Research Article

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Explicit and Implicit Factors That Determine Private Labels' Possible Purchase: Eyetracking and EEG Research

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Abstract: Objective: This paper investigates the explicit and implicit factors affecting private-label (PL) products' possible purchase decision for different retailers. Design: The study uses eyetracking and electroencephalography (EEG) to explore the differences in eye movement and brain activity for PL products. This article examines how approach motivation, measured by total fixation duration and by EEG asymmetry over the frontal hemisphere of the brain, predicts PL purchase decision. Findings: This study investigates implicit variables that can influence consumers' willingness to PL purchase. The relatively greater left frontal activation (i.e., higher approach motivation) during the predecision period predicted an affirmative purchase decision in some cases. The eyetracking study did not reveal differences between women's and men's esthetics sensitivity toward the presented PL products. EEG research proved that consumers were not influenced by the PL product price. Originality/value: Literature lacks credible information on young buyers' behavior in the context of PL products. This paper elaborates on PL perception, revealing the neural origins of the associated psychological processes.

Keywords: neuromarketing, EEG, eyetracking, private labels, consumer behavior

JEL codes: M31, L81

1 Introduction and Background

1.1 The Concept of Neuromarketing

While neuromarketing (NM) research methods are gaining popularity, there is still insufficient exemplification of their actual application. NM has emerged after the applicable concepts were brought together from the field of neural science. In the past few years, it has been one of the most commonly applied concepts, making use of brain research in a managerial context, slowly and steadily gaining considerable attention from academia and practitioners [Agarwal, 2015]. At its core, NM aims to better understand the impact of marketing stimuli, by examining and interpreting human emotions [Thomas, 2017]. Calvert and Brammer [2012] define NM as the application of cognitive neuroscientific tools in marketing in order to measure the unconscious responses of consumers. This tool can provide measures of hidden preferences and of implicit processes [Venkatraman et al., 2012]. NM possesses knowledge on subjects' perception and

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memory and thus can be applied in real-life marketing situations [Sharma et al., 2010]. According to Häusel [2007], it can help in gaining understanding of the unconscious decision-making processes and the neural mechanisms which they are based on, since it focuses on assessing consumers' cognitive and emotional responses to various marketing stimuli [Karmarkar, 2011]. Classic marketing methods (which harvest qualitative, subjective data) do not carry the same degree of accuracy regarding the decision-making process as NM does [Ariely and Berns, 2010]. Zurawicki [2010] highlights that the major part in decision-making is governed by unconscious processes, which need to be studied for obtaining better understanding of the human decision-making process.

1.2 NM Methods

There are different tools and methods in neuroscience that can be applied in marketing to determine consumer reactions and decision-making, which can be grouped into 3 categories, based on the purpose for which they are used. Functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) record the metabolic reactions occurring in the brain, to localize and exhibit neural activity, by measuring the changes that occur in the blood flow. Electroencephalography (EEG), magnetoencephalography (MEG), steady-state topography (SST), and transcranial magnetic stimulation (TMS) monitor and document electric activity in the brain to measure the frequency of electrical current and electrochemical changes in the signals. And the last group – nonneurological tools – contains the biometric and other body response tools, measuring specific elements of the body (e.g., skin, face, and eye – to read the responses of these body parts to stimuli) [Bulley et al., 2016, p. 271]. EEG, fMRI, and MEG rank among the most frequently used NM technologies [Goker and Dursun, 2016, p. 158]. Some authors suggest that the greatest benefit can be probably derived from combining the use of multiple technologies. Brain imaging tools (such as EEG) and physiological measures (such as eyetracking [ET]) can be used to predict the engagement and vigilance decrement during various tasks [Berka et al., 2007; Martel et al., 2014]. According to Zurawicki [2010], EEG integrated with ET is a better predictor of consumer behavior that any of these 2 tools alone. Similarly, Ohme et al. [2011] clarify that combining EEG with ET can enrich marketing research on static advertising. The integration of EEG and ET measures offers deeper understanding of the emotional reactions experienced by a consumer while seeing a chosen stimulus (e.g., product or advertisement). Bridger [2015, p. 183] explains that, in theory, this can be a good combination that can provide more-specific interpretation of how people are reacting to each stimulus. Such an integrated approach can identify a causal relationship between marketing communication and emotions on an analytical level. Pairing ET with biometric data gives the opportunity to collect unbiased, behavioral, quantitative data.

