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**Neural correlates for price involvement in purchase decisions with regards to fast-moving-  
consumer-goods**

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**Abstract**

Some customers are loyal to their favorite brands, others easily switch between them. A new technique is available to assess differences in brand related behavior. We assume that price and brand-conscious participants show nearly the same activations in emotionally associated brain areas. Price-conscious participants also show an activation of cognitive associated regions. We employed functional magnet resonance imaging during a preference judgment task for fast moving consumer goods. We discuss the results with differences in product and price specific involvement and advance that involvement of price-conscious participants is higher because of a higher price interest.

**Keywords:**

Neuro market research, Involvement, Price Interest, Reward Circuitry

## INTRODUCTION

Processes of purchase decisions undergo various phases of searching and processing of information, depending on the complexity of such decisions. The price and the brand of a product are two substantial factors which affect its purchase. Whereas brands are closely related to preference judgment, prices, on the other hand, have two functions: First, a consideration function (the sacrifice to get the product); second, they serve the function of an indicator for product quality (Obermiller 1988). However, not only brands are associated with emotional aspects (special favorite brands), prices also do have emotional characteristics. The cognitive behavioral theory stipulates that only through notional contention do emotions become consciously perceived. This refers particularly to prices, which mostly underlie evaluations (that is high or low price) (Schachter and Singer 1962). The extent to which the process of purchase decision runs through all phases depends on behavioral components, which could, in turn, be distinguished between activating (emotional, motivational) and cognitive (processing) components of behavior. Activation, in this context, is a necessary condition for attention which again sensitizes to take stimuli like brands and prices. A price related activating process is the individual price interest of consumers, which is, inter alia, determined by individual involvement (Diller 2000). Former studies had analyzed, that a higher price consciousness comes along with a decreased product involvement, personal involvement concerning prices, not necessarily products, should be increased. Therefore, if one defines the involvement construct as the extent of personal activation with regards to seeking, reception, and processing of information (Bloch 1981), then involvement would have an impact on decision making depending on individual perceived relevance based on inherent needs, values and interests. Concerning purchase behavior, it seems appropriate to dis-

tinguish between low and high involvement purchases (Zaichkowsky 1985). This distinction is based on the intensity of information seeking, the amplitude of information quantity, and the degree of activation (Bloch 1981).

Common purchase situations in terms of fast moving consumer goods (FMCG) were classified into low involvement purchases, due to low cognitive efforts and emotional or reactive guided behavior. Furthermore, the negative consequences associated to such purchases are not of a profound nature (Laurent and Kapferer 1985). According to this, habitual purchase decisions of FMCG should occur as a result of learned satisfaction with a product or brand and lead to stable preferences. Since preference judgments are in turn dependent on cognitive processes (Paulus and Frank 2003), consumers with a stable brand preference show a low level of involvement due to the fact that they need low cognitive processes as well as information. We thus assume that this would certainly hold true for brand-conscious persons because of their stable loyalty to certain brands which consequently influence their decision process.

In addition to widespread investigations concerning product specific involvement, this survey made use of the functional Magnetic Resonance Imaging (fMRI) in order to measure a new concept: Price involvement. We aim at demonstrate that price-conscious participants show higher involvement than brand-conscious participants. This is because of a higher price interest and this again, as mentioned above, depends on involvement. Thus, higher price interests should be consistent with higher price specific involvement and therefore higher measurable arousals in the brain. Furthermore, we assume arousals of reward circuitry for favorite chocolate brands in contrast to non-favorite ones (Erk et al. 2002; Schaefer, Heinze, and Rotte 2007) because one facet which correlates and enhances involvement is the “pleasure value” of a product, which is above average for chocolate (when compared for instance to champagne). Despite the fact that choco-

late is a low involvement product and possesses a weak „sign-value“, (Laurent and Kapferer 1985) reward areas had to be activated due to its pleasure-values. In addition, even routine purchase decisions (such as the purchase of a chocolate bar) must not be a low involvement decision, if consumers are aware of the differences between the various brands. (Mittal and Lee 1989)

Price-conscious participants may especially show higher arousals in reward area. This hypothesis relies on the fact that in some cases, even for low involvement product categories - where, due to low involvement levels, little price search and interest are expected-consumers spare no efforts to acquire products for lower prices. The satisfaction one would gain, if one acquires a favorite brand at a preferably low price should be higher for price-conscious persons. Therefore, they are expected to undertake a more extensive purchase decision, weighing prices in a bid to make the right purchase decision. Within the framework of this analysis, the goal shall be to find a cognitive area for price-involvement. This area becomes activated when a subject is shown his favorite brands, although in actual fact this rational area should show reduced activities (Schaefer et al. 2007). To this end, a distinction is made between various consumer behavior patterns: Price-conscious (rational area becomes activated when favorite brands were shown) versus brand-conscious (rational area remains deactivated when favorite brands were shown).

