The Use of Biometrics in Testing the Perception of a Selected Indicator of the Nutritional Composition of Food

Katarína Neomáňiová1, Jakub Berčík2, Roderik Virágh3, Johana Paluchová4
Slovak University of Agriculture in Nitra1,2,3,4
Institute of Marketing, Trade and Social Studies1,2,4
Institute of Accounting and Informatics3
Tr. Andreja Hlinku 2
Nitra, Slovak Republic
e-mail: katarina.neomaniova@uniag.sk1, jakub.bercik@uniag.sk2, roderik.viragh@uniag.sk3,
johana.paluchova@uniag.sk4
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Abstract
Poor eating has a direct impact on increasing the percentage of overweight and obese people in the global population. It is scientifically proven that obesity directly increases the risk of human health problems (cardiovascular, oncological diseases), which ultimately leads to higher health care costs. In this context, it is a society-wide problem. This is the reason why a change in eating habits must be a priority and a subject of interest in the global understanding. Knowing the process of consumer behavior when buying food creates room for influencing towards healthier products or a balanced diet. The point of sale is the last place that can influence the consumer. The aim of food indicators is primarily to point out the balance of diet, or healthier alternatives, but in no case the complete elimination of consumption of products that achieve worse nutritional scores. There are several models of nutritional indicators on the market that have their advantages and disadvantages. The fact is that successful is the one that is generally accepted by producers, retailers, and by consumers. The paper examines the perception of the Nutri-score food indicator on a selected well-known product using consumer neuroscience tools and an online platform. Finally, the paper points to the perception of the food indicator as well as its effectiveness in terms of changing consumer preferences.

Keywords: biometrics, consumer behaviour, foodstuffs, healthy eating, nutritional composition

JEL Classification: M30, M31, M39

1. Introduction
Nowadays, people during the food selection take into consideration their lifestyle, which could be considered as an increasing trend on the food market. When making a buying decision, they focus on health or nutritive aspects of each product category (Predanócyová et al., 2018). As the foods and drinks associated with improved health generally have low negative environmental influence, a dietary transition toward greater eating of healthier foods would generally improve environmental sustainability. The importance of eating a healthy diet and its impact on healthy human lifestyles and natural sustainability has been recognized. There is a growing interest in developing f.e. functional foods that contribute to the maintenance and improvement of human health (Huang et al., 2022). Health consciousness refers to the psychological inclination that motivates consumers to take better actions (Michaelidou-Hassan, 2008). With the increase in life expectancy and income levels, health concerns are increasing along with the health boom (Schlarb, 2017). Customer awareness of healthy eating habits and lifestyles continues to increase, and consumers are beginning to view the healthiness of food/ drinks as one of the most important attributes and are choosing more products that are positively associated with their health (Holotová, Horská & Nagyová, 2020). Health-conscious people care about their health, and they strive to enhance and maintain status by engaging in behaviors, such as consuming nutritional foods (Kim, Yim & Kim, 2021). One modifiable aspect of reducing non-communicable diseases is to prevent obesity. The prevalence of it is a serious health problem worldwide (Rahamat et al., 2022). In the last decades, there has been
growing interest in the development and adding of health promotion interventions in the workplace, on the other hand, the eating of added sugars, processed meats, and trans fats is higher than the recommended daily intake (Sogari et al., 2018). Front-of-package (FOP) labels promote healthy diets as an ancillary tool to the more comprehensive food-based dietary guidelines by increasing consumer understanding of the nutrient content of their food, informing healthier food purchases and consumption, and encouraging product reformulation (Wartella, Lichtenstein & Boon, 2020). Differences in their design, nutrition criteria, nutrients displayed, products targets, and their mandatory or voluntary implementation can stimulate various responses by consumers and industry (Khandpur, Swinburn & Monteiro, 2018). Understandings of health, these food and meals, and the contextualization of the concept have been investigated in consumer studies and the sociology of food for more than a decade. There are three concepts to reflect better consuming purchase behavior and decision: health as nutritional value; health as pleasure; and health as purity (Ditlevsen, Sandoe & Lassen, 2019).