1.3 EEG Studies

EEG allows for the monitoring of large-scale human brain activity patterns noninvasively and with millisecond precision. It measures changes in the electrical fields of the brain by reading electrical signals as they register with varying degrees of frequency and amplitude across a series of electrodes applied to the scalp [Ariely and Berns, 2010]. EEG captures variations in brain waves, and the amplitudes of the recorded brain waves correspond to certain mental states when the brain undergoes any stimulus [Agarwal and Xavier, 2015, p. 31]. For standardization reasons, the International 10-20 system (where 16-20 electrodes are separated by 10%–20% the total distance around the circumference of the head) has been used to describe the locations of EEG scalp electrodes relative to anatomic landmarks on the human head to minimize the variation in electrode placement [Freeman and Quian Quiroga, 2013, p. 5]. Some alternatives, providing for a larger number of channels, have been proposed. A revised system, called the 10-10 electrode placement system is based on the same landmarks as the 10-20 system, but it involves the addition of electrodes[1]. More closely spaced electrodes in the 10-10 system clearly provide better spatial resolution [Acharya et al., 2013]. The most commonly noted, commonly present, and easily recognized rhythm in clinical EEG interpretation is the alpha

1 The modified 10-10 terminology replaces the inconsistent T3/T4 and T5/T6 terms with the consistent terms T7/T8 and P7/P8.

rhythm. It has a frequency of 8–13 Hz, with amplitude between 40 and 50 mV in adults, and is present over the posterior head regions. Alpha activity can be suppressed or desynchronized when individuals open their eyes, engage in mental activity, or become alert or drowsy [Pizzagalli, 2007], so it attenuates or disappears with concentration, drowsiness, stimulation, or visual fixation [Stern, 2013]. According to Winkler et al. [2010, p. 373], the phenomenon of frontal EEG asymmetry has played a prominent role in research on emotions. Frontal asymmetry in alpha oscillations has been studied in research on individual differences in emotional and motivational processes. It refers to the average difference in brain activity between the left and right frontal areas, measured as hemispheric differences in alpha power in EEG recordings [Harmon-Jones et al., 2010]. Frontal asymmetry, assumed to be associated with individual differences in emotional responses [Quaedflieg et al., 2015], can be extracted using EEG headsets with electrodes located at frontal scalp regions (ideally, F3 and F4). John's [1977] neurometric analytic approach to quantitative EEG typically defined amplitude asymmetry of transformed measures at specific electrode sites by the following ratio: Brain symmetry index (BSI) = (left − right)/(left + right). As in previous research, a frontal asymmetry index was computed as follows: *log (alpha EEG power right F4) minus log (alpha EEG power left F3)* [Allen et al., 2004]. This index captures a particular asymmetry in spectral power between hemispheres and is normalized between 0 (perfect symmetry) and 1 (maximal asymmetry) [Billeci et al., 2013]. The excellent time resolution of the EEG allows for the analysis of short-term changes in motivation over the course of a stimulus presentation (e.g., picture of a product/s). According to Davidson's [1993] influential approach/withdraw motivational model of emotion, left frontal activity indicates a positive (or approach-related) emotion, whereas higher right frontal activity indicates a negative (or withdrawal-related) emotion. It should be emphasized that the EEG's sensors are sensitive to a certain amount of artifacts, so it is important to create a recording environment that minimizes the potential for ambient artifacts [Gutberlet et al., 2009, p. 34]. This term refers to any electrical potential that is recorded on an EEG but does not originate in the brain (they can be both physiological and nonphysiological) [Freeman and Quian Quiroga, 2013].

1.4 ET Studies

ET is used for the analysis of visual attention and, from the perspective of NM, it seeks to associate visual attention with the cognitive and emotional responses of consumers [Santos et al. 2015, p. 32]. According to Romano-Bergstom and Schall [2014, p. 6], an eyetracker can be a powerful tool that gives researchers a highly accurate representation and understanding of a respondent's eye movement behavior. Most modern eyetrackers rely on a method called corneal reflection to track the location of the eye as it moves. In this case, light source is used to illuminate the eye, which then causes a reflection that is detected by a high-resolution camera. The captured image is used to identify the reflection of the light source on the cornea and in the pupil. Then, advanced image-processing algorithms are used to establish the point of gaze related to the eye and the stimuli [Romano-Bergstom and Schall, 2014, p. 3–4]. In order to understand the ET operation, basic attributes must be clarified. The location of the user's eye gaze at a particular moment in time provided the most basic unit of analysis for visual attention understanding. Generally, eye movements consist of a series of fixations and saccades while viewing images or reading information. The duration describes the length of time that a user fixates on a particular area on the screen. It is used to understand whether the subject is paying attention to a specific visual element. A fixation is usually defined as a relatively stable state of eye movement (ranges from 100 to 500 ms, depending on the viewed materials), and a saccade as the rapid eye movement between 2 consecutive fixations [Rodrigues and Rosa, 2017, p. 4]. During fixations, the eye is almost completely still and information can be extracted from a stimulus; during saccades, the focus of visual attention is moved to another location [Azevedo and Aleven, 2013, p. 9]. Long prevalence at a certain region points to a high level of interest, while shorter prevalence times may indicate that other areas on the screen might be more catchy [Imotions 2015]. Duchowski [2007, p. 173], among the most common set of ET metrics, listed fixation (and its duration, rate, mean, and number), scan path, area of interest (AOI), gaze% of AOI, number of fixations per AOI, and mean gaze duration per AOI. Fixations can be mapped to specific *x*- and *y*-coordinates on a grid that help pinpoint where the user looked on a given display, but it does not necessarily mean that the user really saw it or that it registered cognitively in his/her brain. To interpret

