Santeramo, Carlucci, De Devitiis, Seccia, Stasi, Viscecchia, & Nardone, 2018).

For these reasons, the present paper proposes to measure orientation responses towards two kind of low-fat foods (juices and sweets) using two kind of physiological reactions [(a) cardiac reactions and (b) electromyographycal reactions]. By measuring low-fat foods reactions, it could be possible to anticipate the acceptance/rejection of new products before they have been developed and launched to the market.

Taking this into account, this paper aims to analyse diverse young consumers' responses that can affect their food purchase intentions. Specifically, a healthy food (juice with milk) versus an unhealthy one (candy bars) were considered in our research. Studies with milk packaged as a healthy product can be seen in different papers (Levin & Levin, 2010; Samant & Seo, 2020), and other studies [(Underwood, Klein & Burke 2001; Wansink, Chandon & Can, 2010) propose candies as an unhealthy and hedonic product. There is an expanded consumption of pre-packaged foods that usually contain high levels of sugar, fat, saturated fatty acids, trans-fatty acids, and sodium (Borgmeier & Westenhöfer, 2009). To avoid nutrition-related diseases, the World Health Organization (WHO) recommends decreasing these nutrients with the aim of increasing the nutritional value. In this regard, food packaging has received considerable attention [(Borgmeier & Westenhöfer, 2009)

Through this paper, we try to add value to previous works in different ways. As Hailu, Boecker, Henson & Cranfield (2009) explain, previous studies have focused on the role of health claims in consumer acceptance of different kinds of functional foods. However, the literature has paid less attention to sources of health claim acceptation (Hailu, Boecker, Henson & Cranfield, 2009; da Silva Junior, Neto, Leal & Carneiro, 2020). For this reason, the first contribution of this paper is to analyze some orientation responses to two different low fat (a kind of functional food) product categories: juice 0% and sweets 0%.

Second, and as Niva & Mäkelä (2007) state, previous consumer studies have neglected an examination of the acceptability certain foods (such as low-fat foods), so that both the diversity of consumers' backgrounds and the multifaceted nature of low-fat foods must be taken into account. That is, although previous studies have paid attention to specific product categories and concrete types of products or to diverse claim formats (Verbeke, Scholderer & Lähteenmäki, 2009; da Silva Junior, Neto, Leal & Carneiro, 2020), study of gender differences when physiological responses are analysed is scarce.

Therefore, this paper is in line with the two latest developments in the field of consumer studies and, specifically, in the area of low fat foods: (i) examining consumers' physiological reactions and their evolution to two specific 0% product categories and (ii) analysing differences between men and women.

In sum, and although recent studies have analyzed the physiological responses to certain categories of food (Motoki, Saito, Nouchi, Kawashima & Sugiura, 2018; Rana & Paul, 2020; Samant & Seo, 2020), this is an incipient field of research where it is still necessary a deeper investigation (Le Goff & Delarue 2017; Verastegui-Tena, van Trijp & Piqueras-Fiszman, 2018). Therefore, the main objective of this study is to analyze the differences between juices with milk 0% (healthy product) and sweets 0% (unhealthy product) in relation to the orientation responses (OR) in the autonomic nervous system (ANC) taking into account, on one side, gender differences and, on another side, the category of the product presented. It is hypothesized that men and women will show different ORs depending on the product category (juices 0% -healthy product versus sweets 0% -unhealthy product). The evaluation of the effects of the selected products and the gender of the participants is carried out by electrocardiogram (ECG) and electromyography (EMG) measurements; with a sample of 100 young people, (18-26 years old, 46 men and 51 women). We can justify the election of these measures because, although for many consumer neuromarketing researchers, the use of functional magnetic resonance imaging has been the most preferred neuroscience technique, electroencephalography, eye

tracking, and implicit measurements are becoming increasingly popular market research methods due to rapid technological improvements and reduced costs (Harris, Ciorciari & Gountas, 2017).

In this sense, the paper has been structured as follows. After this section (Section 1. Introduction), Section 2, Literature Review, presents the literature review that helps to justify the two hypotheses and the research question to be studied. Section 3, Method, explains the experiment (participants, protocol, task, psychophysiological measures, and data reduction and statistical analyses). Section 4, Results, offers, first a preliminary analysis of the sample description, and second, the main outcomes of the study of OR differences. The article finishes with Section 5, Discussion, Conclusions and Managerial Implications.

2. LITERATURE REVIEW

Most research on packaging has used self-reporting methods but they have limitations in measuring emotions because people are not aware about how they exactly feel (Lacoste-Badie, Gallopel-Morvan, Lajante & Droulers, 2019). As Liao, Corsi, Chrysochou & Lockshin (2015, p. 49) explain "compared to self-report measures, physiological measures capture additional information for the understanding of the dynamics of the emotional responses". In this sense, and considering the objectives of this paper, the following section justifies the ORs possible related to the type of low-fat product (healthy versus unhealthy) and the gender of respondents.

Sokolov (1963) defined orienting response as the variety of physiological changes that novel or emotional events can induce in the autonomic nervous system. According to Ferrari, De Cesarei, Mastria, Lugli, Baroni, Nicoletti & Codispoti (2016), motivationally relevant stimuli, such as a product presentation, can elicit an orienting response that is observable as a modulation of an extensive range of physiological reactions (i.e., heart rate or skin conductance). This OR is of special relevance in new products presentations because new stimuli pose novel opportunities that may result in beneficial outcomes or may pose a threat (Ferrari, De Cesarei, Mastria, Lugli, Baroni, Nicoletti & Codispoti, 2016).

On one side, and as Verastegui-Tena, van Trijp & Piqueras-Fiszman (2018) point out, food research regarding autonomic nervous system responses have used different types of stimuli and shown different results. The authors state that these different results can be explained due the novelty of the product, the kind of product or the physiological measures used. For example, a previous study (Verastegui-Tena, Schulte-Holierhoek, van Trijp & Piqueras-Fiszman, 2017) showed that ingredient images that disconfirmed expectations led to cardiac deceleration while in the case of skin conductance only the negative image led to an increase that differed from that of a neutral congruent image. In this sense, it is expected that a healthy message (using the claim 0%) in a healthy food (such as juices) is more congruent than this 0% message in an unhealthy food (such as sweets). Based in this congruency theory, different ORs will be expected depending on the product category. Therefore, the following hypothesis is established.

H1: Different low-fat food product categories (juices 0% versus sweets 0%) lead to different ORs in terms of (a) cardiac reactions and (b) electromyographical reactions.

On another side, an evolution of orienting responses is other aspect that should be considered. It could be interesting to analyse fatigue/boring effects when a consumer is exposed many times to a stimulus. As Cohen & Babey (2012) and Gardner (2015) point out, repeated exposure to the same food context can lead to routine/habitual behaviour, which might be non-cognitive, but nevertheless leads to preferences for some actions and choices. In this sense, Bradley (2009) reviews the most relevant literature in the orienting responses and states that psychophysiologist have found that both novelty and significance expositions to a stimulus affect skin conductance and heart rate changes during picture viewing. In this sense, for example, Öhman (1979), in his Information Processing Theory, states that the orientation response will occur before novel stimuli that do not agree with the elements of our short-term memory. That is, the first time we see a stimulus there will be an orientation response but if in a short period of time we see it again, that response will not occur, or it will be less. More recently, in his article entitled "Habituation of the orienting reflex and the development of Preliminary Process

Theory", he also mentions that the novelty is one of the most determining factors for the psychophysiological response to occur and, therefore, response is reduced as repetition increases. Tuvblad, Gao, Isen, Botwick, Raine & Baker (2011) add, to the above, that the habituation can occur more or less quickly depending on the unit of measurement, with the response of cardiovascular orientation of the fastest disappearing because of the repetition, while the electrodermic is more resistant. So, and considering previous literature results, the following hypothesis is stated.

H2: ORs will evolve as far as several presentations of the product are shown in terms of (a) cardiac reactions and (b) electromyographical reactions.

Finally, together with possible ORs differences related to the kind of product, it is possible to expect that men and women could differ in their responses to the products showed because stimuli can reflect individual differences in significance (Dindo & Fowles, 2008). As González, Meyer & Toldos (2021) state, women and men differ in their decision-making processes and evaluate different attributes and benefits prior to purchase.

In this vein, previous literature has shown contradictory results. On one hand, Codispoti, Surcinelli & Baldaro (2008) found a similar skin conductance increase and heart rate deceleration in men and women. They conclude that sustained exposure to pleasant and unpleasant stimuli elicit similar cardiac orienting, so that, from this approach, physiological responses will not differ between men and women By other hand, Rohrmann, Hopp & Quirin (2008), replicating previous studies, test that women show a higher increase in skin conductance level than men and report stronger feelings of disgust than men across all disgust inductions. Dindo & Fowles (2008) reached a same conclusion on electrodermal responses; there was a significant main effect of gender. From this approach, gender differences in physiological responses could not be probed.

Therefore, and given that different results have been obtained regarding gender differences, the following research question is stated.

RQ: Are there different ORs in men and women?

3. METHODS

3.1. Participants

In this experiment, 100 young participants (46 men and 54 women) aged 18 to 26 years (Mean ± Standard Deviation (SD) = 21.49 ± 2.46) and a mean Body Mass Index (BMI) of 23.34 ± kg / m2 (SD = 4.00) participated voluntarily. All participants were recruited for the experiment through verbal claims, and only users of the product that would be presented later in the task were selected. After some initial filtering questions (e.g. age), they were invited to come to the laboratory and complete a questionnaire on various socio-demographic aspects, as well as on consumption habits. Additionally, for the analysis of the psychophysiological response, participants with chronic heart disease, psychiatric disorders, abuse of drugs or alcohol, persons who smoked 10 or more cigarettes per day and persons who did not perform a maximum of 15 hours of physical activity per week were excluded by means of a screening questionnaire.

