

# Neuromarketing Study of Consumers' Cognitive Perception of Labeling Information on a Product's Package

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**Abstract.** The article studies the information technologies' application possibility in the process of placing the labeling information on the products' package. In order to inform the consumer effectively about the product and its ingredients on the basis of determining the best location of the labeling information it is necessary to conduct pilot neurophysiological studies. The aim of the study is to analyze and assess the visual and neurocognitive consumers' perception of prescribed labeling information on the package of dairy products to determine the range of its best location.

**Research methods.** A complex neuromarketing experiment was carried out in order to study the visual and cognitive perception of labeling information on a soft package of milk. 36 testees aged from 18 to 50 took part in the experiment involved. They were divided into two groups – experimental and control, which were equal in the number of men and women. Two types of thinking were assessed on the basis of the data of combined oculomotor fixations and the speed of visual study of the same stimulus material given to each group. The consumers' behavior was studied in the experimental group in the process of visual analysis of packages according to D Kahneman's System 1. In the control group the experimental problem was set to find errors and inaccuracies on the stimulus material and the cognitive behavior was studied according to D Kahneman's System 2. It is experimentally proved that it is quite difficult for consumers to study and perceive objectively the labeling information on the milk packages, which increases the probability of purchasing a low-quality product.

As a result of the processing of the total fixation data in the areas of interest on the package, the best location of the production date and the expiry date was revealed on the back side of the package. The stimulus materials were tested in the experimental and control groups for the purpose of drawing testees' attention to the date of production, located at the top, at the bottom and in the center of the package. Then the zones of interest were pointed out on the packages of milk. The results obtained in the study work can be used as a practical tool for managing consumer's attention in the process of choosing milk.

## 1. Introduction

Effective socio-economic development of each country is predetermined inter alia by the development and sustainable functioning of the agro-industrial complex in its territory. Undoubtedly, providing the population with high-quality and affordable products is one of the priorities of the national security of the country because it affects the standard of living and health of the nation as a whole. In Russia the dairy industry is one of the most important areas of specialization of agricultural enterprises, as dairy products occupy a significant place in the structure of consumption. Thus, the share of expenditures on

dairy products is 15% of the total cost of nutrition, in consequence of which their production should be large-scale, and the range of items should be steadily expanding. In accordance with the "Recommendations on rational standards of consumption of food products that meet modern requirements of a healthy diet", approved by the order of the Ministry of Health of the Russian Federation as of 19.08.2016 № 614, the consumption of milk and dairy products in terms of milk is 325 kg a year per person [1], but if this figure in 2016 was only 236 kg per person a year (73% of the recommended norm), in 2017 it is 231 kg per person a year (71% of the recommended norm), in 2018 amounted to only 226.5 kg per each Russian [2, p. 11], which was due to the continuing fall of real incomes of the population, a decrease in actual consumption of milk due to the increase in sales prices for it, reorientation to cheaper products (for example, products with milk fat replacer, potatoes, bakery and pasta, etc.). These factors have had a negative impact on the quality of nutrition and health of most people. It should be born in mind that the dairy products sector has an important feature: the result of production are short-lived commodities, the sale of which requires control of quality and food safety, since citizens' health is a priority for the national security of any country. The importance of control measures is due to the presence of counterfeit dairy products in the wholesale and retail trade, as a result of which the Federal Service for Consumers Protection and Human Welfare (further – Rospotrebnadzor) conducts laboratory tests, during which the number of notifications of territorial bodies of Rospotrebnadzor on detected counterfeit dairy products in 2016 amounted to 2,568, in 2017 it amounted to 1,545. In the first quarter of 2018 22 manufacturing enterprises were detected, which are actually absent at the addresses indicated on the packages of the goods. The laboratory control on the basis of sample studies of more than 2 million samples of food products, out of which more than 300 thousand samples were the samples of dairy products, showed a decrease in the proportion of counterfeit dairy products from 5% to 4% [3]. Thus, in the first quarter of 2018 more than 45 thousand samples of dairy products were studied in terms of microbiological criteria, as a result, the share of milk and dairy products that do not meet the requirements for microbiological criteria was 3.8%, the content of chemical contaminants was 0.02% [3]. In general, the country's share of counterfeit dairy products in retail chains is 7-8% [4]. It should be noted that the basic requirements for the application of the necessary information about the product on the package of milk and its derivative products, packaged in a consumer's container and sold in the Russian Federation in wholesale and retail trade are regulated by paragraph 25 of article 35 of the Federal Law "Technical Regulations on Milk and Dairy Products" as of 12.06.2008 № 88-FZ [6]. The following parameters should be reflected on the package of the product: product's name, mass fraction of fat in percentage, name and location of the manufacturer, net weight of the product or its volume, content of the product indicating the ingredients, nutritional value, date of production, expiry date, etc. At the same time, this legal document do not contain clear requirements for the necessity of placing the information about the product and its manufacturer on the front or back side of its package or in a particular area (section) of a consumer's package. In this regard, the placement of labeling information on the package of products is decided by each manufacturer independently, which creates difficulties for the consumer in the process of studying of various packages of dairy products and can lead to an increase of time spent on making decision to purchase. Thus, in the course of pilot studies in regional retail chains, it was found out that the average duration of the decision making process on the choice of a particular dairy product in a store or trade organization, based on a visual study of the basic information about it, located on its package, is about 10-15 seconds, which is insufficient to obtain basic information about the product and may be misinterpreted by a consumer.