ET data, the researcher must choose some aspects (dependent variable or metrics) to analyze in the data stream. It is difficult to provide general guidelines to suit all specific experiments. The aim here was to provide something of a workable context or framework for designing an ET study.

1.5 The Growth of Private-Label Brands

According to Sebri and Zaccour [2017], private labels (PLs) (brands sold exclusively by retailers) are no longer a marginal phenomenon in retailing. Cuneo et al. [2015] suggest that PLs have become a challenge for manufacturer brands, as evidenced by PLs' impressive growth over the past decade, having earned the trust of a large number of customers [Lamey et al., 2012]. The latest Private Label Manufacturers Association (PLMA) [2017] data shows that the popularity of PL keeps growing across Europe, with increasing interest in this topic among both managers and academic researchers [Koschate-Fischer et al., 2014]. The *2017 Yearbook* statistics reveals that PL's market share reached all-time highs in 9 European counties. Poland led the way among the Central and Eastern European countries, climbing 1.4 points to cross over the 30% market share mark (the PLs' market value was estimated at >PLN 48 billion, by experts brought together for the 4th Future Private Labels Exhibition and Conference in Targi Kielce), just behind the biggest market share increases posted in Austria and Germany.

Noormann and Tillmanns [2017] notice that, recently, the positioning of PLs in consumers' minds seems to have changed. For the consumer, PL represents the choice and opportunity to regularly purchase good-quality food and nonfood products with savings compared to purchasing manufacturer brands (without waiting for discount). The PLMA report [2017] indicates that PL products consist of the same or better ingredients than the manufacturer brands, and because the retailer's name or symbol is on the package, the consumer is assured that the product meets the retailer's quality standards and specifications.

Most of the scientific interest in PLs is in terms of the impact they have on the food market with reference to national brands [Gaviglio et al., 2015], since PLs have gained an increasing share of the food market [Ailawadi et al., 2008], with a growth rate twice as high as for national brands [Martenson, 2007]. Doyle [2013] explains that customers show different responses to different categories of PLs and, in terms of beauty products, consumers feel bigger personal risk, making this category problematic for PL producers to increase their market shares. However, major supermarkets and hypermarkets now offer almost any product under the retailer's brand (PLs cover, inter alia, full lines of health and beauty, over-the-counter drugs, cosmetics, as well as household and laundry products). Moreover, among the 10 top categories in store brands, dollars, and unit sales gains by channel in the U.S. PL market for supermarkets, PLMA [2017] listed predominantly nonfood sections. The illustrative list included, inter alia, seasonal general merchandise, women's fragrances, fresheners and deodorizers, total grooming aids, buckets and bins, as well as bath accessories, which offers an interesting snapshot of where opportunistic store brand innovation and growth are taking place.

2 Methodology

A total of 16 healthy right-handed[2] respondents (8 female, 8 male)[3] in the age group of 21–30 years (mean = 26 years and SD = 3 years), participated in the EEG and ET study conducted simultaneously. Subjects were informed about all factors that constituted potential contraindications in EEG research, such as

2 Only right-handed individuals were chosen, because of the differences that occur in brain lateralization between right- and left- handed persons.

3 It should be pointed out that there is no one sample size appropriate for all eyetracking and EEG studies. As in any other type of study, the sample size depends on multiple factors, including research **objectives and study design [Bojko and Adamczyk, 2010]. Literature review revealed that reasonable minimum eyetracking sample size ranged from 12 [Bertola and Balk, 2011] to 16 participants [Glaholt and Reingold, 2011], as well as 10 participants in case of EEG research [i.e., Vijaya-lakshmi et al., 2010].** Usually, in EEG consumer preference research, the sample consists of 15 [i.e., Telpaz et al., 2015] to 20 **consumers [i.e. Aprilianty and Purwanegara, 2016]. The results of the research by Indira et al. [2012] on EEG research proved that "it was evident that 16 samples per class are required in order to have a power level of 95% and an α error probability of 5%".** The general rule of thumb in literature is 10–20 subjects per group in a directional assessment of observable behaviors, but adding statistical comparisons requires larger samples, even up to 50 participants [Eyetracking, 2018].