## MATERIALS AND METHOD

In order to accomplish the experimental task, we used chocolate brands as FMCG. They play a much greater role in general consumption, and it is much more harder to detect involvement without brain scans. Products bought with more limited or extensive purchases decisions (like cars, assurances) have inherent purchasing risks and high involvement factors. Those factors have to be excluded, in order to give price, as a varying parameter, more weight in purchase decision. A further reason for the use of FMCG in research has to do with their suitability for experimental analysis due to the fact that the purchasing intensity (purchases done per period) is appropriate in terms of the given knowledge of product and additionally, the price variations deliver immediate effects.

The self-assessment of the test persons served as a distinguishing variable in determining the group to which they belong: either price-conscious or brand-conscious. This self-assessment was obtained through a polling conducted prior to the fMRI analysis. Moreover, an approximately identical Relevant Set was determined for all the eleven test persons. The same pattern applied in the distinction between favorite and not-favorite brands.

### Respondents

Eleven healthy right handed individuals - six of which were male and five of which were female - participated in the present study (Age:  $M = 24.5$  years, ranging from 21 – 31 years,  $SD = 2,78$ ). The standard exclusion criteria for magnetic resonance examinations (metal implants) were ap-

plied. Due to the use of visual stimuli, participants with vision constraints were excluded. All test persons were recruited randomly via public announcement and they all provided a written agreement prior to the scanning. Information received from the self-assessment of the participants (whether they perceive themselves as price or brand-conscious individuals) served as a differentiating factor for the experimental splitting. All respondents were used for data analysis.

### **Experimental task: preference judgments, price simulation, fMRI**

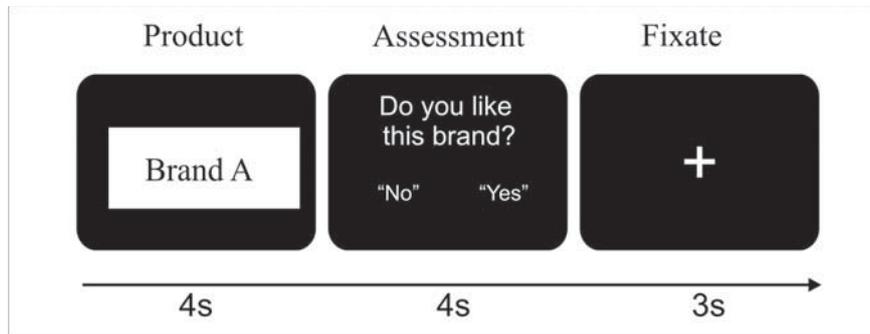
We began with a standard questionnaire which aimed to assess brand awareness, preference as well as the participants' favorite brands, all these arranged in Relevant Sets. Furthermore, the price mindfulness (whether the participants do place more weight on the price of chocolate or on its brand) as well as the frequency of purchase was inquired. To ensure, that participants understand this question clearly, we gave an example: What is more important to you: get your favorite brand independent of the fact, that the brand is maybe more expensive than you expect; or is the price more important to you, so brand is not as important as spending this amount of money that you planned to spend. After that, the respondents participated in a price game, based on the TESI price model (TPM), as well as a price awareness query using the Price-Sensitivity-Meter by van Westendorp. For this purpose, a brand set (containing 15 brands altogether) was presented to the participants from which they had to select the brands they knew and have once purchased (in order to constitute an individual Relevant Set,  $n \leq 15$ ). Of the remaining brands, a Choice-Set was created (that is all the brands that the subject is willing to buy in the test situation-at a maximum of five brands (Choice-Set,  $n \leq 5$ )). Thereafter participants were asked to rank all brands in the Choice-Set according to their individual scale of preference, taking into account that all

brands have the same cost. Subsequent to that, with the help of the Price-Sensitivity-Meter, a price range was calculated, within which the prices of the following price simulation will fluctuate in such a way that an individual price interrogation could be used for each test person. This method has the advantage that the consumers' difference in price perception would be taken into account and the fluctuations between minimum and maximum prices are not going to be identical for everybody. The price interrogation/inquiry will also help to ascertain consumers' willingness to pay in order to be able to place the given price in an ordinal scaled price category and make it comparable. The price interrogation/inquiry according to van Westendorp (1976), which we used for this purpose, is based on 4 central questions: At what price level would participants begin to perceive chocolate as cheap, as expensive, as too expensive (such that participants would consider not to buy it), and at least as too cheap (such that they get doubts about its quality).