The problem of falsification is relevant not only for the B2C market, because the consumer is not able to discern the quality of dairy products at the sales outlet only by examining the label on the package, but also this problem is very relevant for the B2G market, since it is impossible to ensure the efficiency and safety of purchases of dairy products for nutrition in kindergartens and schools, hospitals, participating in the public procurement system in accordance with Federal Law No. 44, under which the contract is received by the supplier who offers the lowest price, unsecured by high quality products, as a result, the state of health of less protected consumer groups like children and

sick people may go downhill. Thus, in 2018 in the Republic of Crimea the non-conformity with the quality standards of dairy products entering kindergartens and schools was detected in 62 samples out of 154 (40.2%) (in 2017 out of 95 samples which was 45% of falsification). Moreover, the highest percentage of falsified products (about 65%) came on the dairy products imported from other regions of Russia [5]. It is also necessary to take into account the export direction of sales of dairy products in Russia, which in 2018 was only 3% in the structure of the volume of goods produced (\$310 million), the increase of which is one of the priority elements of the strategy of the Ministry of Agriculture of the Russian Federation "Export of Agricultural Products" [2, p. 5]. However, 90% of dairy products export falls on the CIS countries, where the potential growth is already low, and the share of Russia is already large enough, so it is necessary to grab new export markets, including European, Asian, Chinese, etc., using the gustatory quality of dairy products as a competitive advantage. Thus, the further effective development of the dairy products industry requires the introduction of new, innovative communication tools to prevent the falsification of dairy products, informing the consumer about the product and its ingredients through the use of a standardized system of placement of mandatory labeling information, which will let optimize the information on the packages of dairy products and reduce the presence of unnecessary information.

*The purpose of this study* is to analyze and assess the visual and neurocognitive perception of consumers of mandatory labeling information on the package of dairy products in order to find the area of its best location, which will allow the consumer to assess the quality of sold products quickly.

Both Russian and foreign scientists were engaged in the research of milk package design as an important element in the promotion of goods on the market. Thus, in the work of V V Kuzmich [7, p. 64] the questions of implementation of the elements of the paragraphemics in the design of a package are considered, the effectiveness of the use of mechanisms of punctuation and typographic variations are justified, as well as the mechanisms of the use of the surface and space. The merchandising research of product labels as subcomponent of quality was held in the works of A V Proskochilo, V G Demyanenko, etc. [8], in which scientists attempted to eliminate the most problematic elements of a label, which include Braille print and bar codes. In the publications of V V Bov, V V Kureychik and others [9] a problem-oriented genetic algorithm of packaging was developed, the use of which will allow to enable the process of finding the best packaging solutions in acceptable period of time. The prospects for the use of extensive evolutionary packaging systems for a wide variety of products, proven by predicting the evolution of packaging technologies, presented in the writings of A V Potekha, A A Shvedko and others. [10]. Studies conducted in the work [11], prove the dissatisfaction of consumers associated with the presence of excessive labeling information, duplication of it on food package, which increases the "information noise" for the consumer and can mislead them. The style, color, composition and graphic brand identity on the milk package was studied by N M Sokolnikova and others [12]. Foreign researchers considered package as an element of recognition in the decision-making process of buying and creating positive associations with the brand [13]. The proof of the influence of the package and its individual elements on positive consumer's behavior in the food market is studied in this work [14]. The study of the influence of visual elements (color, design, packaging material, size and graphics) and verbal ones (the list of ingredients, fat status and country of origin) on the package of dairy products in the process of consumer's decision-making on its purchase were done by scientists J Shahram [15], J Hossein and others [16]. Scientists proved that the visual elements of color on the milk package, as well as the placed information factors (label) affect the consumers' behavior significantly [15]. In the work [16] the interrelation between expiry date, the name of the manufacturer and brand recognition was proved on the basis of positive correlation. Thus, according to the authors, the visual elements of the package are the carrier of information, affect the consumer's emotions, and, as a result, determine their behavior. Despite the considerable number of publications on the study of elements on the goods packages, yet there is a lack of coordination of individual national systems of standardization and certification of products, the imperfection, or the absence of a comprehensive approach to the volume and location of labeling information, which leads to difficulty for the consumer to choose a product of high quality [17].