3.2. Protocol

The experimental protocol was carried out in a single session of 1-hour duration that was carried out between 09:00 and 19:00 hours. Once participants arrived at the laboratory, they were welcomed in the hall and passed to room 1, where they were told to take a seat and the experimenter explained the general procedure of the study. Subsequently, the subjects signed an informed consent, approved by the Research Ethics Committee of the University. Electrodes were then placed in the electrocardiogram (ECG) and electromyogram (EMG). To minimise artefacts, participants were instructed to avoid moving.

After the placement of the electrodes, participants spent 10 minutes in the experimental room to get used to the experimental situation, meanwhile participants were asked to complete questionnaires to check compliance with the selection criteria. Later they were explained that they were going to perform one computer task, instructing them to follow the instructions that appeared on the screen and

reinforcing them with oral instructions by experimenters. After completing the task, participants were instructed to stay in the room for 5 minutes until the electrodes were removed. Right after, participants were asked to move to another room to take measures of weight, height and waist and hip circumference (WHR) to guarantee the equivalence of the samples (men and women). At the end of the session, they were offered a sample of the product they had previously seen (juices or sweets) and were informed of some of the main objectives of the study, the possible doubts were resolved, and the farewell was given.

3.3. Task

The products presented were juices or sweets (Figure 1), and the participants were assigned randomly to one or another product, the final sample was 51 participants in the presentation of juices % and 49 in the presentation of sweets %. The task consisted in the presentation of the products on the screen. The task was programmed using the E-Prime software. The immutable feature, present in all stimuli, was the message that communicated "0% fats. The visualization of the products was designed; first of all, with a black screen (with a white cross in the centre) during 2 seconds (Baseline), after that, the product appeared for 8 seconds, followed by a second of habituation after the disappearance of the product of the screen. Subsequently, the sequence was restarted (Bradley, Codispoti, Cuthbert & Lang, 2001). Therefore, each stimulus presented in a series of 11 seconds, with a total of 330 seconds (5.5 minutes) of exposure to the 30 stimuli in total.

Figure 1: Products presented

3.4. Psychophysiological measures

PowerLab / 16SP equipment (ADInstruments) was used to obtain psychophysiological measures. To analyse these measures, we used the LabChart 5.2 software. All signals were acquired and scanned at 1000 Hz. Each of the recorded measurements is described below.

(a) Electrocardiogram (ECG). The ECG allows us to record the sum of potentials of the cardiac muscle cells that enable contraction and relaxation (Berntson, Quigley & Lozano, 2007). From the ECG, we extracted the interval of the R – R peaks (ms.). Recording was performed by placing 3 disposable cup-type surface Ag / AgCl electrodes (Kendall) on the forearm of the non-dominant hand and at the ankles.

The analysis of R-R stimuli responses was performed following Bradley's recommendations (2009) to maximise the probability of finding the OR to a stimulus. The Baseline was assessed with the mean of the R – R interval of the one second before the stimulus presentation, the initial OR response with the maximum R – R interval between 0-3 seconds after. The second part of the OR was obtained with the minimum R – R interval between 4-6 seconds after the beginning of the stimuli presentation. The OR in R – R implies a first increase in the second between beats following by a decrease in those seconds. Then, higher maximum R-R means and lower minimum R-R means represents higher OR.

(b) Electromyography (EMG): corrugator muscle. Electrodermal activity (EDA) is a psychophysiological indicator of emotional arousal which measurement was first employed in consumer research in 1979 but has been scarcely used since (Caruelle, Gustafsson, Shams & Line, 2019). The EMG is a measure of the facial muscle response by placing three low-voltage Ag / AgCl cup surface electrodes, one in the middle of the forehead and two at the beginning of the left eyebrow where the superciliary corrugator muscle is located. The activation of corrugator muscle is associated to fear and disgust. In this case, the recommendations of Fridlund & Cacioppo (1986) are followed. A band pass filter between 20 and 250 Hz and 50 Hz high pass filter was established to eliminate the possible interferences.

The analysis of the EMG response was obtained assessing the mean EMG of the 2 seconds for the BL, and the mean of the 0-6 seconds from the beginning of the stimulus presentation.

3.5. Data reduction and statistical analyses

To carry out the analysis the responses reactivity to the stimulus on screen (juice or sweets) were calculated. In the case of R – R interval, the Baseline was subtracted from the response between 0 - 3 (Reactivity_MAX_R - R) and the response between the seconds 4 - 6 (Reactivity_MIN_R - R) of the stimulus presentation. Finally, the reactivity of the EMG was calculated subtracting the Baseline to the average of the 6 seconds of the stimulus presentation (Reactivity_EMG). This transformation was performed in each presentation. Means of Baselines and stimuli reactivity of each stimulus also were calculated.

In order to characterize the final sample, two-way ANOVA with "Gender" (Men/Women) and "Products" (Sweets/Juices) as independent variables and the means of Body Mass Index (BMI), Waist-to-Hip Ratio (WHR), Age, Socio-economic Status (SES), Sweets per Week (SpW), Juices per Week (JpW) and the mean of the Baseline of all the physiological variables were carried out.

To answer the objectives (hypotheses and research question), series of ANOVAs with physiological dependent variables were carried out.

Firstly, and in order to answer H1 and RQ, we made two-way ANOVA with "Gender" and "Products" as independent variables and the means of maximum reactivity R – R interval, minimum reactivity R – R interval and reactivity EMG as dependent variables.

Secondly, and to test H2, repeated measured MANOVA with "Gender", "Products" (Juices / Sweets) as between-subject factor and "Evolution" of presentation as within-subject factor was carried out. *Post hoc* tests were performed with simple contrasts using the Bonferroni correction.

The alpha significance level was fixed at 0.05. Partial eta squared for ANOVAs and MANOVAs was reported as a measure of effect size *d* was reported as a measure of power. All statistical analyses were performed with the SPSS 20.0.

4. RESULTS

4.1. Preliminary Analysis: Sample Description

The two-way ANOVA with "Product" and "Gender" as independent variables led us to conclude that: First, regarding "product category", a significant effect for this factor has not been demonstrated (*p´s* > 0.05). So, the sample viewing a healthy stimulus (juice %) does not differ to the sample viewing a unhealthy one (sweet %) regarding anthropometrical variables, neither sociodemographic ones.

Second, regarding "gender" some significant effects have been identified for this factor concerning:

- BMI ($F_{(1, 98)} = 5.55$, $p < 0.03$, $\eta^2_p = .055$, $d = .645$),
- WHR ($F_{(1, 95)} = 29.35$, $p < 0.001$, $\eta^2_p = .242$, $d = 1$)
- and Baseline of R – R interval ($F_{(1, 99)} = 9.82$, $p < 0.003$, $\eta^2_p = .093$, $d = .873$)

As this results show, men have higher BMI (Mean ± SD: Men = 24.36 ± 4.36 kg/m^2 *vs* Women = 22.50 ± 3.50 kg/m^2) WHR (Mean ± SD: Men = 0.82 ± 0.05 *vs* Women = 0.71 ± 0.12) and Baseline of R – R interval than women (Mean ± SD: Men = 0.86 ± 0.12 *vs* Women = 0.79 ± 0.11). Means (SD) of the variables and the Baselines of physiological measures was presented at Table 1.

Consequently, only BMI, WHR and RR-BL were considered in a MANOVA analysis in order to control the differences between males and females (RQ).

Table 1. Sample description: Means (SD) of anthropometrical, sociodemographic and baseline physiological measures in juices and sweets, for men and women

	Women			Men		
	Juices	**Sweets**	**Total**	**Juices**	**Sweets**	**Total**
BMI	22,26 (3,25)	22,76 (3,79)	22,50 (3,50)	25,02 (5,72)	23,72 (2,44)	24,36 (4,36)
WHR	0,72 (0,05)	0,71 (0,16)	0,72 (0,12)	0,82 (0,05)	0,82 (0,05)	0,82 (0,05)
Age	21,25 (1,94)	21,00 (2,19)	21,13 (2,04)	22,59 (3,32)	21,23 (2,14)	21,91 (2,84)
SES	5,75 (1,48)	6,26 (1,14)	5,98 (1,35)	6,08 (1,47)	6,55 (1,01)	6,30 (1,28)

SpW	0,71 (1,12)	0,52 (0,73)	0,63 (0,96)	0,52 (0,71)	0,78 (1,09)	0,65 (0,91)
JpW	3,18 (2,55)	3,43 (3,36)	3,29 (2,91)	2,72 (2,59)	2,48 (2,25)	2,60 (2,41)
Physiological Reponses						
RR-BL	0,80 (0,12)	0,77 (0,11)	0,79 (0,11)	0,87 (0,13)	0,85 (0,10)	0,86 (0,12)
EMG-	-0,0030	-0,0021	-0,0026	-0,0002	-0,0034	-0,0018
BL	(0,0103)	(0,0091)	(0.0096)	(0.0116)	(0,0083)	(0,0101)

Note: Body Mass Index (BMI), Waist-to-Hip Ratio (WHR), Age, Socio-economic Status (SES), Sweets consumption per Week (SpW), Juices consumption per Week (JpW), R – R interval Baseline (RR-BL) and Corrugator Activity Baseline (EMG-BL).