A price simulation exercise followed in which brands were presented in a Choice-Set with random prices ranging from those thought of as being cheap and those thought of being expensive. The test persons were asked to select the brands which they would buy at a given price. This exercise covered several rounds and several purchase decisions.

The fMRI analysis began thereafter. In this process, participants were shown images of the 15 chocolate brands which they had previously appraised. We used a block-design composed of four blocks with duration of eleven minutes per block and break between two blocks. Every image lasted four seconds. After each picture, participants had to assess brands according to sympathy (whether they like the brand or not). Time for these preference judgments was four seconds. The procedure is shown in the following figure 1:

Fig 1: Experimental design



### Data acquisition and analysis

For fMRI data acquisition we used a 3 T Magnetom Trio Siemens scanner. T2\*-weighted functional MR images were obtained using axially oriented echo-planar imaging (repetition time (TR) = 1.5 sec, echo time (TE) = 30 msec, flip angle = 75°, 26 slices, 5 mm thickness, resolution 3.5 x 3.5 x 5 mm). The experiment consisted of four scanning sessions (functional runs) for each subject (duration: 11 min). Due to T1 equilibration effects, the first four volumes of each session were discarded. For anatomical reference, a high-resolution T1-weighted anatomical image was obtained (3D-SPGR, TR = 24 msec, TE = 8 msec). The visual stimuli were back-projected to a screen mounted on the head coil, allowing the participants to view the images through a mirror. To minimize artifacts resulting from head motion, a foam cushion was placed snugly around the side of the head.

Data preprocessing and statistical analysis were carried out using SPM5 (Statistical Parametric Mapping, Wellcome Institute of Cognitive Neurology, London, UK). All individual functional images were realigned, slice-time corrected, normalized into a standard anatomical space (resulting in isotropic 3 mm voxels) and smoothed with a Gaussian kernel of 6 mm (Friston et al. 1995). A low pass filter was used to remove high frequency noise (Gaussian kernel with 4.0 sec

full-width-at-half-maximum). A block-design model using a boxcar regressor convolved with the hemodynamic response was used to compare activity related to favorite brands vs. non favorite brands (random effects model, one-sample-t-Test). Only those regions were considered as active which contained a minimum of five contiguous voxels (thresholded at  $p < .001$ , uncorrected for multiple comparisons). Brand pictures were presented without direct rewards, so that activations in brain areas correlate with classical conditioning (Schaefer et al. 2007).

## RESULTS

### Behavioral results

Participants were asked to assess all 15 brands with regards to their brand likeability (likeable, dislikeable). The assessment of all eleven participants was approximately identical. For instance all participants found (both in the questionnaire and during the fMRI session) nearly the same brands as most likeable. The Choice-Set during the price simulation mostly comprehends three brands for all participants (except for three test persons). According to the face-to-face interview, Brand A was the chocolate brand most liked by almost all the test persons (eight out of eleven) and the point of sale were Supermarkets (ten out of eleven), implying that all participants should be having approximately the same price knowledge. This would not have been the case, if the point of sale had been gas stations or vending machines, since prices in this regard greatly differ. The most important criteria for choosing a specific brand were cost-performance ratio and quality. Average purchase frequency was one or two times a week. Also no gender specific differences in behavior were observed.

Selection variable for our two groups of participants was based on self assessment with regards to price or brand-consciousness. To verify the reliability of the participants' responses, we used another test. Price-consciousness or awareness is dependent on the ability to recall market prices (Gabor and Granger 1961; Monroe 1973). Therefore, we estimated that price-conscious participants would recall market prices better than brand-conscious participants. So in the questionnaire, we asked for the last bought brand and the price paid for it. Ten out of eleven participants

overestimated the last paid price (one exception: one self assessed price-conscious subject recalled the correct market price). But it turned out that brand-conscious participants showed higher over-assessment than price-conscious participants. Differences were derived through the subtraction of real market prices at the given time and the reported last paid price for the last bought brand following the formula below:

$$\Delta P_i = P_{lastbuy} - P_{MP} \quad (1)$$

with  $P_{lastbuy}$ : last paid price and  $P_{MP}$ : actual market price

and  $i$ :  $pc$  = price-conscious participant,  $bc$ = brand-conscious participant

The overall difference from the last paid price to the real market price for price-conscious participants was  $\Delta P_{pc} = €1.31$ , and  $\Delta P_{bc} = €4.29$  for brand-conscious participants. Thus, the latter showed a higher incorrect estimation than the former. The differences between both groups were significant (one-sided u-test,  $p = .06$ ) price-conscious participants recalled the last paid prices better (average misjudgment ( $M_{\Delta P_i}$ ): €0.26 for price-conscious participants compared to brand-conscious participants: €0.71).