Thus, despite the indisputable importance of the use of package in the process of giving information, there is an objective need to study the cognitive consumers' perception of labeling information, its visual visibility in different areas of the package in order to find the best one.

## 2. Research methods

We studied the samples of drinking milk presented only in a soft pack. This is due to the fact that this type of product is one of the most preferred among regional consumers. This is proved by the data of the primary marketing survey, which was conducted before the neuromarketing experiment. The data obtained say that 32.61% of consumers of retail chains, brand stores of milk producers, small shops in outer-lying residential district prefer to buy milk in soft packages.

The complex neuromarketing experiment was done studying the cognitive consumers' perception of labeling information on the soft package of milk using a stationary eye tracker (Eye-tracker) VT 3mini with software EventID. The resulting data were obtained by recording the pupil's position (fixation) and eye movement (saccade). The experiment involved 36 respondents, who were divided into two groups of 18 tessees (9 men and 9 women) aged from 18 to 50. In the first experimental group objective neurophysiological parameters of visual perception of 10 milk packages of regional manufacturers were tested. In the selected areas of stimulus materials only for the purpose of this experiment inaccuracies and inconsistencies in the information about weight, fat status, date of manufacture and expiry date, GOST (State All-Union Standard) were applied. In the second control group stimulus material was tested for the purpose of attracting attention to the changed zones. In the experimental group while studying visually and selecting a package D Kahneman's System 1 of thinking was tested, whereas in the control group D Kahneman's System 2 was tested [18]. The scientist believed that System 1 is associated with quick thinking and intuitive processing of information when making a purchase decision. System 2 is conscious and deliberate, involves a systematic and careful approach to the analysis of data from the external environment, comparing them with the existing experience of the consumer, performing a number of checks to make the right decision. In everyday life consumers are more likely to use System 1 in the decision-making process, while buying expensive things (for example, a house, a car) they use System 2. As a result of the experiment, the best zones for placing the date of manufacture and expiry date of milk on the package were found. The Visual stimuli were projected onto a 24-inch monitor with a resolution of 1920x1080 pixels. The eye tracker was located at the distance of 600 mm from the participant. The correction angle did not exceed  $0.5^\circ$ , which corresponds to measure of inaccuracy of about 5 mm. The detection algorithm for finding the center of the pupil has reliability of 98% with an accuracy of its zone detection of  $\pm 1$  mm. The Results were processed using economic, mathematical and statistical methods of analysis implemented in the environment of SPSS and author's calculations. The data obtained from the eye tracker were converted into maps of visual significance (heat maps) in OGAMA program.

## 3. The obtained results

The research algorithm includes the author model of obtaining aggregated data, which includes 4 stages.

Stage 1. Measurement of total oculomotor fixations and visual study speed on the selected areas of interest. In this experiment the selection involved 36 tessees is the representative for this cognitive analysis and the type of used experiment. The tessees were divided into two groups: experimental one (18 people) and control one (18 people). The groups were equal in number of men and women. The same stimulus material consisting of 10 visual images of soft milk packages of regional producers, made with a resolution of 1920x1080 pixels was presented to the tessees. The duration of visual study of stimulus material was not limited in time. Specifically for the purpose of this experiment the errors, inaccuracies and inconsistencies in the presented information about fat status, weight, date of manufacture and expiry date, as well as the registration number of GOST (State All-Union Standard) were applied to the front and back sides of the graphically presented milk packages.

Stage 2. As the result of the conducted experiment the average speed of studying of the packages and the percentage of finding errors and inaccuracies using different parameters were calculated in the experimental and control groups and presented in Table 1.