4.2. OR Differences: Hypotheses and research question

a) Heart Rate Variability

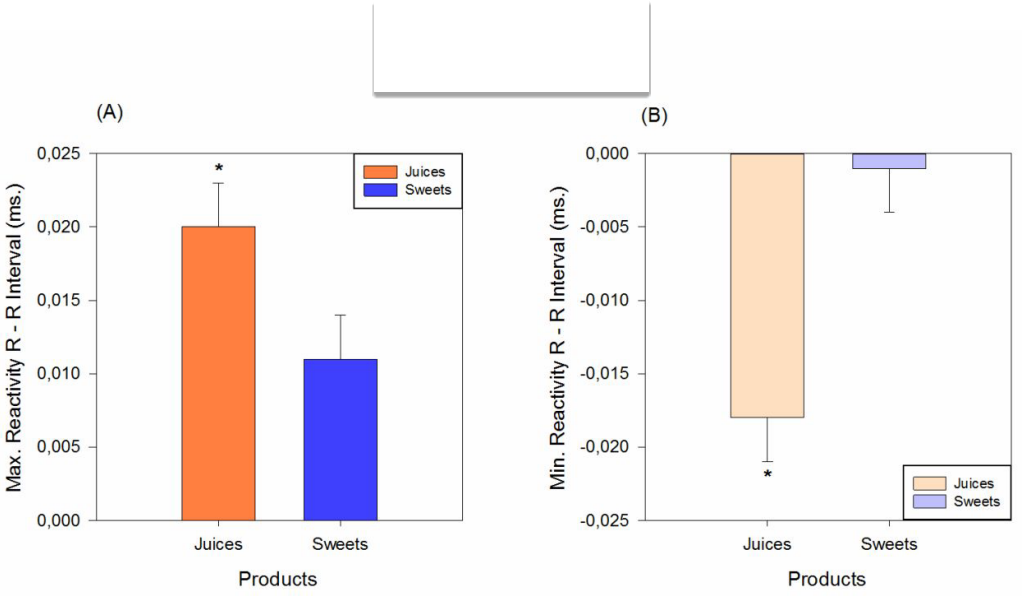
First, our ANOVA shows a significant main effect in products factor regarding maximum measure of R – R interval (F (1, 99) = 5.43, p < 0.03, η2p = .054, d = .636), without taking into account possible gender differences. It was noted that the product "Juices" has obtained higher reactivity score than "Sweets" (Figure 2A). Minimum measures of R – R interval showed a significant main effect in products, as well ($F_{(1, 99)} = 17.29$, $p < 0.001$, $\eta^2_p = .153$, $d = .985$). In this case, the juices have scored lower than sweets in minimum R – R interval reactivity (Figure 2B). That is, product category (healthy-juices versus unhealthy-sweets) affects orientation responses when cardiac reactions are compared. So, H1a could be supported as far as unhealthy products (sweets) lead to higher reactivity than healthy ones (juices).

Second, related to H2a, there are not significant differences in the ANOVA analysis with "Evolution" as independent variable. In this sense, H2a could not be supported. This means that if a participant shows many times the same stimuli in sequence of presentations, heart rate responses will not vary between the first presentation and the last one.

And third and in order to answer to our research question, cardiac responses for men and women have been compared. As our results show, there are not significant differences in the ORs when cardiac

reactions are compared between men and women. That is, men and women react similarly to both products (juices and sweets) in terms of heart responses.

Figure 2. Means of R – R reactivity in juices and sweets, for (A) maximum R – R interval and (B) minimum R – R interval.



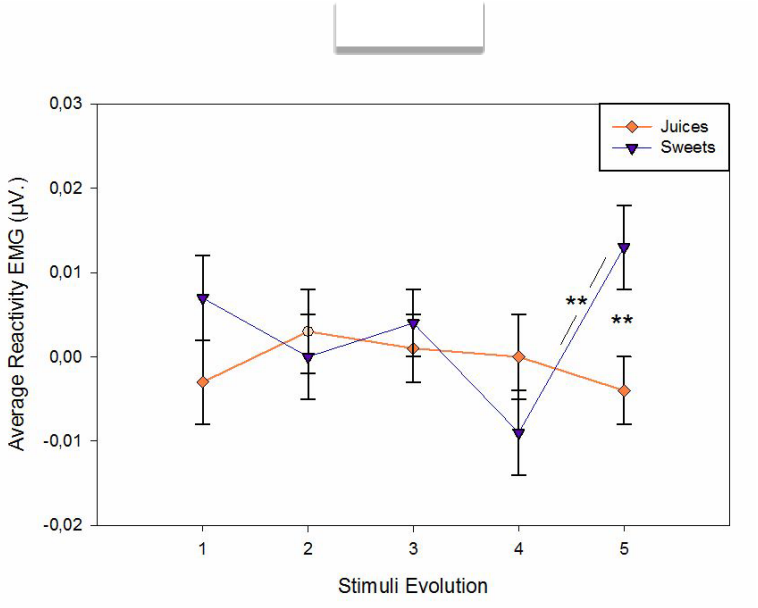
b) Electromyographical reactions

First, the three-way ANOVA with "Evolution", "Products" and "Gender" as independent variables showed significant interaction effects in relation to "Evolution × Product" interaction ($W(4, 177) = 3.47$, $p < 0.01$. $\eta 2p = .073$, $d = .853$). More specifically regarding product category, there are significant differences in the electromyographical responses between juices % and sweets %. These results support H1b.

Second, and related to H2b, a Post Hoc analysis showed significant differences between juices % and sweets % in fifth presentation ($F(1, 180) = 7.35$, $p < 0.01$, $\eta 2p = .039$, $d = .769$), where sweets have higher levels than juices (Figure 3). That is, in the last presentation, there is a higher reaction in the corrugator muscle for sweets. This reaction is related to feelings of disgust and anger. In this sense, H2b could be supported.

Finally, and according to our research question, there is not a significant interaction with "Gender".

Figure 3. Mean EMG reactivity for stimuli evolution in juices and sweets.



In sum, our results allow us: (1) to support H1, that is, different low fat products lead to different orientation responses in terms of cardiac reactions and electromyographical reactions, (2) to support only H2b, that is, for sweets orientation responses, measured in terms of electromyographical reactions, evolve (corrugator responses augment) as far as several presentations of the products are shown, and (3) to answer 'no' to the research question, that is, there are not significant differences between men and women in terms of their orienting responses (cardiac reactions and electromyographical reactions).

5. DISCUSSION, CONCLUSIONS AND MANAGERIAL IMPLICATIONS

Because food choice plays a relevant role in people's lives and well-being and this topic has received more research attention in recent years (Gong, Li, Xie & Tan, 2020), this paper tries to understand consumer reactions to new low-fat food products in order to help the R&D departments that develop this kind of foods to reduce the risks to launch a new product to the market. Specially, and because consumers not always feel that they say, this paper analysis two orientation responses (cardiac

reactions and electromyographic reactions) to two different type of low fat products with a healthy claim 0%: a healthy product (juice) and a unhealthy product (sweets). At the same time, the paper studies possible differences between young men and women.

First, regarding the effect of product category (healthy versus unhealthy), hypothesis 1 can be supported. That is, our results show that young people react better to healthy products (juices 0%) than to unhealthy ones (sweets 0%) when cardio responses and elecgtromyographycal reactions are compared. Perhaps, the different connotation that one product and another possesses can explain this difference. That is, as far as healthy products are consumed to solve nutritional problems, orientation responses towards low-fat healthy products will be better, because there is a coherence between the product category (juice) and the low-fat claim (0%), as the Congruency Theory supports. On the contrary, for unhealthy products (sweets), the low-fat claim (0%) does not seem so coherent, so the more pronounced corrugator muscle response may reflect the perception of incoherence by the participants while the lower cardiac response could represent less interest.

Second, and connected to the repeated exposition to the products, and as we have explained before, repeated exposure to sweets stimuli 0% generates a greater corrugator muscle response (disgust / anger emotions. That is, depending on the product category analyzed, different orientation responses have obtained in successive expositions and, consequently, different results can be achieved. For unhealthy products (sweets%) electromyographic responses evolve negatively, while for healthy ones (juices%) successive responses remain stable. That is, when juices are evaluated using a sequence of stimulus presentations, the physiologic response towards the first presentation and towards the last one does not vary significantly.

Finally, and related to possible gender differences (RQ), results do not show significant differences between men and women. Both targets behave equally. That is, gender has not led to different orienting responses. This result is congruent with other studies in other fields (i.e. Codispoti, Surcinelli & Baldaro, 2008).

These results can possess two main interesting managerial implications.

Firstly, R&D developers in the low-fat food industry should pay attention to the category of product they are going to develop. The achieved results lead us to think that the product developed must be trustworthy to the consumer. A sweet 0% could be less credible than a juice 0%. So, marketing managers should invest more to promote sweets 0% than juices 0%.

Secondly, results have shown that the repeated exposure to a stimulus begins to tire the consumer (anger/disgust emotions). And this is even more significant when the possible product is not credible for it (sweet 0%). In this sense, R&D and marketing departments should consider the product and health claim to be used and the time to exposure to it.

All the conclusions and recommendation must be considered in the context where this study has been done. The sampling, sample size, products and country can condition the generalization of the results, and open new horizons for research in this field.

REFERENCES

Ashwell, M. (2004). Concepts of functional food. *Nutrition & Food Science*, 34(1), 47-47.

Barry, R. J. (2009). Habituation of the orienting reflex and the development of preliminary process theory. *Neurobiology of learning and memory*, 92(2), 235-242.

Berntson, G. G., Quigley, K. S., & Lozano, D. (2007). Cardiovascular psychophysiology. *Handbook of psychophysiology*, 3, 182-210.

Borgmeier, I.; Westenhöfer, J. (2009): Impact of different food label formats on healthiness evaluation and food choice of consumers: A randomized-controlled study. *BMC Public Health*, 9, 184, doi:10.1186/1471-2458-9-184.