In order to verify the reliability of the self assessed price-brand-consciousness, the observed price-brand-consciousness was brought into comparison with the last-paid price. The critical threshold should be the average price misjudgment ( $M_{\Delta P_i}$ ) which approximately was €0.50 (whereby: price-consciousness ( $M_{\Delta P_{pc}} = €0.26$ ) < €0.50 < brand-consciousness ( $M_{\Delta P_{bc}} = €0.71$ )).

This showed that self assessed classification did not hold for three participants. Two of them

were price-conscious instead of self assessed brand-conscious participants, in contrast to one brand-conscious subject. Because of the fact that the question contemplated just one brand with one price, we used a second questionnaire with more brands for which prices should be recalled. For one of the participants who, according to self assessment, fell under the price-conscious category, but whose answer for the last paid price query exposed him to be brand-conscious, there was an eventual confirmation that this was in actual fact a price-conscious subject. The misjudgment with regards to all the brands under scrutiny lay below the €0.50 threshold. Similar conclusions apply to the erroneous classification of the other two participants, but due to its marginal nature, one could assume a tendency to brand-consciousness. In conclusion, it could be advanced that the self-assessments, in approximate terms, are a reflection of the observed assessments and that the established groups would be maintained in the aforementioned composition for further inquiries.

### **Response times during fMRI session**

With regards to the response time of the participants during their assessment of all 15 brands as to which ones they like or dislike, assessing a brand as likeable (992 msec) took more time than assessing a brand as dislikeable (899 msec) (difference is significant Mann-Whitney U test,  $p = .000$ ). With a differentiated view, price-conscious participants needed 113 msec more to decide whether a brand is likeable than to decide whether it is dislikeable (significant, Mann-Whitney U test,  $p = .000$ ). The same holds true for brand-conscious participants: they needed an average of 59 msec more to decide whether a brand is likeable than to decide whether it is not likeable (not significant, Mann-Whitney U test,  $p = .34$ ). The price-conscious participants (their preference

notwithstanding), needed, in average, more time as compared to brand-conscious participants. The average time for price-conscious participants was 983 msec, and that for brand-conscious 939 msec. This difference is significant (due to non-normal distribution of the response times, we used the Mann-Whitney U test,  $p = .006$ ). Furthermore, price-conscious participants needed 74 msec more to classify a brand as likeable, than brand-conscious participants needed; and 19 msec longer to classify a brand as dislikeable. These differences between brand and price-consciousness participants are again significant (Mann-Whitney U test,  $p = .003$  for likable brands, but not for dislikeable brands Mann-Whitney U test,  $p = .41$ ).

Moreover, concerning the overall favorite Brand A, price-conscious participants needed more time to evaluate the likeability (price-consciousness: 953 msec; brand-consciousness: 872 msec, but not significant differences, Mann-Whitney U test,  $p = .253$ ).

### **Purchase simulation**

Within the TESI price model (TPM) (Erichson 2005; Erichson and Börtzler 1992) prices shown to the respondents were randomly generated by a computer for each subject. The relevant price range during the random process is based on the prior price query with the Price-Sensitivity-Meter. TPM provides individual purchase probabilities, which are functions of prices, thus, behavioral effects of price changes could be observed. The individual purchase probabilities depend upon prices and individual perceived utility of each brand. Based on this assumption, the choice of a brand ( $a$ ) of an individual ( $i$ ) is given only when the individual derived satisfaction of a brand ( $u_{ia}$ ) does exceed the price paid for this brand ( $p_a$ ). This net utility ( $v_{ia} = u_{ia} - p_a$ ) stipulates

the following principle: Choose those brands which maximize your net utility. The following applies in case of two competing brands (*a and b*):

$$\text{Choose } \text{MAX } G_{ia} [v_{ia}, v_{ib}] \quad \text{with } v_{ia} = u_{ia} - p_a \text{ and } v_{ib} = u_{ib} - p_b \quad (2)$$

$G_{ia}$  = Individual's total net utility (*i*) for brand (*a*):  $G_{ia} = (u_{ia} - u_{ib}) + (p_b - p_a)$

with:  $(u_{ia} - u_{ib})$  = utility advantage/ disadvantage of brand (*a*) and

$(p_b - p_a)$  = price advantage/ disadvantage of brand (*a*).