neurological and sleep disorders, being under the influence of stimulants/sedatives and psychoactive substances (including strong coffee or tea), as well as the restrictions on ET research (which included, among others, nystagmus, vision defects >3 D [diopters]). With these constraints, a homogeneous group in terms of gender, age, and laterality was recruited, which is important in experiments such as this. When recruiting subjects for the study, a determinant criterion was that they had to have been shopping on a weekly basis in supermarkets that have both national and own-label branded products. This guaranteed that the subjects were aware of the existence of national and PL products and also guaranteed that they were acquainted with market prices. Pictures of high-quality products were combined on the gray board (instead of white, in order to avoid distracting the participants).

EEG and eye movements were recorded simultaneously after participants were informed about the procedure and the purpose of the study and they had signed an informed consent. Anonymization of the participants was followed. The research was conducted in a protected environment, under strict hygiene conditions. All subjects received financial compensation for their participation. B-Alert X10 wireless EEG Headset System (Advanced Brain Monitoring), with the 9-channel combination of midline and lateral EEG sites placed according to the International 10–10 system, was used. The impedance of all electrodes was reduced to <40 kW. The data were recorded at a sampling rate of 256 Hz and online bandpass filtered between 0.1 Hz and 100 Hz. A set of baseline tasks (3 minutes: a 3-choice vigilance task, an eyes-open rest task, and an eyes-closed task) was performed to ensure that the EEG system was working properly. Participants were instructed to remain relaxed for the duration of the recording. Once the EEG baseline was complete, the participant underwent a calibration procedure to align the eyetracker coordinate system (Tobii X-60) with that of the monitor (Dell PC with 21″ screen) displaying the content. This eyetracker has an accuracy of 0.5, which averages to 15 pixels of error, with a drift factor of <0.3 and a sampling rate of 60 Hz. To calibrate the eye position, a 9-point grid was used. The experiment was carried out in a quiet room with controlled level of luminance. The eye tracker was recalibrated for each subject to provide accurate measurements for the participant's gaze during the experiments. IMotions (version 6.0) software platform was used to integrate ET and EEG data. Detecting and removing artifacts in the EEG data due to muscle activity, eye blinks, electrical noise, etc., is an important problem in EEG signal-processing research. Advanced brain-monitoring algorithm was used to detect and automatically clean the artifacts in the EEG signal (in the time domain related to amplifier saturation and deviations). Discrete wavelet transform was used for denoising nonstationary signals, such as blink artifacts and muscle movements). After the decontamination, the EEG signal was analyzed in a second step. The main aim of this research is to identify the implicit factors that determine young customers' behavior in the process of buying PL products of distributive networks in Poland. Consumers' decision-making processes are way more complicated than any single construct could possibly and clearly explain [Weib, 2015, p. 203].

First of all, there are important biological and behavioral differences between the 2 genders [Regitz-Zagrosek, 2012, p. 596]. In the marketing literature, researchers have examined gender differences in different streams of research, such as message processing, price promotions, impulse purchases, advertising, and attitudes toward shopping forms [Sohail, 2015, p. 36]. In terms of PL products, there are important differences between men and women in their behavioral attitude toward the PL's packaging. In the literature on the subject, it is said that women seem to possess a higher esthetic sensitivity to the design of products [Krishna, 2006, p. 3]. Gender had a significant influence, in that females indicated attaching more importance to esthetics than males [Creusen, 2010, p. 29–30]. The esthetics is basically in the eyes, and the perception formed is based on the senses of the observer [Baisya and Das, 2008, p. 24]. Thus, the first hypothesis reflects this difference.

H1. Women possess a relatively greater esthetic sensitivity to the private-label product's appearance than men.

The term "esthetic sensitivity" needs to be operationalized. The total fixation time (total duration of all fixations) on the certain AOI during the participant's evaluation of each of the presented product's esthetics was adopted. It is assumed that the longer the subject is looking, the more he or she is sensitive to esthetic aspects. Eventually, the hypothesis took a measurable form: women's total fixation time within particular product categories will be longer than men's.

An important factor in the purchase decision-making process is price, specifically, price in relation to the product's value [Schindler, 2012, p. 6]. It has been observed that many consumers are sensitive to price while making purchase decisions [Vicdan et al., 2007]. It is also assumed that perceptions of quality are positively correlated with price [Rao and Monroe, 1989]. In the past, there was a general assumption that PLs were for low-income households or those that needed to economize by buying bigger sizes [Lincoln and Thomassen, 2008, p. 25]. Nowadays, it is rather considered smart shopping to purchase PL products of supposedly comparable quality for a much lower price [Kumar and Steenkamp, 2007, p. 12]. PL brands have become increasingly essential in the marketplace, since they have come to represent better selection, value, and savings for many consumers [Wu, 2016, p. 3]. Because price is a differentiating characteristic, allowing for distinguishing between PL brands (despite the similar price), its influence is also studied [Santos et al., 2016].