Bradley, M. M. (2009). Natural selective attention: Orienting and emotion. *Psychophysiology*, *46*(1), 1-11.

Bradley, M. M., Codispoti, M., Cuthbert, B. N., & Lang, P. J. (2001). Emotion and motivation I: defensive and appetitive reactions in picture processing. *Emotion*, 1(3), 276.

Caruelle, D., Gustafsson, A., Shams, P., & Line, L. O. (2019). The use of electrodermal activity (EDA) measurement to understand consumer emotions–A literature review and a call for action. *Journal of Business Research*, 104(C), 146-160.

Chekima, B., Oswald, A. I., Wafa Syed, S., & Chekima, K. (2017). Narrowing the gap: Factors driving organic food consumption. *Journal of Cleaner Production, 166*, 1438-1447

Codispoti, M., Surcinelli, P., & Baldaro, B. (2008). Watching emotional movies: Affective reactions and gender differences. *International Journal of Psychophysiology*, *69*(2), 90-95.

Cohen, D. A., & Babey, S. H. (2012). Contextual influences on eating behaviours: heuristic processing and dietary choices. *Obesity Reviews*, 13(9), 766-779.

da Silva Junior, G. C., Neto, J. B. S., Leal, J. S., & Carneiro, J. S. (2020). Packaging visual elements: an analysis of breakfast cereals for children. Journal of Business Studies and Law, 13(1), 4759. http://dx.doi.org/10.28950/compliance.v13i1.4759

Dindo, L., & Fowles, D. C. (2008). The skin conductance orienting response to semantic stimuli: Significance can be independent of arousal. *Psychophysiology*, 45(1), 111-118.

Ferrari, V., De Cesarei, A., Mastria, S., Lugli, L., Baroni, G., Nicoletti, R., & Codispoti, M. (2016). Novelty and emotion: Pupillary and cortical responses during viewing of natural scenes. *Biological Psychology*, 113, 75-82.

Fridlund, A. J., & Cacioppo, J. T. (1986). Guidelines for human electromyographic research. *Psychophysiology*, *23*(5), 567-589.

Gardner, B. (2015). A review and analysis of the use of 'habit'in understanding, predicting and influencing health-related behaviour. *Health psychology review*, 9(3), 277-295.

Gong, Y., Li, J., Xie, J., & Tan, Y. (2020). Relationship between types of food choice motives and well-being among young and middle-aged Chinese adults. *International Journal of Consumer Studies*. https://doi.org/10.1111/ijcs.12573.

González, E. M., Meyer, J. H., & Toldos, M. P. (2021). What women want? How contextual product displays influence women's online shopping behavior. Journal of Business Research, 123, 625-641. https://doi.org/10.1016/j.jbusres.2020.10.002

Gray, J., Armstrong, G., & Farley, H. (2003). Opportunities and constraints in the functional food market. *Nutrition & Food Science*, 33(5), 213-218.

Harris, J. M., Ciorciari, J., & Gountas, J. (2018). Consumer neuroscience for marketing researchers. *Journal of Consumer Behaviour*, 17(3), 239-252.

Khan, R. S., Grigor, J. V., Win, A. G., & Boland, M. (2014). Differentiating aspects of product innovation processes in the food industry: An exploratory study on New Zealand. *British Food Journal*, 116(8), 1346-1368.

Köster, E. P., & Mojet, J. (2015). From mood to food and from food to mood: A psychological perspective on the measurement of food-related emotions in consumer research. *Food Research International*, *76*, 180-191.

Küster, I. & Vidal, I. (2017): Consumer attitudes in the election of functional foods. *Spanish Journal of Marketing-ESIC*, 21: 65-79.

Lacoste-Badie, S., Gallopel-Morvan, K., Lajante, M., & Droulers, O. (2019). How do smokers respond to pictorial and threatening tobacco warnings? The role of threat level, repeated exposure, type of packs and warning size. *Journal of Consumer Marketing*.

Le Goff, G., & Delarue, J. (2017). Non-verbal evaluation of acceptance of insect-based products using a simple and holistic analysis of facial expressions. *Food Quality and Preference*, 56: 285-293.

Levin, A.M.; Levin, I.P. (2010): Packaging of healthy and unhealthy food products for children and parents: The relative influence of licensed characters and brand names. *Journal of Consumer Behaviour*, 9, 393–402, doi:10.1002/cb.326.

Liao, L. X., Corsi, A. M., Chrysochou, P., & Lockshin, L. (2015). Emotional responses towards food packaging: A joint application of self-report and physiological measures of emotion. *Food Quality and Preference*, *42*, 48-55.

McKeown, A., & Nelson, R. (2018). Independent decision making of adolescents regarding food choice. *International Journal of Consumer Studies*, 42(5), 469-477.

Mellentin, J. (2014). *Failures in functional foods and beverages*. New Nutrition Business, London.

Menrad, K. (2003). Market and marketing of functional food in Europe. *Journal of Food Engineering*, 56(2), 181-188.

Micale, R., Giallanza, A., Enea, M., & La Scalia, G. (2018). Economic assessment based on scenario analysis for the production of a new functional pasta. *Journal of Food Engineering*.

Motoki, K., Saito, T., Nouchi, R., Kawashima, R., & Sugiura, M. (2018). Anxiety increases visual attention to hedonic foods: A preliminary eye-tracking study on the impact of the interplay of integral and incidental affect on foods. *PsyArXiv*. December, 7.

Niva, M. & Mäkelä, J. (2007): Finns and functional foods: socio-demographics, health efforts, notions of technology and the acceptability of health-promoting foods. *International Journal of Consumer Studies*, 31 (2007), pp. 34–45.

Ohman, A. (1979). The Orienting response, attention and learning: An information-processing response. *The orienting reflex in humans*, 443-471.

Özen, A. E., del Mar Bibiloni, M., Pons, A., & Tur, J. A. (2014). Consumption of functional foods in europe; a systematic review. *Nutr.Hosp*, 29, 470-478.

Poels, K., & Dewitte, S. (2006). How to capture the heart? Reviewing 20 years of emotion measurement in advertising. *Journal of Advertising Research*, *46*(1), 18-37.

Rana, J. & Paul, J. (2020). Health motive and the purchase of organic food: A meta-analytic review. International Journal of Consumer Studies, 44(2), 162-171.https://doi.org/10.1111/ijcs.12556

Rohrmann, S., Hopp, H., & Quirin, M. (2008). Gender differences in psychophysiological responses to disgust. *Journal of Psychophysiology*, 22(2), 65-75.

Samant, S. S., & Seo, H. S. (2020). Influences of sensory attribute intensity, emotional responses, and non-sensory factors on purchase intent toward mixed-vegetable juice products under informed tasting condition. Food Research International, 132, 109095. https://doi.org/10.1016/j.foodres.2020.109095

Santeramo, F. G., Carlucci, D., De Devitiis, B., Seccia, A., Stasi, A., Viscecchia, R., & Nardone, G. (2018). Emerging trends in European food, diets and food industry. *Food Research International,* 104, 39-47.

Sokolov, E. N. (1963). *Perception and the conditioned reflex*.

Tuvblad, C., Gao, Y., Isen, J., Botwick, T., Raine, A., & Baker, L. A. (2011). The heritability of the skin conductance orienting response: a longitudinal twin study. *Biological psychology*, 89(1), 47-53

Underwood, R.L.; Klein, N.M.; Burke, R.R. (2001): Packaging communication: Attentional effects of product imagery. J. Prod. Brand Manag, 10, 403–422, doi:10.1108/10610420110410531.

Urala, N., & Lähteenmäki, L. (2003). Reasons behind consumers' functional food choices. *Nutrition & Food Science*, 33(4), 148-158.

Van Kleef, E., van Trijp, H. C., & Luning, P. (2005). Functional foods: health claim-food product compatibility and the impact of health claim framing on consumer evaluation. *Appetite*, 44(3), 299-308.

Verastegui-Tena, L., Schulte-Holierhoek, A., van Trijp, H., & Piqueras-Fiszman, B. (2017). Beyond expectations: The responses of the autonomic nervous system to visual food cues. *Physiology & behavio*r, 179, 478-486.

Verastegui-Tena, L., van Trijp, H., & Piqueras-Fiszman, B. (2018). Heart rate and skin conductance responses to taste, taste novelty, and the (dis) confirmation of expectations. *Food Quality and Preference*, 65, 1-9.

Verbeke, W., Scholderer, J., & Lähteenmäki, L. (2009). Consumer appeal of nutrition and health claims in three existing product concepts. *Appetite*, 52(3), 684-692.

Wansink, B. (2004). Environmental factors that increase the food intake and consumption volume of unknowing consumers. *Annual Review of Nutrition* 24, 455-479

Wansink, B.; Chandon, P. Can (2006): "Low-Fat" Nutrition Labels Lead to Obesity? *Journal of Marketing Research*, 43, 605–617, doi:10.1509/jmkr.43.4.605.

ORIENTATION RESPONSE IN LOW-FAT FOODS: DIFFERENCES BASED ON PRODUCT CATEGORY AND GENDER.

Abstract

Because most consistent findings from previous studies have found the inconsistency between consumers' statements and their behaviour, this paper analyses diverse young consumers' responses that can affect their low-fat food purchase intentions. The main objective is to evaluate the differences in the orientation response (OR) between two product categories ("juice 0%" and "sweet 0%") considering also the gender of the participant. To this end, responses from men and women towards two kind of product presentation (juice 0% vs. sweet 0%) were collected through Heart Rate Variability (HRV) and Electromyography (EMG) measures. We hypothesize that men would obtain different OR regarding women, and we explore possible different OR regarding product category. With a sample of young consumers (46 men and 51 women), our results show product category differences but not gender differences.