Purchase probabilities are drawn from the result of the difference between price and utility. A negative total net utility ( $G_{ia} < 0$ ) would lead to a less than 50% purchase probability. Due to the stochastic model formulation of the TPM, an individual's adhering principle in choice making between two brands could be concretized as follows:

$$\text{Prob}_i(a, b) = f(v_{ia} - v_{ib}) \text{ or } \text{Prob}_i(a, b) = f[(u_{ia} - u_{ib}) + (p_b - p_a)] \quad (3)$$

with  $\text{Prob}_i(a, b)$  as purchase probability of individual (*i*) for brand (*a*) in contrast to brand (*b*)

In order to derive the purchase probability of a brand vis-à-vis other brands, the stochastic formulated multinomial logit model shall be used as a basis as seen below. The exponential nature of the equation assures that the purchase probability remains within the limits of the acceptable  $[0; 1]$ .

$$prob_i(a) = \frac{1}{1 + \sum_{-a \neq a} e^{-\beta[(u_{ia} - u_{i-a}) + (p_{-a} - p_a)]}} \quad (4)$$

with  $a$  and  $-a \in A_i$ , whereby  $A_i = \text{Choice-Set}$

Following equation (4), the purchase probability  $prob_i(a)$  of brand ( $a$ ) by person ( $i$ ) subject to the accumulated total net utility of the brand ( $a$ ) compared to all other brands ( $-a$ ) (with  $-a \in A_i$ ).

The constant  $e$  (Euler's constant) and the brand price are given. The utility value of the brands for the person ( $u_{ia}$ ,  $u_{ib}$ ) as well as the  $\beta$ - value  $[0; \infty]$  are to be estimated, whereby the latter could be seen as a measure of the individual degree of rationality for each subject. Where  $\beta$  increases person's decision behavior would get more deterministic ( $\beta = \infty$ , deterministic choice). The brand which allows for the biggest utility, that is maximizing the difference ( $u_{ia} - p_a$ ), would therefore be given the purchasing probability 1. Should  $\beta$  on the contrary be near zero, price and utility contemplation cease to play any relevant role in decision making ( $\beta = 0$ , random choice). Due to this, the purchase probability of all brands becomes equal. Equation (4) will be optimized in an iterative way in the next steps with the help of the maximum likelihood estimation (ML). Using ML the unknown parameter ( $u_{ia}$ ,  $u_{ib}$ ,  $\beta_i$ ) would be estimated in such a way that the given prices  $p$ , unobserved purchase probability, comes as close as possible to the observed purchase decision ( $d_{ika}$ ), see equation (5) (Erichson and Börtzler 1992).

$$Z_i = \sum_{k=1}^{K_i} \sum_{a \in A_i} d_{ika} \cdot \log[prob_i(a)] \xrightarrow{!} Max \quad (5)$$

with:  $d_{ika}$  = dummy variable  $\begin{cases} 1, & \text{if subject } i \text{ chooses brand } a \text{ in situation } k \\ 0 & \text{else} \end{cases}$

$A_i$  = Set of brands, which were chosen at least one time by subject  $i$

$K_i$  = Quantity of purchase situations of subject  $i$

A Newton-Raphson-Algorithm is used for the maximization of the log-likelihood-function (Erichson and Börtzler 1992). The results of the calculation are ultimately rationality parameter on an individual basis for each person as well as the purchase probability and the utility value of the brands (Erichson 2005). In order to strengthen the significance of the estimated utility value of the brands, they would have to be shifted to the accepted maximum price and in so doing an utility value would be calculated in monetary terms.

$$\hat{u}_j = u_j + \max_j(p_j^{\max} - u_j) \quad (6)$$

Concerning monetary utility values, we derived that brand-conscious participants have higher values and all calculated values were considerably over real market prices. This is one indicator for brand strength and approves the result derived by Esch et al. (2007): Brand strength differs among brands, that is empirically Brand A is seen as a strong brand, Brand C as a weak one. In our small population we obtain strong and weak brands: Brand A has a stronger brand strength than Brand C. Since differences between average monetary values (prices which respondents would pay for the brand) and real market prices are greater for Brand A than for Brand C, figure 1 below shows the appropriate values:

Fig 2: Monetary utility values

Brand	Monetary utility values $\hat{u}_j$ [11 respondents, 6 brand-consciousness participants, five price-consciousness participants, self assessed]		Average monetary utility values $\hat{u}_j$ [11 participants]	Market price per brand
	Brand-consciousness	Price-consciousness		
Brand A	1.60	1.26	1.45	0.56
Brand B	1.24	0.90	1.43	0.69
Brand C	0.78	0.50	0.84	0.35
Brand D*	1.73	1.82	1.80	1.36
Brand E*	2.15	1.26	1.47	0.65

Quoted in Euro, \* insufficient ratings and bias

Significant differences concerning the  $\beta$ -parameter could not be derived for the respondents (one sided u-test:  $p = .22$ , NS).