H2. The price knowledge will not affect the subjects' private-label products' purchase decision within particular retailers.

This hypothesis is verified by comparing the choices measured on the Juster scale in the 2 parts of the research (products projected without and with the product market price).

According to Smith [2014], price is not the only decisive factor in the customers' purchasing decisions. Identifying the motives that underlie a buying decision is sometimes quite easy, but at other times, it may be impossible. Buying motives can be grouped into 3 levels: conscious, preconscious, and latent, depending on the buyer's awareness of them and willingness to divulge them. At the third, latent level, customers cannot explain the factors motivating their buying actions because these are unconscious or subconscious motives [Cant et al., 2009, p. 77]. To further complicate the situation, a purchase is often a result of multiple reasons (even in conflict with another). Implicit attitude measures are valid predictors of behavior across very different domains, including person perception, nonverbal behaviors, and consumer choices [Greenwald et al., 2009]. Therefore, it is proposed the following:

H3. Young customers' behavior in the process of buying private-label products of distributive networks can be highly affected not only by declared, but also by latent, factors.

Indirect measurement was used to detect implicit factors determining customers' attitude toward private labels (respondent's task was to watch and evaluate different products).

3 Procedure

A 10 (Product Category) × 6 (Brand) × 2 (Variant) within-subjects design was used. As the majority of consumer studies on PLs focus on the food market [i.e., Marques dos Santos et al., 2016], both food products and body care products were taken into consideration in order to look for potential differences in purchase decision-making. Seven food product categories (chips, chocolate, biscuits, cornflakes, jam, milk, and juice) and 3 hygiene-related products (tissues, toilet paper, and liquid soap) were selected for the research. For each product category, 6 products were chosen from different retailers: Auchan, Biedronka, Lidl, Piotr i Paweł, Stokrotka, and Tesco. The selection of product categories was based on the product's similarity to branded products in terms of their potential attractiveness to the young customers and the everyday usage. The third factor included variants without showing the price and with normal price to control for the meaning of this factor. Products were displayed in random order, to minimize the risk of achieving the same scan path for each retailer's product combination.

During the experiment, the participant filled in a questionnaire on the computer where they rated each of the products on 2 dimensions. Perceived product esthetic appearance was rated on a 6-point scale, ranging from 1 (poor) to 6 (high). Perceived likelihood of buying the product was also rated, but using the Juster scale, ranging from 0 (not at all) to 11 (for sure).

Before the study itself, the participants were asked about prompted awareness of different PL brands (the name of which was not identical with the retailer's). The most popular ones were Biedronka's brands, bought by 10 participants. However, the respondents declared purchasing PL at least from 2 retailers.

Additionally, subjects made an evaluation of the retailers' service quality based on the following aspects: 1 – price/quality ratio, 2 – friendly service, 3 – vast offer, 4 – organized merchandise spacing, 5 – efficient cashier's service, 6 – nice atmosphere, 7 – store reputation, and 8 – retailer image, in order to determine their preferences that lead toward the point of purchase. Cronbach's alpha[4] is considered to be a measure of scale reliability. The alpha coefficient for the 8 items was 0.863, suggesting that the items have relatively high internal consistency. Average notes for each retailer were quite approximate, and their ranges were between 31 and 34 points (only the Polish retailer Piotr i Paweł got a higher score – 38 points). Surprisingly, while analyzing notes given by individuals, one could notice huge discrepancies between the respondents (i.e., service quality in Auchan ranged between 16 and 48 points).

Subsequently, it was examined whether women and men may vary, depending on the following variables: age, income, PL familiarity, and combined service quality. The results revealed only 1 statistically significant variable differentiating females and males: only service quality assessment, and that too only in the case of 1 retailer, namely, Piotr i Paweł. Mann–Whitney *U*-test revealed that women evaluated service quality significantly higher (median = 40) than men (median = 35), $U = 10$, $p<0.05$.