Keywords: orientation responses (OR); low-fat foods; gender differences; Heart Rate Variability (HRV) and Electromyography (EMG) measures

1. INTRODUCTION

Today, more and more consumers try to find foods that are safe and, additionally, positively promotes good health because they see food to improve their health and well-being (Gray, Armstrong & Farley, 2003). McKeown & Nelson (2018) state that for young consumers healthy eating and the consumption of an adequate quality diet is important for cognitive growth and wellbeing. In this context, functional foods have been launched in Europe since the mid-1990s (Menrad, 2003) and show a growing expansion (Özen, del Mar Bibiloni, Pons & Tur, 2014). The International Life Sciences Institute states that functional foods are those that incorporate a variety of relevant components to improve health status or reduce the risk (non-prevention) of the disease

(Ashwell, 2004). These foods also must cause benefits beyond those of basic nutrition. For example, foods that are low in fats and sugars, among others, are functional foods (Küster & Vidal, 2017).

In this context, it is interesting to be able to explain the behaviour of the consumer who chooses these products to succeed in the development of products and marketing strategies (Urala & Lähteenmäki, 2003). However, the most consistent findings from previous studies have found the inconsistency between consumers' statements and their behaviour – the so-called intention-behaviour or attitude-behaviour gap. (Chekima, Oswald, Wafa Syed & Chekima, 2017).

According to McKeown & Nelson (2018), adolescence is a period when individuals develop into independent active consumers that participate in food related decisions and it is important to analyse decisions that are made by adolescents in the selection and consumption of food when given free choice as to what they would like to eat. In this sense, Santeramo, Carlucci, De Devitiis, Seccia, Stasi, Viscecchia, & Nardone (2018) review several studies that have emphasized the relevance of consumers' opinions about awareness, preferences, attitudes, perception and purchase intentions towards functional foods considering various product categories such as dairy, meat, bakery, and beverages. In this vein, and as Poels & Dewitte (2006) review, many times, emotions (physiological responses) dominate cognition (verbal responses), and not always the best-evaluated product is the chosen one. In this sense, and according to Wansink (2004), most of the choices related to eating behavior, including food purchases, are unarticulated and unconscious. Even more, as Köster & Mojet (2015) have remarked, physiological reactions could be used without explicit awareness of the relation between the measurement and the food eaten although in most cases the subjects are aware of the relationship.

But not only from a consumers' perspective, from a firm's perspective, also, it is especially interesting the evaluation that a certain food can have on the consumer before being developed and launched on the market (Le Goff & Delarue 2017) because the development and launch of food products involves a large amount of investment for companies. And this is especially relevant when a

company develops low-fat functional foods which market forecasts more than $300 billion for 2020 (Santeramo, Carlucci, De Devitiis, Seccia, Stasi, Viscecchia, & Nardone, 2018).

For these reasons, the present paper proposes to measure orientation responses towards two kind of low-fat foods (juices and sweets) using two kind of physiological reactions [(a) cardiac reactions and (b) electromyographycal reactions]. By measuring low-fat foods reactions, it could be possible to anticipate the acceptance/rejection of new products before they have been developed and launched to the market.

Taking this into account, this paper aims to analyse diverse young consumers' responses that can affect their food purchase intentions. Specifically, a healthy food (juice with milk) versus an unhealthy one (candy bars) were considered in our research. Studies with milk packaged as a healthy product can be seen in different papers (Levin & Levin, 2010), and other studies [(Underwood, Klein & Burke 2001; Wansink, Chandon & Can, 2010) propose candies as a unhealthy and hedonic product. There is an expanded consumption of pre-packaged foods that usually contain high levels of sugar, fat, saturated fatty acids, trans-fatty acids, and sodium (Borgmeier & Westenhöfer, 2009). To avoid nutrition-related diseases, the World Health Organization (WHO) recommends decreasing these nutrients with the aim of increasing the nutritional value. In this regard, food packaging has received considerable attention [(Borgmeier & Westenhöfer, 2009)

Through this paper, we try to add value to previous works in different ways. As Hailu, Boecker, Henson & Cranfield (2009) explain, previous studies have focused on the role of health claims in consumer acceptance of different kinds of functional foods. However, the literature has paid less attention to sources of health claim acceptation (Hailu, Boecker, Henson & Cranfield, 2009). For this reason, the first contribution of this paper is to analyze some orientation responses to two different low fat (a kind of functional food) product categories: juice 0% and sweets 0%.

Second, and as Niva & Mäkelä (2007) state, previous consumer studies have neglected an examination of the acceptability certain foods (such as low-fat foods), so that both the diversity of

consumers' backgrounds and the multifaceted nature of low-fat foods must be taken into account. That is, although previous studies have paid attention to specific product categories and concrete types of products or to diverse claim formats (Verbeke, Scholderer & Lähteenmäki, 2009), study of gender differences when physiological responses are analysed is scarce.

Therefore, this paper is in line with the two latest developments in the field of consumer studies and, specifically, in the area of low fat foods: (i) examining consumers' physiological reactions and their evolution to two specific 0% product categories and (ii) analysing differences between men and women.

In sum, and although recent studies have analyzed the physiological responses to certain categories of food (Motoki, Saito, Nouchi, Kawashima & Sugiura, 2018), this is an incipient field of research where it is still necessary a deeper investigation (Le Goff & Delarue 2017; Verastegui-Tena, van Trijp & Piqueras-Fiszman, 2018). Therefore, the main objective of this study is to analyze the differences between juices with milk 0% (healthy product) and sweets 0% (unhealthy product) in relation to the orientation responses (OR) in the autonomic nervous system (ANC) taking into account, on one side, gender differences and, on another side, the category of the product presented. It is hypothesized that men and women will show different ORs depending on the product category (juices 0% -healthy product versus sweets 0% -unhealthy product). The evaluation of the effects of the selected products and the gender of the participants is carried out by electrocardiogram (ECG) and electromyography (EMG) measurements; with a sample of 100 young people, (18-26 years old, 46 men and 51 women). We can justify the election of these measures because, although for many consumer neuromarketing researchers, the use of functional magnetic resonance imaging has been the most preferred neuroscience technique, electroencephalography, eye tracking, and implicit measurements are becoming increasingly popular market research methods due to rapid technological improvements and reduced costs (Harris, Ciorciari & Gountas, 2017).

2. LITERATURE REVIEW

Most research on packaging has used self-reporting methods but they have limitations in measuring emotions because people are not aware about how they exactly feel (Lacoste-Badie, Gallopel-Morvan, Lajante & Droulers, 2019). As Liao, Corsi, Chrysochou & Lockshin (2015, p. 49) explain "compared to self-report measures, physiological measures capture additional information for the understanding of the dynamics of the emotional responses". In this sense, and considering the objectives of this paper, the following section justifies the ORs possible related to the type of low-fat product (healthy versus unhealthy) and the gender of respondents.

Sokolov (1963) defined orienting response as the variety of physiological changes that novel or emotional events can induce in the autonomic nervous system. According to Ferrari, De Cesarei, Mastria, Lugli, Baroni, Nicoletti & Codispoti (2016), motivationally relevant stimuli, such as a product presentation, can elicit an orienting response that is observable as a modulation of an extensive range of physiological reactions (i.e., heart rate or skin conductance). This OR is of special relevance in new products presentations because new stimuli pose novel opportunities that may result in beneficial outcomes or may pose a threat (Ferrari, De Cesarei, Mastria, Lugli, Baroni, Nicoletti & Codispoti, 2016).

On one side, and as Verastegui-Tena, van Trijp & Piqueras-Fiszman (2018) point out, food research regarding autonomic nervous system responses have used different types of stimuli and shown different results. The authors state that these different results can be explained due the novelty of the product, the kind of product or the physiological measures used. For example, a previous study (Verastegui-Tena, Schulte-Holierhoek, van Trijp & Piqueras-Fiszman, 2017) showed that ingredient images that disconfirmed expectations led to cardiac deceleration while in the case of skin conductance only the negative image led to an increase that differed from that of a neutral congruent image. In this sense, it is expected that a healthy message (using the claim 0%) in a healthy food (such as juices) is more congruent than this 0% message in an unhealthy food (such as sweets).

Based in this congruency theory, different ORs will be expected depending on the product category. Therefore, the following hypothesis is established.

H1: Different low-fat food product categories (juices 0% versus sweets 0%) lead to different ORs in terms of (a) cardiac reactions and (b) electromyographical reactions.

On another side, an evolution of orienting responses is other aspect that should be considered. It could be interesting to analyse fatigue/boring effects when a consumer is exposed many times to a stimulus. As Cohen & Babey (2012) and Gardner (2015) point out, repeated exposure to the same food context can lead to routine/habitual behaviour, which might be non-cognitive, but nevertheless leads to preferences for some actions and choices. In this sense, Bradley (2009) reviews the most relevant literature in the orienting responses and states that psychophysiologist have found that both novelty and significance expositions to a stimulus affect skin conductance and heart rate changes during picture viewing. In this sense, for example, Öhman (1979), in his Information Processing Theory, states that the orientation response will occur before novel stimuli that do not agree with the elements of our short-term memory. That is, the first time we see a stimulus there will be an orientation response but if in a short period of time we see it again, that response will not occur, or it will be less. More recently, in his article entitled "Habituation of the orienting reflex and the development of Preliminary Process Theory", also mentions that the novelty is one of the most determining factors for the psychophysiological response to occur and, therefore, response is reduced as repetition increases. Tuvblad, Gao, Isen, Botwick, Raine & Baker (2011) add, to the above, that the habituation can occur more or less quickly depending on the unit of measurement, with the response of cardiovascular orientation of the fastest disappearing because of the repetition, while the electrodermic is more resistant. So, and considering previous literature results, the following hypothesis is stated.