Another test, seeking to know whether the cheapest chocolate brand during the price simulation was chosen or not, revealed that brand-conscious participants tend to choose more often expensive brands (at an average of seven times) from the Choice-Set contrary to price-conscious participants (at an average of four times). While price-conscious respondents frequently switched between brands, brand-conscious participants remained loyal to one brand until this brand was deemed too expensive. Only then they switch to another brand whereby the newly selected brand was not necessarily the cheapest one. However, this difference was not significant (one-sided u-test:  $p = .12$ , NS). The brands which were mostly chosen were Brand A and Brand B despite the fact that the Choice-Set contained even cheaper brands. This holds particularly true for brand-conscious respondents. This result could already be seen as following the high utility values in monetary terms.

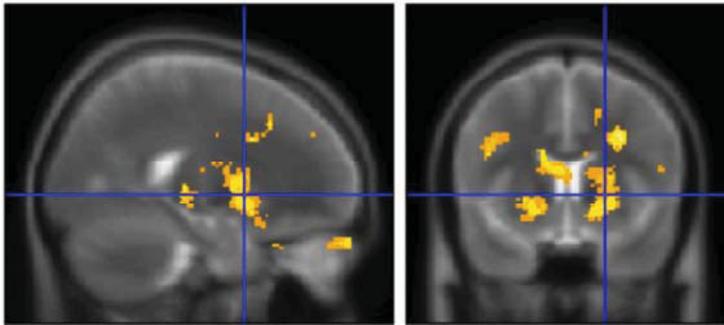
Direct price enquiry based on Price-Sensitivity-Meter revealed the following results: average maximum accepted price (expensive price) is higher for brand-conscious participants (brand-consciousness: €1.65, price-consciousness: €1.53), this also applies to the average accepted minimum price (cheap price) (brand-consciousness: €0.71, price-consciousness: €0.54). Thus, price ranges are marginally smaller for brand-conscious (€0.94) than for price-conscious respondents (€0.99). Too cheap prices which cause participants get doubts concerning the quality are eight cents higher for brand-conscious respondents (brand-consciousness: €0.43, price-consciousness: €0.35).

In conclusion it could be seen, in regards to price, that price-conscious consumers have a broadly acceptable price range but this lies nonetheless beneath that of the brand-conscious consumers and they better orientate themselves to actual market prices. The monetary utility value could already be shown. The results could be traced back to the better market price knowledge of the price-conscious participants in the product category. Assuming an equal product involvement, some kind of individual price involvement would seem to exist here.

### **fMRI results**

The first hypothesis, which stipulates that favorite chocolate brands activate the reward area, was tested with a random effect model and two contrasts: all eleven participants assessed like versus dislike brands and dislike versus like brands. The results show that there are significant arousals in reward circuitry, especially striatum/putamen ( $p < .005$ ). Results are shown in figure 2.

Fig. 3: Overall activation of assessed like versus dislike brands



Contrast: like > dislike brands,  $t = 3.11$ , [ $x = 22$ ;  $y = 8$ ;  $z = 0$ ], ventral striatum (putamen)

To identify regional differences of activations between price and brand-conscious respondents, we also used a random effect model (one-sample-t-test) with contrasts: price versus brand-consciousness and brand versus price-consciousness. The results of the one-sample t-test revealed a strong difference concerning arousals. Price-conscious respondents had higher all over arousals, significant for the dorsolateral prefrontal cortex, striatum, insular cortex, and medial prefrontal cortex. Contrasts for brand vs. price-conscious respondents revealed differences of significance for voxels thresholded at  $p < .001$  (uncorrected for multiple comparisons). Results are listed below:

Fig. 4: Activations for the contrast price versus brand-conscious respondents for like brands

Description	$x$	$y$	$z$	$p_{uncorr}$	$t$ -values (voxel)
dIPFC	-36	38	48	.001	10.52
Striatum	22	-10	20	.001	10.93
Insular cortex	42	64	26	.001	6.40
mPFC/ superior frontal gyrus	12	56	40	.001	6.3481

Activations in the striatum could be interpreted as reward (Schaefer et al. 2007; Knutson et al. 2007). Price-conscious participants get a higher reward while watching their favorite brands in contrast to brand-conscious participants. This is, initially, confusing but then, understandable within the context of the involvement construct. Price-conscious participants weighed prices stronger because of a higher interest while evaluating products. Therefore, if a price-conscious subject can get his favorite brand for a low or adequate price, then this price effect is also some kind of reward and thus, the price effect and the brand effect result in a stronger activation than solely a brand for brand-conscious participants.