4 Findings

In the ET study, there was a hypothesis (H1) predicting that women's total fixation time within particular product categories are longer than men's, due to their sensitivity to esthetics. Because the assumption of the normality of data was not met, a nonparametric version of the test was used. There were no statistically significant differences in women's and men's total fixation time within food and hygiene product categories in the 2 research parts ($p<0.05$). Even when the significance threshold was 0.1, there were no differences between female and male total fixation times spent viewing and evaluating product esthetics in both categories (Table 1). Therefore, Hypothesis 1 was negatively verified. Hypothesis 2 from EEG research suggested that knowledge of the PL products' price will not affect the subjects' PL products purchase decision. A small sample determined the choice of the Wilcoxon signed-rank test, which is a useful nonparametric alternative to the dependent samples *t*-test, used to make a comparison between 2 dependent groups. Dependence test analyses did not reveal a significant difference ($p<0.05$) between PL products without and with the market price for both product categories within particular retailers. Afterward, a frontal asymmetry index in alpha oscillation at F4–F3 was computed for each period using midfrontal sites. Positive alpha asymmetry scores indicate greater relative left than right frontal activity (either as a trait or a state, indicates a propensity to approach or engage a stimulus), while negative alpha asymmetry scores indicate greater relative right than left frontal activity (indicates a propensity to withdraw or disengage from a stimulus). This coefficient might not always be correlated with subjects' declarations; therefore, it was computed despite obtaining nonsignificant Juster scale results. The results did not reveal significant main effects ($p<0.05$) for both variants, within particular retailers and product categories (Table 2), which means that H2 was positively verified.

Finally, Hypothesis 3 predicted that young customers' behavior in terms of PL product assessment and willingness to buy them can be affected not only by declared factors (age, income, esthetic assessment, PL familiarity, and service quality) but also by implicit factors (frontal EEG alpha asymmetry) and esthetic sensitivity (measured by the eyetracker). Based on the results from the previous analysis, in this case also, results were averaged over both parts of the study. SPSS was used to calculate the Spearman's (rho) correlation coefficients between the explicit and implicit variables with the probability of a future PL purchase (on a Juster scale). Table 3 contains several variables that are statistically significant for each retailer (only in the case of Stokrotka brand, statistically significant results were not achieved at all, perhaps due to the declared unfamiliarity of the brand and its products).

4 Cronbach's alpha for each retailer was as follows: Auchan – 0.881; Piotr i Paweł – 0.814; Tesco – 0.808; Lidl 0.835; Biedronka 0.875; Stokrotka – no adequate data due to the retailer's unfamiliarity.

Table 1. Comparisons between genders in terms of total fixation time for both product categories (version with the price)

	A	B	L	S	P	T
Food products						
Mann–Whitney *U*	26.000	27.000	31.000	30.000	32.000	23.000
Wilcoxon *W*	62.000	63.000	67.000	66.000	68.000	59.000
Z	−0.630	−0.525	−0.105	−0.210	0.000	−0.954
Asymp. sig.[a]	0.529	0.600	0.916	0.834	1.000	0.345
Exact sig.[b]	0.574[b]	0.645[b]	0.959[b]	0.878[b]	1.000[b]	0.382[b]
Hygiene products						
Mann–Whitney *U*	25.000	30.000	26.000	21.000	32.000	26.500
Wilcoxon *W*	61.000	66.000	62.000	57.000	68.000	62.500
Z	−0.735	−0.210	−0.630	−1.155	0.000	−0.578
Asymp. sig.[a]	0.462	0.834	0.529	0.248	1.000	0.563
Exact sig.[b]	0.505[c]	0.878[c]	0.574[c]	0.279[c]	1.000[c]	0.574[c]

Notes: Grouping variable – gender, [a]2-tailed; [b]2*1-tailed sig.; [c]not corrected for ties. A – Auchan, B – Biedronka, L – Lidl, S – Stokrotka, P – Piotr i Paweł, and T – Tesco.

Abbreviations: Asymp. = asymptotic; sig. = significance.

Table 2. Comparing the price knowledge in terms of frontal alpha asymmetry measurement for both product categories

	A	B	L	S	P	T
Food products						
Z	−1.647[a]	−0.625[a]	−1.155[b]	−0.582[b]	−1.306[a]	−1.874[a]
Asymp. sig.*	0.100	0.532	0.125	0.394	0.191	0.061
Hygiene products						
Z	−1.533[b]	−0.144[b]	−0.966[a]	−1.420[b]	−0.057[a]	−0.852[b]
Asymp. sig.*	0.125	0.900	0.334	0.156	0.955	0.394

Notes: [a]Based on positive ranks; [b]based on negative ranks; *2-tailed.

Abbreviations: Asymp. = asymptotic; sig. = significance.

Table 3. Spearman correlations between private-label purchase probability and the categories explicit and implicit variables

		Explicit factors				Implicit factors			
Mean Q	**F/H**	**Age**	**Income**	**Esthetic assessment**	**PL familiarity**	**Service quality**	**Mean EEG – purchase probability assessment**	**Mean EEG – esthetics**	**Mean ET – esthetic sensitivity**
Auchan	F	**0.512**				**0.669**		−0.462	
	H			−0.441					
Biedronka	F			**0.741**			**0.544**		
	H				**0.559**				**0.440**
Lidl	F					**0.616**			
	H		**0.600**				**−0.572**		
Piotr i Paweł	F								
	H	−0.472							
Tesco	F								
	H							**0.680**	

Notes: Statistically significant (p<0.05) findings are in bold. For other results, p-value was <0.1.