H2: ORs will evolve as far as several presentations of the product are shown in terms of (a) cardiac reactions and (b) electromyographical reactions.

Finally, together with possible ORs differences related to the kind of product, it is possible to expect that men and women could differ in their responses to the products showed because stimuli can reflect individual differences in significance (Dindo & Fowles, 2008).

In this vein, previous literature has shown contradictory results. On one hand, Codispoti, Surcinelli & Baldaro (2008) found a similar skin conductance increase and heart rate deceleration in men and women. They conclude that sustained exposure to pleasant and unpleasant stimuli elicit similar cardiac orienting, so that, from this approach, physiological responses will not differ between men and women

By other hand, Rohrmann, Hopp & Quirin (2008), replicating previous studies, test that women show a higher increase in skin conductance level than men and report stronger feelings of disgust than men across all disgust inductions. Dindo & Fowles (2008) reached a same conclusion on electrodermal responses; there was a significant main effect of gender. From this approach, gender differences in physiological responses could not be probed.

Therefore, and given that different results have been obtained regarding gender differences, the following research question is stated.

RQ: Are there different ORs in men and women?

3. METHODS

3.1. Participants

In this experiment, 100 young participants (46 men and 54 women) aged 18 to 26 years (Mean ± Standard Deviation (SD) = 21.49 ± 2.46) and a mean Body Mass Index (BMI) of 23.34 ± kg / m2 (SD = 4.00) participated voluntarily. All participants were recruited for the experiment through verbal claims, and only users of the product that would be presented later in the task were selected. After some initial filtering questions (e.g. age), they were invited to come to the laboratory and complete a questionnaire on various socio-demographic aspects, as well as on consumption habits.

Additionally, for the analysis of the psychophysiological response, participants with chronic heart disease, psychiatric disorders, abuse of drugs or alcohol, persons who smoked 10 or more cigarettes per day and persons who did not perform a maximum of 15 hours of physical activity per week were excluded by means of a screening questionnaire.

3.2. Protocol

The experimental protocol was carried out in a single session of 1-hour duration that was carried out between 09:00 and 19:00 hours. Once participants arrived at the laboratory, they were welcomed in the hall and passed to room 1, where they were told to take a seat and the experimenter explained the general procedure of the study. Subsequently, the subjects signed an informed consent, approved by the Research Ethics Committee of the University. Electrodes were then placed in the electrocardiogram (ECG) and electromyogram (EMG). To minimise artefacts, participants were instructed to avoid moving.

After the placement of the electrodes, participants spent 10 minutes in the experimental room to get used to the experimental situation, meanwhile participants were asked to complete questionnaires to check compliance with the selection criteria. Later they were explained that they were going to perform one computer task, instructing them to follow the instructions that appeared on the screen and reinforcing them with oral instructions by experimenters. After completing the task, participants were instructed to stay in the room for 5 minutes until the electrodes were removed. Right after, participants were asked to move to another room to take measures of weight, height and waist and hip circumference (WHR) to Addguarantee the equivalence of the samples (men and women). At the end of the session, they were offered a sample of the product they had previously seen (juices or sweets) and were informed of some of the main objectives of the study, the possible doubts were resolved, and the farewell was given.

3.3. Task

The products presented were juices or sweets (Figure 1), and the participants were assigned randomly to one or another product, the final sample was 51 participants in the presentation of juices % and 49 in the presentation of sweets %. The task consisted in the presentation of the products on the screen. The task was programmed using the E-Prime software. The immutable feature, present in all stimuli, was the message that communicated "0% fats. The visualization of the products was designed; first of all, with a black screen (with a white cross in the centre) during 2 seconds (Baseline), after that, the product appeared for 8 seconds, followed by a second of habituation after the disappearance of the product of the screen. Subsequently, the sequence was restarted (Bradley, Codispoti, Cuthbert & Lang, 2001). Therefore, each stimulus presented in a series of 11 seconds, with a total of 330 seconds (5.5 minutes) of exposure to the 30 stimuli in total.

Figure 1: Products presented

3.4. Psychophysiological measures

PowerLab / 16SP equipment (ADInstruments) was used to obtain psychophysiological measures. To analyse these measures, we used the LabChart 5.2 software. All signals were acquired and scanned at 1000 Hz. Each of the recorded measurements is described below.

(a) Electrocardiogram (ECG). The ECG allows us to record the sum of potentials of the cardiac muscle cells that enable contraction and relaxation (Berntson, Quigley & Lozano, 2007). From the ECG, we extracted the interval of the R – R peaks (ms.). Recording was performed by placing 3 disposable cup-type surface Ag / AgCl electrodes (Kendall) on the forearm of the non-dominant hand and at the ankles.

The analysis of R-R stimuli responses was performed following Bradley's recommendations (2009) to maximise the probability of finding the OR to a stimulus. The Baseline was assessed with the mean of the R – R interval of the one second before the stimulus presentation, the initial OR response with the maximum R – R interval between 0-3 seconds after. The second part of the OR was obtained with the minimum R – R interval between 4-6 seconds after the beginning of the stimuli presentation. The OR in R – R implies a first increase in the second between beats following by a decrease in those seconds. Then, higher maximum R-R means and lower minimum R-R means represents higher OR.

(b) Electromyography (EMG): corrugator muscle. Electrodermal activity (EDA) is a psychophysiological indicator of emotional arousal which measurement was first employed in consumer research in 1979 but has been scarcely used since (Caruelle, Gustafsson, Shams & Line, 2019). The EMG is a measure of the facial muscle response by placing three low-voltage Ag / AgCl cup surface electrodes, one in the middle of the forehead and two at the beginning of the left eyebrow where the superciliary corrugator muscle is located. The activation of corrugator muscle is associated to fear and disgust. In this case, the recommendations of Fridlund & Cacioppo (1986) are followed. A band pass filter between 20 and 250 Hz and 50 Hz high pass filter was established to eliminate the possible interferences.

The analysis of the EMG response was obtained assessing the mean EMG of the 2 seconds for the BL, and the mean of the 0-6 seconds from the beginning of the stimulus presentation.

3.5. Data reduction and statistical analyses

To carry out the analysis the responses reactivity to the stimulus on screen (juice or sweets) were calculated. In the case of R – R interval, the Baseline was subtracted from the response between 0 - 3 (Reactivity_MAX_R - R) and the response between the seconds 4 - 6 (Reactivity_MIN_R - R) of the stimulus presentation. Finally, the reactivity of the EMG was calculated subtracting the Baseline to the average of the 6 seconds of the stimulus presentation (Reactivity_EMG). This transformation was

performed in each presentation. Means of Baselines and stimuli reactivity of each stimulus also were calculated.

In order to characterize the final sample, two-way ANOVA with "Gender" (Men/Women) and "Products" (Sweets/Juices) as independent variables and the means of Body Mass Index (BMI), Waist-to-Hip Ratio (WHR), Age, Socio-economic Status (SES), Sweets per Week (SpW), Juices per Week (JpW) and the mean of the Baseline of all the physiological variables were carried out.

To answer the objectives (hypotheses and research question), series of ANOVAs with physiological dependent variables were carried out.

Firstly, and in order to answer H1 and RQ, we made two-way ANOVA with "Gender" and "Products" as independent variables and the means of maximum reactivity R – R interval, minimum reactivity R – R interval and reactivity EMG as dependent variables.

Secondly, and to test H2, repeated measured MANOVA with "Gender", "Products" (Juices / Sweets) as between-subject factor and "Evolution" of presentation as within-subject factor was carried out. *Post hoc* tests were performed with simple contrasts using the Bonferroni correction.

The alpha significance level was fixed at 0.05. Partial eta squared for ANOVAs and MANOVAs was reported as a measure of effect size *d* was reported as a measure of power. All statistical analyses were performed with the SPSS 20.0.

4. RESULTS

4.1. Preliminary Analysis: Sample Description

The two-way ANOVA with "Product" and "Gender" as independent variables led us to conclude that:

First, regarding "product category", a significant effect for this factor has not been demonstrated (*p´s* > 0.05). So, the sample viewing a healthy stimulus (juice %) does not differ to the sample viewing a unhealthy one (sweet %) regarding anthropometrical variables, neither sociodemographic ones.

Second, regarding "gender" some significant effects have been identified for this factor concerning:

- BMI ($F_{(1, 98)} = 5.55$, $p < 0.03$, $\eta^2_p = .055$, $d = .645$),
- WHR ($F_{(1, 95)} = 29.35$, $p < 0.001$, $\eta^2_p = .242$, $d = 1$)
- and Baseline of R – R interval ($F_{(1, 99)} = 9.82$, $p < 0.003$, $\eta^2_p = .093$, $d = .873$)

As this results show, men have higher BMI (Mean ± SD: Men = 24.36 ± 4.36 kg/m^2 *vs* Women = 22.50 ± 3.50 kg/m^2) WHR (Mean ± SD: Men = 0.82 ± 0.05 *vs* Women = 0.71 ± 0.12) and Baseline of R – R interval than women (Mean ± SD: Men = 0.86 ± 0.12 *vs* Women = 0.79 ± 0.11). Means (SD) of the variables and the Baselines of physiological measures was presented at Table 1.

Consequently, only BMI, WHR and RR-BL were considered in a MANOVA analysis in order to control the differences between males and females (RQ).

