

CHAPTER 17

Neuroeconomics: in search of the neural representation of brands

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Abstract: In modern economy the customer is confronted with a huge amount of consumer goods. In this situation, culturally based brands seem to play an important role in establishing strong emotional bonds between customers and goods and to guide people's economic behavior by biasing selections and preference decisions based on affect. Recently, neuroscientific approaches have demonstrated that cultural objects like brands or brand-related behavior may successfully be investigated with neuroimaging tools like fMRI. First studies suggested that structures associated with the reward circuit (striatum) and the dorsolateral part of the prefrontal cortex may be involved when perceiving a favorite brand. Hence, brands that have been associated with appetitive stimuli due to marketing efforts or cultural factors seem to engage similar brain networks than artificially associated reward stimuli. However, brands have different and complex meanings in our life far beyond representing objects of desire. For example, the possession of goods from certain kinds of brands often is used to mark the social state of the owner and to distinguish him or her from other groups. In particular, luxury goods often seem to have this function. Recent neuroimaging results support this observation by showing that viewing logos of luxury brands is associated with brain activity in the anterior medial prefrontal cortex, a region known to be associated with self-centered cognitions. Thus, it seems that brands of luxury goods improve self-relevant thoughts, pointing to the role of luxury brands to mark the superior position of the owner in society. These results demonstrate that cultural symbols like brands can successfully be examined with neuroimaging approaches. Thus, along with advanced cultural theories, neuroeconomics may provide important contributions to the understanding of brand-related or economic behavior.

Keywords: cultural objects; prefrontal cortex; brands; fMRI

Introduction: brands as cultural symbols

In 1998, the car manufacturers BMW as well as Volkswagen aimed to buy the "Rolls-Royce/Bentley" company. The struggle went on for

several months. Finally, Volkswagen managed to buy the brand "Bentley" and the factory of "Rolls-Royce/Bentley" in England. In contrast, BMW only received the rights to use the brand "Rolls-Royce" for about 50 mio euros — without any factories or other material counterpart. However, despite this huge price, experts treated the BMW group as the winner of this deal because they could use the famous brand "Rolls-Royce," whereas Volkswagen received the less value

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brand “Bentley” and some older factories. So why do companies pay so much money just for the right to use a name and a logo, even if everybody knows that the owner of the brand has changed? What is going on in our brains when we see a popular brand?

Brands can be defined as culture-based symbols, which promise certain advantages of a consumer good to the customer. This implies that brands may have different meanings or brand images for different cultures. A different culture does not necessarily mean a different country. Hence, brands even may have different meanings for certain groups in society. For example, clothes of a brand that symbolizes value products for adult people often have completely different connotations for young people. Furthermore, sometimes the image of a brand is not fixed but changes over time. Thus, the meaning of a brand may change very dynamically over time and subjects. The main reason for this seems to be that brands are prone to cultural factors like fashion or marketing campaigns. Therefore, we describe brands here as complex cultural symbols. However, it still remains an issue how brands affect people’s choices.

Investigating brand-related behavior with neuroimaging tools

Brands seem to play an important role in establishing strong emotional bonds between customers and consumer goods and guide people’s economic behavior by biasing selections and preference decisions based on affect. Marketing experts use highly sophisticated tools to assess subjects’ attitudes toward certain brands and obtain information about the image of a brand. In spite of those efforts, these analyses often fail to predict the success of brand products.

Only recently, neuroscientific approaches have demonstrated that cultural objects like brands or brand-related behavior may be also successfully investigated with neuroimaging tools. In particular, functional magnetic resonance imaging (fMRI) seems to be a powerful tool to understand what happens in the brain when we see a famous

brand. Furthermore, other techniques like positron emission tomography (PET, Smith et al., 2002), electroencephalography (EEG, Astolfi et al., 2008), or magnetoencephalography (MEG, Ambler et al., 2004; Braeutigam et al., 2004) have also been used to examine economic behavior or neural representations of brands.

Most studies using imaging tools examined economic behavior of subjects under different circumstances. For example, many approaches focused on neural correlates for economic decision processes in social interaction experiments, such as the prisoners’ dilemma or the ultimatum game (e.g., Rilling et al., 2002; Sanfey et al., 2003). Other studies investigated trust in economic interpersonal relationships (McCabe et al., 2001; Fehr and Gächter, 2002; Delgado et al., 2005; King-Casas et al., 2005; Kosfeld et al., 2005; Moll et al., 2006).