In order to facilitate the choice of foods for a healthy and balanced diet, products in some countries display nutrition values, with the three most common versions of the labeling being: NS (Nutri-Score), Guideline Daily Amounts (GDA), MTL (Multiple Traffic Light) (Berčík, 2020). EuroHealth Magazine (2019) and Folkvord, Bergmans & Pabian (2021) present the explanation of Nutri-Score as a nutritional label based on a five-color coded scale going from dark green to dark orange, associated with letters from A to E. Dark green and the letter A is attached to products with the best nutritional quality, while dark orange and the letter E is attached to products with the lowest nutritional quality. Nutri-Score equips consumers with information about the general nutritional quality of products on the front of packaging. The underlying nutritional scoring method was developed by the British Food Standard Agency and is known as the ‘FSA score’. This score, which goes from -15 to 40, allows us to evaluate the overall nutritional quality of food. Based on 100g of product, it incorporates unfavorable factors such as calories (kj), saturated fatty acids (g), sugars (g), and sodium (mg); and favorable factors such as protein (g) fiber (g), and fruits, vegetables, legumes, nuts, and olive, nut, and colza oils (%). There are two objectives when using Nutri-Score: supporting consumers, and encouraging the improvement of products. By giving access to information and helping people to compare products at a glance, consumers are pointed towards products with the best nutritional quality (Egnell et al., 2020; Chantal & Hercberg, 2017; Chantal & Charpak et al., 2018). Front-of-Pack Nutrition Labels (FoPLs) have received growing attention from public health authorities. They have been demonstrated to be efficient tools to help consumers make healthier food choices at the point-of-purchase as they deliver at-a-glance nutritional information (Egnell et al., 2020). Numerous studies in the French context, and one study in other countries including some European countries, have been carried out to validate the graphical format of the Nutri-Score, regarding several dimensions of its effectiveness (Dréano-Trécant et al., 2020). Tests of perception and understanding of the Nutri-Score indicator are currently underway, as it takes into account food labeling criteria at the EU level, to which our legislation is directly subject. In case of Slovakia, food traffic light has been approved. There has even been an informal platform to support this indicator (Berčík, 2021).

Face reader is about facial-expression coding as it reads muscles in the face. It measures emotional responses through the face and represents an automatized facial expression analysis software that provides an objective assessment of emotions (Půchovský & Kohoutová, 2015; Neomániová, Berčík & Pavelka, 2019; HBR, 2020). Noldus Co. (2022) describes that Face Reader is the most robust automated system for the recognition of a number of specific properties in facial images, including the six basic or universal expressions: happy, sad, angry, surprised, scared, and disgusted. It immediately analyzes data (live, video, or still images), saving valuable time. The option to record audio as well as video makes it possible to hear what people have been saying. Eye tracker can measure attention (via the eyes’ fixation points) and arousal (via pupil
dilation). It allows us to examine consumer behavior by the point of gaze, how long it lasts, and also the motion of the eye. It measures the intensity and frequency of gaze (Puchovský & Kohoutová, 2015; HBR, 2020; Berčík et al., 2020). Tabletop eye trackers and glasses-type eye trackers exist. Eye tracking facilitates the measurement of unconscious movements in gaze and provides objective data that cannot be obtained via interviews (Yasui et al., 2019). Eye-tracking has been used to evaluate the effectiveness of nutrition labels and nutrition information. It is obvious that paying attention to the nutrition information does not mean that doing so will result in healthier food choices. However, it is also clear that consumers need to view the information on the food package before they can use it. The results of eye-tracking studies have suggested that consumers pay less attention to nutrition information as they indicate when are explicitly asked how much attention they pay to this information (Siegrist, Leins Hess & Keller, 2015; Oliveira et al., 2016).

2. Data and Methods

The subject of interest was testing the understanding and perception of the nutritional indicator Nutri-Score on the subpage of a food retailer. The testing was performed by viewing the "Nutri-Score" website by 30 respondents aged 18 to 75 years (50% men, 50% women). The testing process consisted of three parts. The first part was an in-depth interview, the second part a test of the perception of a website with information about Nutri-Score and the third part a test of understanding and influencing consumer preferences.

The introductory interview consisted of questions about shopping, lifestyle, diet and perceptions of food labelling as well as food quality.

In the second part, the visual attention of the respondents was monitored by a Tobii X30 static eye camera (eye tracking) and emotional response was captured by face reading (FA) by Noldus company. The assignment for the respondents was as follows:

"Imagine you want to eat healthily. The retail chain is now coming up with a new Nutri-Score product label. Please take a look at this company's website."

After studying the website and getting acquainted with the Nutri-Score, the task of the respondents was to make a product selection based on the nutrition label through a graphical display. The third part of the testing process was realized using a special platform samolab.online for sensing emotional response and reaction time.

The survey was conducted on 23rd, 24th and 27th of November 2021 in the Laboratory of Consumer Studies at FEM SUA in Nitra.

3. Results and Discussion

In the introductory interview, the majority (77%) of respondents (6 certainly yes, 17 rather yes) stated that they care about a healthy lifestyle most often through exercise / physical activity (23), 19 out of the total number stated that they also eat healthily (4 certainly yes, 15 rather yes) and half (50%) of respondents are interested in the nutritional composition of food (6 certainly yes, 9 rather yes).