Abbreviations: EEG = electroencephalography; ET = eyetracking; F = food; H = hygiene; PL = private label.

As predicted, the results revealed a significant main effect for the explicit and implicit variables, correlated with the predicting of purchase decision evaluated by the subjects. However, the unequivocal correlation cannot be definite, due to the fact that correlation is greatly dependent on the specific retailer, as well as on the product category. The purchase probability (measured on a Juster scale) was statistically significantly correlated at least with every variable for at least 1 retailer. For a significance level of 0.05, the purchase probability was moderately correlated with almost every implicit and explicit variable, except for the esthetics assessment for food from Biedronka (a strong correlation). Tesco's food product purchase probability intent was not significantly associated with any explicit variables, as were the Piotr i Paweł's hygiene products with any implicit variables.

Basically, the majority of foodstuffs' correlations were positive (except for esthetics' frontal alpha asymmetry for Auchan). Such regularity was not observed in the case of hygiene products. Moreover, for 2 retailers, some correlations were positive, while for others, negative. In case of Lidl hygiene products, purchase probability was positively correlated with the participant income, whereas negatively with the frontal alpha asymmetry (for product esthetics). In addition, in the case of Auchan, correlation coefficients were positive between PL purchase probability and the factors age and service quality; the coefficients were negative for esthetics (frontal alpha asymmetry).

Nine out of 13 correlations were positive, and this constitutes a logical relationship. The better the perception of PL products, the more willing are the participants to buy this type of goods. PL purchase probability tends to increase with age and income (people have their own money and gain buyers' experience). It is worth looking for answers and explanations for the negative correlations. There was a negative moderate association between probable purchase decision and the declared esthetics assessment for Auchan hygiene products (p<0.1). This relationship would lack any entrepreneurial or economic logic. The increasing esthetics mark being connected with decreasing purchase probability decision is difficult to interpret, and further investigations should be carried out to clarify that relationship. Subjects did not declare the acquisition of Auchans's hygiene products, therefore such articles were unknown. It may be assumed that the commitment to the branded products from that category may have a huge impact on their unconscious decisions. Moreover, it should be noted that mean esthetics assessment for Auchan hygiene products was the lowest among all retailers (only 1.60, on a scale from 1 to 6), just as the perceived likelihood of buying (3.19 on a Juster scale). A slightly different situation occurred in the negative correlation between hygiene PL probable purchase and the participant's age in the case of Piotr i Paweł products (p<0.1). Here, the relationship indicated that the likelihood of buying declines significantly as people get older. As consumers gain shopping experience and have increasing possession of financial resources, they may have higher expectations of PLs and decide to buy only branded products.

In case of the implicit variables' (frontal EEG asymmetry and ET fixations) correlations, 2 were negative and 3 were positive. Since alpha power is inversely related to cortical activity, positive alpha asymmetry scores reflect relatively greater left frontal cortical activity and negative alpha asymmetry scores reflect relatively greater right frontal cortical activity (Allen et al., 2004). For different retailers, different levels of correlation were obtained. Biedronka's food products purchase probability was positively correlated with frontal alpha asymmetry (p<0.05). In other words, the relatively greater the left frontal activation experienced (higher approach motivation when seeing an image of a product), the more likely the participant was to purchase a product. However, in the case of Lidl's hygiene products, the purchase probability were negatively correlated with frontal EEG asymmetry scores, meaning that there was negative or withdrawal-related motivation, connected with an increasing likelihood of consumer purchase decision. An analogous situation arises from the esthetics frontal EEG asymmetry scores (p<0.1) for Auchan's foodstuff purchase probability. These results are not in line with logic and are difficult to interpret; therefore, they require further investigation. For Tesco's hygiene products, purchase probability was positively correlated (p<0.1) with frontal asymmetry for products' esthetics, indicating an approach motivation.

The fixation duration was positively associated with an affirmative purchase decision. Such a relation for Biedronka's hygiene products (p<0.1) means that the longer the participants maintain the gaze in a constant direction (the longer the total fixation time), the greater is the likelihood of buying PL products. It is possible that the longer the respondents view the products, the more attractive they seem, and that enhances purchase opportunities.