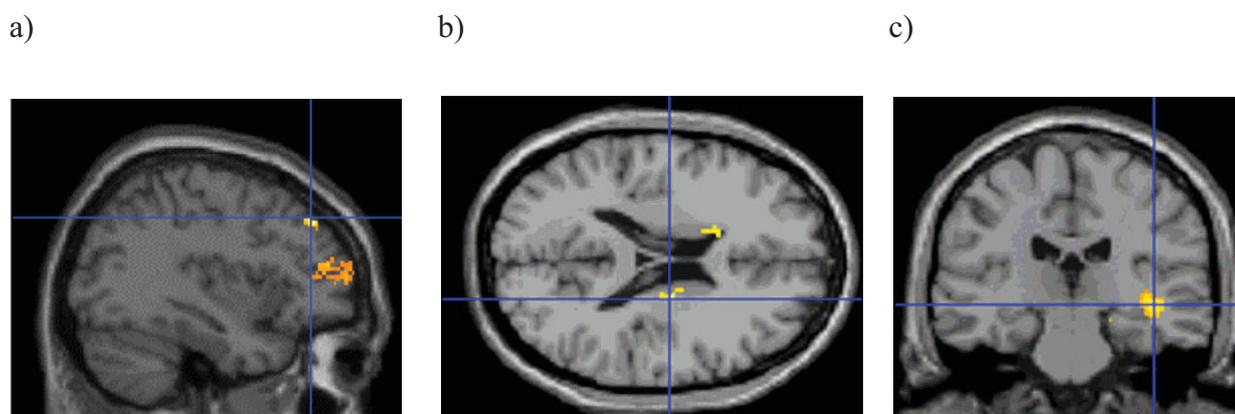
Activations in medial prefrontal cortex (mPFC) are connected to emotionally based preferences. Furthermore, this region is correlated with the perception of price reduction and an area for losses and gains (Knutson et al. 2007). We assume that price-conscious respondents show a higher activation in this region, because of comparing gains (utility of the brand) and losses (price to pay) and a mental accounting between both. More explicitly, activations in superior frontal gyrus are critical within preference judgments. As part of the ventromedial prefrontal cortex (vmPFC) there is a correlation with somatic marker theory of Damasio (1994) and corresponds therefore with competitive bearings of appetitive (like) and aversive (dislike) stimuli in case of preference judgments. Thus, if price-conscious respondents show higher arousals in this region, we hypothesize that they weigh preferences stronger for like-brands against those for dislike-brands because, due to higher price interest, not only brands play a vital role in this constellation. To this end, questions arise if the respondents anticipated quality for the paid price. If this was not true in the past, this is responsible for bad experiences, connected to aversive somatic markers. Again, prefrontal cortex (PFC) is correlated with control of participants' behavior and centre of the human control system (Paulus and Frank 2003; Ridderinkhof, Nieuwenhuis,

and Braver 2007). Furthermore, prefrontal cortex is an indicator for individual processing of framing-effects; hence brand changes assessment and perception of products (Deppe et al. 2005). Price-conscious participants show higher activations in the dorsolateral prefrontal cortex (dlPFC) than brand-conscious participants. Following the fact that favorite brands lead to a deactivation of the dlPFC and therefore reduce strategic assessments and cognitive control (Schaefer et al. 2007), activation for price-conscious participants show higher control mechanisms especially while evaluating favorite brands. Functionally, this area is correlated with target achievements and realization control (Kenning and Plassmann 2005).

Following Knutson et al.(2007) and King-Casas et al. (2005), activations in the insular cortex were associated with anticipated losses and excessive prices. Price-conscious respondents show higher arousals in this region. This was anticipated, because they recalled prices better and could therefore much better anticipate monetary losses by buying an expensive brand than brand-conscious respondents.

Significant voxels for the second contrast (brand vs. price-conscious participants) showed higher activations in the frontal medial cingulated gyrus for brand-conscious participants, but not significantly thresholded at  $p < .05$ .

Fig. 5: Statistical parametric mapping



a) dorsolateral prefrontal cortex/ medial prefrontal cortex, b) striatum and c) insular cortex; Contrast: price>brand,  $p < 0,001$ , extent threshold 20 voxels, radius 6 mm, SVC

To summarize the results, price-conscious participants show significantly higher arousals while watching favorite brands compared to brand-conscious participants. It could be shown that although prices were not available during the scans, price-conscious participants demonstrated a high activation in several brain areas associated with emotional and cognitive functions. The major difference between both groups—brand and price-conscious respondents—was an activation in loss anticipating areas for price-conscious respondents. All respondents showed activations in the reward area: Brand-conscious participants showed a less high activation because of stable preferences and therefore due to reduced involvement, a weaker activation in the reward circuitry.