**Table 1.** The resulting data of visual study of milk package in the experimental and control groups.

The error/ inaccuracies parameter	Experimental group				Control group			
	Men		Women		Men		Women	
	The speed of the visual scanning, ms	finding an error, %	The speed of the visual scanning, ms	finding an error, %	The speed of the visual scanning, ms	finding an error, %	The speed of the visual scanning, ms	finding an error, %
Weight	34105,0	0,0	26415,1	0,0	46835,7	44,4	37933,5	88,9
The date at the top of the package	32558,7	0,0	27682,3	11,1	68529,4	22,2	47254,0	66,7
Fat status	27058,2	11,1	22385,9	0,0	35590,9	66,7	27177,8	88,9
Date at the bottom of the package	32890,6	0,0	25158,6	0,0	46036,1	55,6	36395,3	66,7
GOST	25037,1	11,1	24023,1	11,1	17460,3	88,9	15776,4	88,9
Weight	24612,2	22,2	16953,4	11,1	22269,8	100,0	21927,9	77,8
Weight	25192,7	22,2	22067,6	22,2	20282,6	100,0	17285,0	100,0
Fat status	31498,0	0,0	23464,8	33,3	33962,1	88,9	34240,6	55,6
GOST	28984,7	11,1	26375,7	11,1	54109,2	66,7	43991,9	55,6
The date in the center of the package	51338,7	22,2	26575,9	33,3	41928,4	88,9	29150,6	88,9
Average	31327,6		24110,2		38700,5		31113,3	

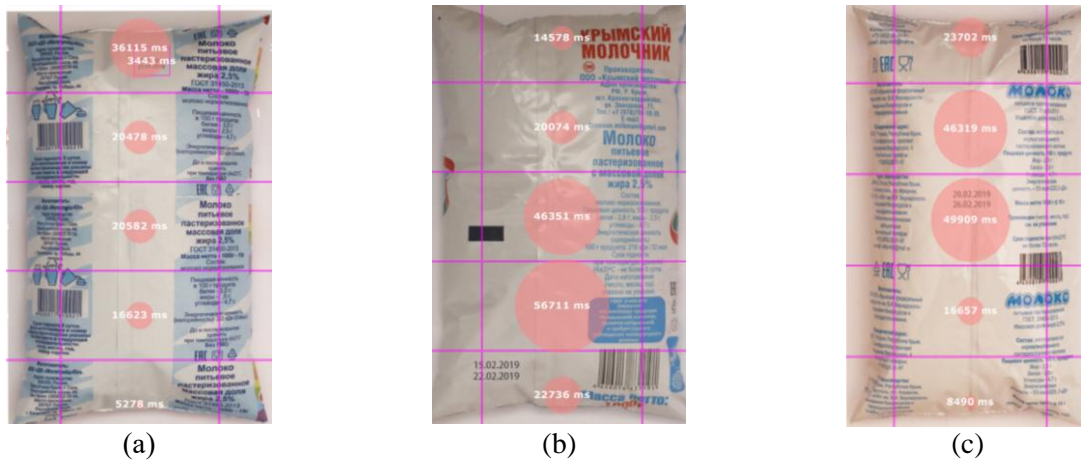
The results of the experiment (table 1) justify D Kahneman's conclusions [18], since the testees in the experimental group spent less time on the study of the package (on average 31327,6 ms by men and 24110.2 ms by women), they practically did not detect mistakes on packages and did not compare the inaccuracies made on its front and back sides, i.e. in this case the type of thinking works that is presented by System 1 which is characterized by automatic, fast, reflective thinking. This type of "automatical" thinking guides human's judgments, decisions, and behavior most of the time, but the consumer implementing this type of thinking may be at a higher risk of jumping to wrong conclusions.

The testees in the control group after receiving the experimental task spent more time on visual and cognitive study of the package and comparison of labeling information on average 23.5% more by men and 29.0% more by women compared to the results of the experimental group, resulting in the increased percentage of found errors and inaccuracies, i.e. System 2 got involved, activating rational thinking and careful reasoning. It should be noted that women in the experimental and control groups were more attentive than men, in some error parameters the deviation is two to three times, because they are more frequent buyers.