Table 1. Sample description: Means (SD) of anthropometrical, sociodemographic and baseline physiological measures in juices and sweets, for men and women

	Women			Men		
	Juices	**Sweets**	**Total**	**Juices**	**Sweets**	**Total**
BMI	22,26 (3,25)	22,76 (3,79)	22,50 (3,50)	25,02 (5,72)	23,72 (2,44)	24,36 (4,36)
WHR	0,72 (0,05)	0,71 (0,16)	0,72 (0,12)	0,82 (0,05)	0,82 (0,05)	0,82 (0,05)
Age	21,25 (1,94)	21,00 (2,19)	21,13 (2,04)	22,59 (3,32)	21,23 (2,14)	21,91 (2,84)
SES	5,75 (1,48)	6,26 (1,14)	5,98 (1,35)	6,08 (1,47)	6,55 (1,01)	6,30 (1,28)
SpW	0,71 (1,12)	0,52 (0,73)	0,63 (0,96)	0,52 (0,71)	0,78 (1,09)	0,65 (0,91)
JpW	3,18 (2,55)	3,43 (3,36)	3,29 (2,91)	2,72 (2,59)	2,48 (2,25)	2,60 (2,41)
Physiological Reponses						
RR-BL	0,80 (0,12)	0,77 (0,11)	0,79 (0,11)	0,87 (0,13)	0,85 (0,10)	0,86 (0,12)
EMG-BL	-0,0030 (0,0103)	-0,0021 (0,0091)	-0,0026 (0.0096)	-0,0002 (0.0116)	-0,0034 (0,0083)	-0,0018 (0,0101)

Note: Body Mass Index (BMI), Waist-to-Hip Ratio (WHR), Age, Socio-economic Status (SES), Sweets consumption per Week (SpW), Juices consumption per Week (JpW), R – R interval Baseline (RR-BL) and Corrugator Activity Baseline (EMG-BL).

4.2. OR Differences: Hypotheses and research question

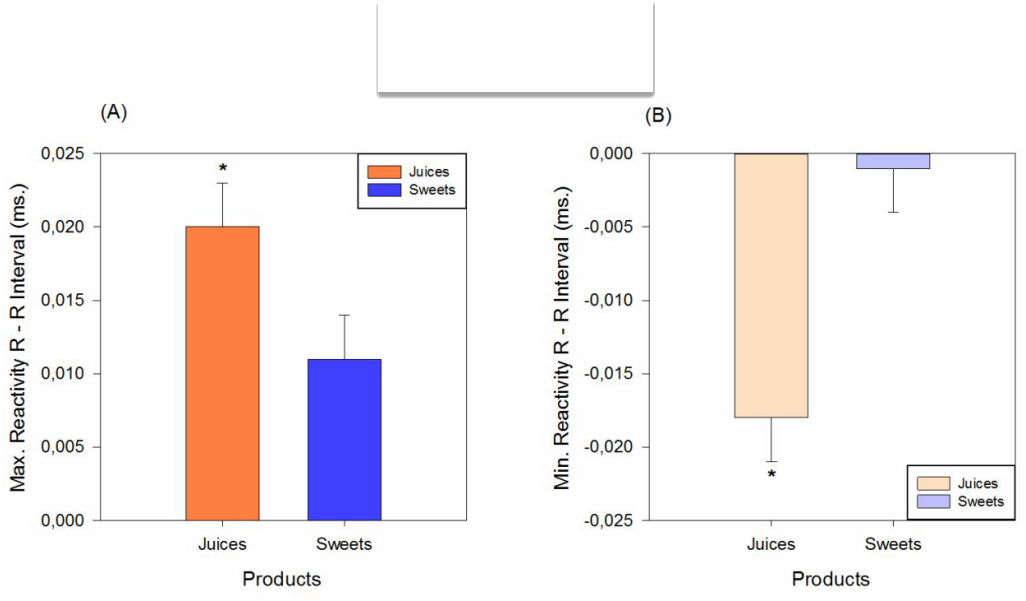
a) Heart Rate Variability

First, our ANOVA shows a significant main effect in products factor regarding maximum measure of R – R interval (F (1, 99) = 5.43, p < 0.03, η2p = .054, d = .636), without taking into account possible gender differences. It was noted that the product "Juices" has obtained higher reactivity score than "Sweets" (Figure 2A). Minimum measures of R – R interval showed a significant main effect in products, as well ($F_{(1, 99)} = 17.29$, p < 0.001, $\eta^2_p = .153$, $d = .985$). In this case, the juices have scored lower than sweets in minimum R – R interval reactivity (Figure 2B). That is, product category (healthy-juices versus unhealthy-sweets) affects orientation responses when cardiac reactions are compared. So, H1a could be supported as far as unhealthy products (sweets) lead to higher reactivity than healthy ones (juices).

Second, related to H2a, there are not significant differences in the ANOVA analysis with "Evolution" as independent variable. In this sense, H2a could not be supported. This means that if a participant shows many times the same stimuli in sequence of presentations, heart rate responses will not vary between the first presentation and the last one.

And third and in order to answer to our research question, cardiac responses for men and women have been compared. As our results show, there are not significant differences in the ORs when cardiac reactions are compared between men and women. That is, men and women react similarly to both products (juices and sweets) in terms of heart responses.

Figure 2. Means of R – R reactivity in juices and sweets, for (A) maximum R – R interval and (B) minimum R – R interval.



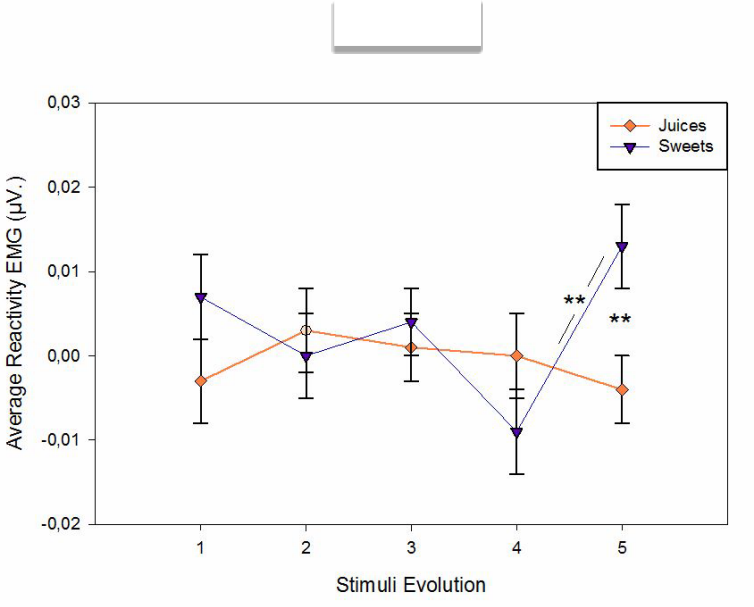
b) Electromyographical reactions

First, the three-way ANOVA with "Evolution", "Products" and "Gender" as independent variables showed significant interaction effects in relation to "Evolution × Product" interaction ($W(4, 177) = 3.47$, $p < 0.01$. $\eta 2p = .073$, $d = .853$). More specifically regarding product category, there are significant differences in the electromyographical responses between juices % and sweets %. These results support H1b.

Second, and related to H2b, a Post Hoc analysis showed significant differences between juices % and sweets % in fifth presentation ($F(1, 180) = 7.35$, $p < 0.01$, $\eta 2p = .039$, $d = .769$), where sweets have higher levels than juices (Figure 3). That is, in the last presentation, there is a higher reaction in the corrugator muscle for sweets. This reaction is related to feelings of disgust and anger. In this sense, H2b could be supported.

Finally, and according to our research question, there is not a significant interaction with "Gender".

Figure 3. Mean EMG reactivity for stimuli evolution in juices and sweets.



In sum, our results allow us: (1) to support H1, that is, different low fat products lead to different orientation responses in terms of cardiac reactions and electromyographical reactions, (2) to support only H2b, that is, for sweets orientation responses, measured in terms of electromyographical reactions, evolve (corrugator responses augment) as far as several presentations of the products are shown, and (3) to answer 'no' to the research question, that is, there are not significant differences between men and women in terms of their orienting responses (cardiac reactions and electromyographical reactions).

Gong, Y., Li, J., Xie, J., & Tan, Y. (2020). Relationship between types of food choice motives and well-being among young and middle-aged Chinese adults. *International Journal of Consumer Studies*.

5. DISCUSSION, CONCLUSIONS AND MANAGERIAL IMPLICATIONS

Because food choice plays a relevant role in people's lives and well-being and this topic has received more research attention in recent years (Gong, Li, Xie & Tan, 2020), this paper tries to understand consumer reactions to new low-fat food products in order to help the R&D departments that develop this kind of foods to reduce the risks to launch a new product to the market. Specially, and because consumers not always feel that they say, this paper analysis two orientation responses (cardiac

reactions and electromyographic reactions) to two different type of low fat products with the healthy claim 0%: a healthy product (juice) and a unhealthy product (sweets). At the same time, the paper studies possible differences between young men and women.

First, regarding the effect of product category (healthy versus unhealthy), hypothesis 1 can be supported. That is, our results show that young people react better to healthy products (juices 0%) than to unhealthy ones (sweets 0%) when cardio responses and elecgtromyographycal reactions are compared. Perhaps, the different connotation that one product and another possesses can explain this difference. That is, as far as healthy products are consumed to solve nutritional problems, orientation responses towards low-fat healthy products will be better, because there is a coherence between the product category (juice) and the low-fat claim (0%), as the Congruency Theory supports. On the contrary, for unhealthy products (sweets), the low-fat claim (0%) does not seem so coherent, so the more pronounced corrugator muscle response may reflect the perception of incoherence by the participants while the lower cardiac response could represent less interest.

Second, and connected to the repeated exposition to the products, and as we have explained before, repeated exposure to sweets stimuli 0% generates a greater corrugator muscle response (disgust / anger emotions. That is, depending on the product category analyzed, different orientation responses have obtained in successive expositions and, consequently, different results can be achieved. For unhealthy products (sweets%) electromyographic responses evolve negatively, while for healthy ones (juices%) successive responses remain stable. That is, when juices are evaluated using a sequence of stimulus presentations, the physiologic response towards the first presentation and towards the last one does not vary significantly.