In terms of reason for shopping, 80% of respondents (24) most often buy groceries for the family, 6 respondents said, "for themselves", while in terms of frequency of purchase, most respondents said they make purchases several times a week (19) and once a week (6).
The introductory interview also included a question about Coca-Cola consumption. We were mainly interested in whether consumers prefer standard Coca-Cola or with reduced sugar content. From Fig. 1 it can be seen that 17 respondents stated that they did not consume this drink, 7 stated that they prefer classic Coca-Cola, and 6 respondents stated that they prefer Coca-Cola with a reduced sugar content. The reason for including this question is the test of the influence of the nutritional indicator on consumer decision-making after looking at the website of the retail company.

![Coca-Cola consumption](Source: Authors' own elaboration based on research 2021)

After the introductory interview, the respondents continued to familiarize themselves with the food indicator via the Nutri-Score website. Visual and emotional attention was monitored during site browsing.

Based on measurements via a mobile eye camera, the highest level of visual attention was identified through outputs in the form of thermal maps and points of interest (AOI). It can be seen in Figure 2 that most attention (red) was focused on the text describing the nutritional indicator "What is a Nutri-Score?". At the same time, the respondents were the first to notice the logo within the main banner after an average of 6.63 milliseconds, the latest in this section they noticed the Nutri-Score image, including its A-E variants (42.36 milliseconds). They spent the longest time looking at the text "What is a Nutri-Score?" (On average 6.06 seconds).
At the same time, the respondents' emotions were also monitored through facereading. Based on the data on valence (polarity of emotions), a thermal map of negative feelings was created, it is places where respondents had the highest level of frustration based on average values (red means the highest level of frustration).

In the first part of the website, the introductory text paragraph "Nutri-Score" caused increased frustration, which most respondents tried to read and quickly understand. This was also the case with the definition of "What is a Nutri-Score?", probably due to the length of the text and the relatively small letters as can be seen in Figure 3.

Figure 2: Sample visual attention map when viewing Nutri-Score information - part 1 of the subpage
Source: Authors' own elaboration based on research 2021
Following the view, respondents were asked to indicate which Coca-Cola they would choose. In this case, they made their decisions based on the visuals of the product, which was marked with the Nutri-Score food indicator. The classic version of Coca-Cola is according to this indicator in the E category and the sugar-free version (Coca-Cola Light / Zero) in the B category. This test was carried out through a special platform which, in addition to the respondents' response, also recorded the respondent's reaction time and rate and emotional response. From the results (Fig. 4) it can be seen that the studied nutritional labeling indicator had an impact on product choice (20 respondents identified Coca-Cola Light, which is labeled B). At the same time, the relevance of these responses based on facial biometrics is 72%, which indicates a relatively sufficient validity of the results.
The results also show that 16 respondents correctly understood the importance of food labeling with the Nutri-Score indicator and 14 respondents misunderstood this indicator (12 incorrect, 2 partially correct), which confirms the impact on consumer product choice.

Understanding the indicator also suggests measuring the reaction time to this question. The average length of reading a question and choosing answers was 22 seconds. Based on the results of the reaction time measurement, it can be seen that the average response time (including reading the question) was 25 seconds, which indicates a relatively fast selection.

### Table 1: Response time when selecting a Coca-Cola version with a nutritional indicator

<table>
<thead>
<tr>
<th>Reaction Time</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 seconds</td>
<td>64 seconds</td>
<td>25 seconds</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Authors' own elaboration based on research 2021*

4. Conclusion

After studying the Nutri-Score website and based on the interview, we can conclude that the majority of respondents understood the informative meaning of the website (17 correct statements, 5 partially correct). The use of neuromarketing methods suggests that some improvements are needed, as many respondents identified a higher level of frustration with reading "What is a Nutri-Score", which could be a problem in terms of text comprehension (valence -0.075). On the other hand, the control test confirmed the understanding of the indicator at the conscious and subconscious level when choosing a product. The studied nutrition labeling indicator had an impact on product selection, as 20 respondents identified Coca-Cola Light marked as B in the control selection, but most declared before seeing the subpage that if they drink Coca-Cola, then the classic, which is marked as E. Measurement of reaction time and calculation of relevance based on Facereading and pupil dilation showed a relatively fast response and degree of concentration when selecting a product through graphical visuals. The involvement of neuromarketing methods in testing the perception of the selected subpage and consumer choice revealed a lot of detailed information on consumer perception, which is further usable in the process of marketing management and communication.
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