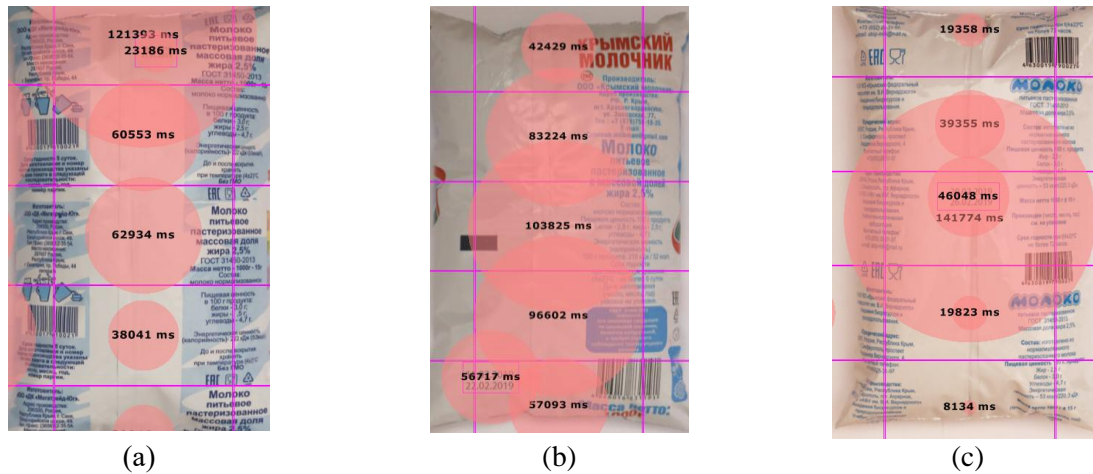
Stage 3. In order to provide consumers with the information effectively and help them in the process of consumer choice, the best location of the date of manufacture and the expiry date of milk on the package was found. This parameter of labeling information is the main for short-lived products and affects its quality and the health of consumers. The experimental task was to assess the areas of interest of the testees with different variants of date placement: at the top of the package, at the bottom of the package and in the center. Table 1 presents the resulting data in the study of packages with the date of manufacture and the expiry date of milk applied on different areas of the package. In the experimental and control groups there is an increase in visual attention to the date of manufacture, placed in the center (in the experimental group the share of men who found an error was 11.1%, the

share of women was 22.2%, in the control group the share of men and women who found an error was the same and it was 88.9%), and a decrease in attention to the dates placed at the top (in the experimental group the share of men who found an error was 0.0%, the share of women was 11.1%, in the control group the share of men who found an error was 22.2%, the share of women was three times bigger and it was 66.7%) and at the bottom of the package (in the experimental group, men and women did not find an error, in the control group the share of men who found an error was 55.6%, the share of women was 66.7%).

Stage 4. The experimental evidence of the visual significance of the location of the date of manufacture and expiry date in the center of the back side of the soft package is the cumulative fixation in the areas of interest among respondents in the experimental and control groups presented in figures 1 and 2.



**Figure 1.** Total fixations of testees of the experimental group on the date of manufacture and expiry date, placed on the back side of the soft package: at the top (a), at the bottom (b), in the center (c).



**Figure 2.** Total fixations of the testees of the control group on the date of manufacture and expiry date, placed on the back side of the soft package: at the top (a), at the bottom (b), in the center (c).

The total fixations of the testees of the experimental group (figure 1) show that the total duration of fixations on the date of manufacture and expiry date on the milk package placed at the top amounts to 36115 ms, at the bottom – 22736 ms, in the center – 49909 ms, which is 1.38 times more than the indicator value in the study of the information placed at the top and 2.19 times more than the indicator value in the study of the information placed at the bottom.

The total fixations of the testees in the control group (figure 2) show that the total duration of fixations on the date of manufacture and expiry date on the milk package placed at the top amounts to 121393 ms, at the bottom – 56717 ms, in the center – 141774 ms, which is 1.17 times more than the indicator value in the study of the information placed at the top and 2.5 times more than the indicator value in the study of the information placed at the bottom.

Thus, it is experimentally proved that there is an objective need for standardization of the parameters of the labeling information location, which is the date of manufacture and expiry date and to place it in the center of the back side of the soft package of milk.

#### **4. Summary**

According to the results of the processed data of neuromarketing experiment it was found out that it is quite difficult for consumers to study and perceive the labeling information on the milk package objectively. This is due to both its large volume and a small amount of time for studying it, which is proved experimentally, as well as by the observations of consumers' behavior in retail chains. According to the results of the experiment it is recommended to introduce changes into paragraph 25 of art. 35 of Federal Law "Technical Regulations on Milk and Dairy Products" as of 12.06.2008 № 88-FZ about mandatory application of the date of manufacture and expiry date horizontally and in the center of the back side of the package to ensure the convenience and speed of visual perception of labeling information. This will reduce the volume of sales of expired products, as well as the probability of purchasing low-quality goods in the process of consumer choice.

*The directions of further research* are related to the study of visual visibility of the labeling information and its color, font of application and the best location on the milk package in the foveal and peripheral vision, which will help to understand the situational behavior of the consumer in the decision-making process of purchasing.

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