Finally, and related to possible gender differences (RQ), results do not show significant differences between men and women. Both targets behave equally. That is, gender has not led to different orienting responses. This result is congruent with other studies in other fields (i.e. Codispoti, Surcinelli & Baldaro, 2008).

These results can possess two main interesting managerial implications.

Firstly, R&D developers in the low-fat food industry should pay attention to the category of product they are going to develop. The achieved results lead us to think that the product developed must be trustworthy to the consumer. A sweet 0% could be less credible than a juice 0%. So, marketing managers should invest more to promote sweets 0% than juices 0%.

Secondly, results have shown that the repeated exposure to a stimulus begins to tire the consumer (anger/disgust emotions). And this is even more significant when the possible product is not credible for it (sweet 0%). In this sense, R&D and marketing departments should consider the product and health claim to be used and the time to exposure to it.

All the conclusions and recommendation must be considered in the context where this study has been done. The sampling, sample size, products and country can condition the generalization of the results, and open new horizons for research in this field.

REFERENCES

Ashwell, M. (2004). Concepts of functional food. *Nutrition & Food Science*, 34(1), 47-47.

Barry, R. J. (2009). Habituation of the orienting reflex and the development of preliminary process theory. *Neurobiology of learning and memory*, 92(2), 235-242.

Berntson, G. G., Quigley, K. S., & Lozano, D. (2007). Cardiovascular psychophysiology. *Handbook of psychophysiology*, 3, 182-210.

Borgmeier, I.; Westenhöfer, J. (2009): Impact of different food label formats on healthiness evaluation and food choice of consumers: A randomized-controlled study. *BMC Public Health*, 9, 184, doi:10.1186/1471-2458-9-184.

Bradley, M. M. (2009). Natural selective attention: Orienting and emotion. *Psychophysiology*, *46*(1), 1-11.

Bradley, M. M., Codispoti, M., Cuthbert, B. N., & Lang, P. J. (2001). Emotion and motivation I: defensive and appetitive reactions in picture processing. *Emotion*, 1(3), 276.

Caruelle, D., Gustafsson, A., Shams, P., & Line, L. O. (2019). The use of electrodermal activity (EDA) measurement to understand consumer emotions–A literature review and a call for action. *Journal of Business Research*, 104(C), 146-160.

Chekima, B., Oswald, A. I., Wafa Syed, S., & Chekima, K. (2017). Narrowing the gap: Factors driving organic food consumption. *Journal of Cleaner Production, 166*, 1438-1447

Codispoti, M., Surcinelli, P., & Baldaro, B. (2008). Watching emotional movies: Affective reactions and gender differences. *International Journal of Psychophysiology*, *69*(2), 90-95.

Cohen, D. A., & Babey, S. H. (2012). Contextual influences on eating behaviours: heuristic processing and dietary choices. *Obesity Reviews*, 13(9), 766-779.

Dindo, L., & Fowles, D. C. (2008). The skin conductance orienting response to semantic stimuli: Significance can be independent of arousal. *Psychophysiology*, 45(1), 111-118.

Ferrari, V., De Cesarei, A., Mastria, S., Lugli, L., Baroni, G., Nicoletti, R., & Codispoti, M. (2016). Novelty and emotion: Pupillary and cortical responses during viewing of natural scenes. *Biological Psychology*, 113, 75-82.

Fridlund, A. J., & Cacioppo, J. T. (1986). Guidelines for human electromyographic research. *Psychophysiology*, *23*(5), 567-589.

Gardner, B. (2015). A review and analysis of the use of 'habit'in understanding, predicting and influencing health-related behaviour. *Health psychology review*, 9(3), 277-295.

Gong, Y., Li, J., Xie, J., & Tan, Y. (2020). Relationship between types of food choice motives and well-being among young and middle-aged Chinese adults. *International Journal of Consumer Studies*.

Gray, J., Armstrong, G., & Farley, H. (2003). Opportunities and constraints in the functional food market. *Nutrition & Food Science*, 33(5), 213-218.

Harris, J. M., Ciorciari, J., & Gountas, J. (2018). Consumer neuroscience for marketing researchers. *Journal of Consumer Behaviour*, 17(3), 239-252.

Khan, R. S., Grigor, J. V., Win, A. G., & Boland, M. (2014). Differentiating aspects of product innovation processes in the food industry: An exploratory study on New Zealand. *British Food Journal*, 116(8), 1346-1368.

Köster, E. P., & Mojet, J. (2015). From mood to food and from food to mood: A psychological perspective on the measurement of food-related emotions in consumer research. *Food Research International*, *76*, 180-191.

Küster, I. & Vidal, I. (2017): Consumer attitudes in the election of functional foods. *Spanish Journal of Marketing-ESIC*, 21: 65-79.

Lacoste-Badie, S., Gallopel-Morvan, K., Lajante, M., & Droulers, O. (2019). How do smokers respond to pictorial and threatening tobacco warnings? The role of threat level, repeated exposure, type of packs and warning size. *Journal of Consumer Marketing*.

Le Goff, G., & Delarue, J. (2017). Non-verbal evaluation of acceptance of insect-based products using a simple and holistic analysis of facial expressions. *Food Quality and Preference*, 56: 285-293.

Levin, A.M.; Levin, I.P. (2010): Packaging of healthy and unhealthy food products for children and parents: The relative influence of licensed characters and brand names. *Journal of Consumer Behaviour*, 9, 393–402, doi:10.1002/cb.326.

Liao, L. X., Corsi, A. M., Chrysochou, P., & Lockshin, L. (2015). Emotional responses towards food packaging: A joint application of self-report and physiological measures of emotion. *Food Quality and Preference*, *42*, 48-55.

McKeown, A., & Nelson, R. (2018). Independent decision making of adolescents regarding food choice. *International Journal of Consumer Studies*, 42(5), 469-477.

Mellentin, J. (2014). *Failures in functional foods and beverages*. New Nutrition Business, London.

Menrad, K. (2003). Market and marketing of functional food in Europe. *Journal of Food Engineering*, 56(2), 181-188.

Micale, R., Giallanza, A., Enea, M., & La Scalia, G. (2018). Economic assessment based on scenario analysis for the production of a new functional pasta. *Journal of Food Engineering*.

Motoki, K., Saito, T., Nouchi, R., Kawashima, R., & Sugiura, M. (2018). Anxiety increases visual attention to hedonic foods: A preliminary eye-tracking study on the impact of the interplay of integral and incidental affect on foods. *PsyArXiv*. December, 7.

Niva, M. & Mäkelä, J. (2007): Finns and functional foods: socio-demographics, health efforts, notions of technology and the acceptability of health-promoting foods. *International Journal of Consumer Studies*, 31 (2007), pp. 34–45.

Ohman, A. (1979). The Orienting response, attention and learning: An information-processing response. *The orienting reflex in humans*, 443-471.

Özen, A. E., del Mar Bibiloni, M., Pons, A., & Tur, J. A. (2014). Consumption of functional foods in europe; a systematic review. *Nutr.Hosp*, 29, 470-478.

Poels, K., & Dewitte, S. (2006). How to capture the heart? Reviewing 20 years of emotion measurement in advertising. *Journal of Advertising Research*, *46*(1), 18-37.

Rohrmann, S., Hopp, H., & Quirin, M. (2008). Gender differences in psychophysiological responses to disgust. *Journal of Psychophysiology*, 22(2), 65-75.

Santeramo, F. G., Carlucci, D., De Devitiis, B., Seccia, A., Stasi, A., Viscecchia, R., & Nardone, G. (2018). Emerging trends in European food, diets and food industry. *Food Research International,* 104, 39-47.

Sokolov, E. N. (1963). *Perception and the conditioned reflex*.

Tuvblad, C., Gao, Y., Isen, J., Botwick, T., Raine, A., & Baker, L. A. (2011). The heritability of the skin conductance orienting response: a longitudinal twin study. *Biological psychology*, 89(1), 47-53

Underwood, R.L.; Klein, N.M.; Burke, R.R. (2001): Packaging communication: Attentional effects of product imagery. J. Prod. Brand Manag, 10, 403–422, doi:10.1108/10610420110410531.

Urala, N., & Lähteenmäki, L. (2003). Reasons behind consumers' functional food choices. *Nutrition & Food Science*, 33(4), 148-158.

Van Kleef, E., van Trijp, H. C., & Luning, P. (2005). Functional foods: health claim-food product compatibility and the impact of health claim framing on consumer evaluation. *Appetite*, 44(3), 299-308.

Verastegui-Tena, L., Schulte-Holierhoek, A., van Trijp, H., & Piqueras-Fiszman, B. (2017). Beyond expectations: The responses of the autonomic nervous system to visual food cues. *Physiology & behavio*r, 179, 478-486.

Verastegui-Tena, L., van Trijp, H., & Piqueras-Fiszman, B. (2018). Heart rate and skin conductance responses to taste, taste novelty, and the (dis) confirmation of expectations. *Food Quality and Preference*, 65, 1-9.

Verbeke, W., Scholderer, J., & Lähteenmäki, L. (2009). Consumer appeal of nutrition and health claims in three existing product concepts. *Appetite*, 52(3), 684-692.

Wansink, B. (2004). Environmental factors that increase the food intake and consumption volume of unknowing consumers. *Annual Review of Nutrition* 24, 455-479

Wansink, B.; Chandon, P. Can (2006): "Low-Fat" Nutrition Labels Lead to Obesity? *Journal of Marketing Research*, 43, 605–617, doi:10.1509/jmkr.43.4.605.