## DISCUSSION

We found differences in brain activations comparing brand-conscious and price-conscious participants.

The only difference between the respondents in both groups was their individual price or brand-consciousness (self assessed and due to market price knowledge). Neither the size of their Relevant-Set or Choice-Set nor their favorite brands, nor their payment reserves varied significantly. Furthermore, all respondents were undergraduate economic students in the same age group. Therefore, only awareness and weighing of prices served as discriminating variable and could be seen as the reason for these differences in the brain activation.

For all respondents, the reward area was significantly activated for the favorite brands (likeable brands). But inter-group comparisons showed that price-conscious participants demonstrated higher arousals for this, and also other, region(s) compared to brand-conscious participants. Since price-consciousness is independent of the product involvement level according to Zaichowsky (1988), both groups could be equally involved with the product category of chocolate bars. Therefore, as a consequence for both groups, significant arousals in reward circuitry could be measured (ventral striatum, more precisely the putamen). This is especially interesting, because all previous studies showing a similar activation for favored brands have used high involvement products like cars (Erk et al 2002; Schaefer et al. 2007). Our study shows that favored brands lead to similar neurological activations also for fast moving consumer goods such as chocolate. But in addition, price-conscious participants showed overall higher arousals. Beside activations in the reward area (striatum) also arousals in areas associated with cognitive control (dlPFC, mPFC ) and loss anticipation (insula).

Due to the fact that prices were not shown during the fMRI sessions, we could assume that price-conscious participants combined the shown brands with known prices. This leads to additional and stronger neuronal activations and, due to weighing up prices and brands, longer response times while assessing a brand as like or dislike was needed. Stronger emotional activation of the reward circuitry could be traced to higher perception of utility, which is caused not only by a favorite brand but also by a recollection of an accepted price. Prices as earlier mentioned, therefore have an emotional character. To this extent, price-conscious participants anticipated losses as consequence of a 'mispurchase' (activations in insular cortex and dlPFC) precisely because of recalling prices and integrating them in the decision and evaluation of brands. We presume that price-conscious participants have a long enduring price involvement concerning a specific product category. The presumption of the long-term nature should be made, because situational involvement only applies for the time in which the (purchase) decision is made and particularly risks, that is perceived risks in purchase situations, exist (Bloch 1981). Test persons were however not in a purchase situation and the price enquiry did not take place during the fMRI-Session. The last paid prices were requested without establishing a purchase situation. This also applies to price simulation where the choice of brands had to be conducted without remuneration. To this end, future research should examine the resulting effects when prices are also shown during the fMRI-scans and respondents should also make real time purchase decisions with money.

The results suggest that stronger activations for price-conscious participants could be traced back to the higher involvement level due to stronger price interest for a product category. So, this could be one explanation for the observed strong price interest for specific FMCG (as low involvement products) even though low price interest was expected. The observation holds true for price-conscious people. They recall market prices better and show a higher enduring price in-

involvement in a specific product category. Various studies had shown, that some consumers are intrinsically more interested in comparing prices and brands in shops (Mägi 2003). Moreover, the price recall accuracy is better for those people who use prices primarily for their purchase decisions (Wakefield and Inman 1993). We assume, that this would, in turn, lead to a stronger rational weighing of prices during purchase decisions and would as such lead to more intense cognitive efforts, even in regards to favorite brands.

The price simulation results had depicted similar findings. Price-conscious persons often choose the cheapest among their favorite brands, while brand-conscious most often choose the more expensive brands, notwithstanding the availability of likeable but cheap brands.

An evaluation of their decision pattern, that is what method they use to select the brands, reveals that they have quite strong structures of preference, as they oftentimes chose the most expensive brands despite the availability of even cheaper and likeable brands. This stable preference pattern, as earlier mentioned, has the effect of reducing the level of involvement as well as intense cognitive efforts during decision making.

## CONCLUSION

This study set out with the aim to test the hypothesis that price involvement and corresponding neural activations depend on the price or brand-consciousness of individuals. To this end, the fMRI was put to use during a preference judgment task. The results lead to the conclusion that price-conscious persons recall market prices better than brand-conscious persons. Activations in dlPFC and insular cortex of the price-conscious participants correlated with higher cognitive efforts (this could also be seen in longer response times while making preference judgments). In addition, higher activations in the reward circuitry (striatum, mPFC) leads to the assumption that not only the brand, but also a corresponding fair price is correlated with areas of the brain associated with emotional functions.

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