5 Discussion

Based on the conducted NM research, it appears that consumers are influenced by a number of different factors when making a PL assessment and declaring the PL purchase probability. In the present investigation, the author examined (a) how the gender of a young customer determines the level of sensitivity toward esthetical aspects in terms of implicit attitude toward PLs, (b) whether a relatively low price of PL does not matter during PL purchase decision-making, and (c) the explicit and implicit factors determining young customers' probable behavior in the process of buying PL products of distributive networks. All the hypotheses except for H1 are accepted. As opposed to the H1 expectation, gender differences do not exist in consumers' PL product esthetics assessment within food and hygiene product categories in the 2 research parts (p<0.05). In agreement with H2, the knowledge of the PL products' price does not affect the subjects' PL product purchase decision. To test H3, Spearman's (rho) correlation coefficients were calculated between perceived purchase probability and the implicit as well as explicit variables. As predicted, the results revealed a significant main effect for explicit and implicit variables, correlated with the predicting of purchase decision as evaluated by the subjects. However, the unequivocal correlation cannot be definite, due to the fact that correlation is greatly dependent on the specific retailer, as well as on the product category. The present data set provides suggestive evidence that the influence of implicit affect on consumers' PL assessment and purchase probability is different. Cuneo et al. [2012, p. 961] propose that PL brand equity is built individually; therefore, treating PLs as 1 single composite of brands should be avoided in future studies. Considering the discrepancies, further research is suggested to understand consumers' behavior. Brown et al. [2012, p. 9] recommend the neuroscience techniques, due to their usefulness in marketing themes application, since they can reveal the true thoughts and emotions of the participants.

6 Conclusions

According to Khushaba et al. [2013, p. 3803] the application of neuroscience methods to analyze and understand human behavior has recently gained research attention. NM can increase the ability to access knowledge and aid in understanding how consumers behave and make decisions while accessing the unconscious thoughts, emotions, feelings, and desires that trigger the purchase decision. Apart from the contribution to the academic theory, the presented PL perceptions might result in relevant managerial implications for retailers and marketing professionals, especially in the field of product development and marketing communication. Measurement of spontaneous reactions of the respondents, based on numerical data, allows for the gathering of credible pieces of information regarding customers' perception of labels. Modern methods and technologies allow to "surpass declarations" included in the questionnaire and discover facts that are hidden from the researcher and the respondent [Ohme et al., 2011]. This suggests that at the current stage of development of brain wave analysis, it is possible to choose the best variant of logo and packaging exposition, describe reactions to images, point out elements that generate the strongest emotional involvement, and decide which version of the product encourages shopping activity. On the other hand, modern research methods allow for determining the areas that the customer is especially interested in (measurement of the level of noticeability and information gathering), as well as the level and time of intense customer concentration. The gathered data, based on the behavioral reactions of users, is objective, as it is not controlled by the user or manipulated by the environment. Combining the above-described methods will make it possible to gather more credible pieces of information than a traditional questionnaire research would. Furthermore, it will exclude the risk of gathering only the declared preferences of buyers, which do not affect their buying decision.

As with most studies, this research was also constrained by some limitations. It must be pointed out that due to the small sample size, transferability of the findings must be done with particular caution. The confinement to a relatively homogeneous group of undergraduate and graduate students participating in the experiments may limit the generalizability of the findings because age, education, and income might affect consumer purchase intentions of PL products [Richardson et al., 1996]. Furthermore, as alleged by

Jackson and Darrow [2005], young people are more susceptible to the influence of celebrity endorsements/recommendations, so this factor could be verified. Another limitation of the present study may be that some individuals had a preference for a particular product, so future research should expand the experiment to include additional demographic and socioeconomic segments and use different experimental products to increase the generalizability of the findings. Examination of differences in consumer perceptions of national vs. PL brands, such as the perceived authenticity gap, is another interesting future research track. According to Abril and Rodriguez-Cánovas [2016, p. 169], in the domain of PL brands, the phenomenon of brand equity is just emerging, and research on the topic is still scarce. There are only a few studies focusing on the manufacturer and PL brand equity comparison [e.g., Ravaja et al., 2013; Dawes and Nenycz-Thiel, 2013]. This research is limited to Poland and to the fast-moving consumer goods (FMCG) category. Future research should consider different countries and market differences in product categories.

Finally, due to the inverse relationship between (8–13 Hz) alpha power and cortical activity (decreased alpha power reflects increased engagement), the frontal asymmetry index can be also computed using the (13–25 Hz) beta or (> 30 Hz) gamma frequency bands to interpret with respect to the amount of motivation toward (approach) or away from (avoidance) a stimulus presentation [Imotions 2015]. Future research in the field of behavioral economics should also consider combining ET with advanced neuroscientific methodologies, such as EEG in combination with electrooculography (EOG), EMG, and galvanic skin response, to provide a full picture of human physiological cognitive activities, which may shed light on the state-of-the-art aspects in human decision-making [Sickmann and Le, 2016, p. 18].

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