In one of the first fMRI-studies on cultural objects, Erk et al. (2002) revealed that cultural objects associated with wealth and social dominance modulate the neural reward circuitry. In this study, they examined brain responses to different types of cars and demonstrated that structures of the reward circuit are involved when viewing pictures of sports cars in contrast to pictures of small cars or limousines. The authors considered cultural objects like sports cars as social reinforcers, signaling wealth and social dominance. However, the study focused on global pictures of different car types. Thus, they eliminated all brand information of the objects. Hence, rather than specific brands, the design or the shape of generic sports cars seemed to activate the reward circuit.

So far, only few studies explicitly examined brain responses to the perception of different kinds of brands (e.g., McClure et al., 2004; Schaefer et al., 2006; Schaefer and Rotte, 2007a, b; Koeneke et al., 2008). This review will focus on studies examining the representation of brands or brand-related behavior in the brain.

Brands as somatic markers

It seems reasonable to assume that the prefrontal cortex plays a crucial role when preference

decisions are biased by brand information. In his somatic marker hypothesis, Damasio suggested that external or internal stimuli initiate a state that is associated with pleasurable or aversive somatic markers (Bechara et al., 1994; Damasio, 1994, 1996). Somatic markers might be crucial for decision-making even when there is no advantage or disadvantage associated with the response alternatives. Thus, these markers may function to guide the person's behavior by biasing selections. The role of the ventromedial prefrontal cortex (VMPFC) seems to be crucial for this theory because this area stores information about past rewards and punishments (Damasio, 1996). By demonstrating dense interactions with limbic structures in a variety of behavioral contexts this theory has gained much support (Price et al., 1996; Greene et al., 2001; Wagar and Thagard, 2004). In particular, many studies were able to link the VMPFC to reward expectations (e.g., Watanabe, 1996; Knutson et al., 2003; O'Doherty et al., 2003; Paulus and Frank, 2003; Knutson and Cooper, 2005; Kable and Glimcher, 2007).

We hypothesized that brands may function as those kinds of external stimuli that initiate a state with pleasurable or aversive somatic markers (Schaefer et al., 2006). Thus, brands might act as somatic markers, working as unconscious hunches that spontaneously and fast influence subjects' attitudes even before subjects are asked to perform a preference judgment task. We further hypothesized that areas in the prefrontal cortex are involved in generating somatic markers and are activated by familiar brands. To test this hypothesis, we conducted an fMRI study (Schaefer et al., 2006). During fMRI scanning, we showed the participants different logos of brands of car manufacturers that were either well known or unfamiliar to the culture of the subject. Since somatic markers should be active before considering possible advantages or disadvantages of a decision, we did not create a forced-choice paradigm in which subjects have to decide for one product in favor of another. Instead we instructed subjects to imagine driving a car of the presented brand. If they did not know a brand, they were told to imagine driving a generic car. Since somatic markers are working as unconscious hunches, we expected the activation of these

markers spontaneously and fast. Based on the theory of Damasio, we hypothesized an activation of the VMPFC when seeing a strong familiar brand. This would support the view that the way brands affect our behavior might be described with the idea of somatic markers.

However, the results showed activation of a region in the anterior medial prefrontal cortex (AMPFC), but failed to show any activation in the VMPFC (Fig. 1). We discussed the results as self-relevant processing induced by the imagined use of cars of familiar brands (see below). Furthermore, other and subsequent studies also did not report activation in the VMPFC when subjects perceived brands (McClure et al., 2004; Schaefer and Rotte, 2007a, b).

For example, in one of the first important studies that explicitly focused on the impact of specific brands on cortical processing, McClure et al. (2004) also used an fMRI approach. The authors reported neural correlates for culturally familiar drinks and suggested two separate brain systems involved in generating preferences. On one hand, activity in the VMPFC predicted people's preferences when judgment decisions were solely based on sensory information, for example, the taste of a favorite drink. On the other hand, a circuitry including dorsolateral prefrontal cortex (DLPFC), hippocampi, and midbrain was engaged when subjects' preference judgments were based on brand information. Thus, preference judgments may be biased by two separate neural networks, based on either sensory or cultural information. The authors suggested that the DLPFC may interact with the ventromedial region of the prefrontal cortex, but it remained unclear how both networks might interact in detail.

Nevertheless, further studies are required to understand the function of the VMPFC for brand-related behavior and the appropriateness of the somatic marker theory for the understanding of how brands affect our behavior.

Neural representation of favorite brands

Since brands can be described as cultural symbols, the effect of a single brand on subjects differs with

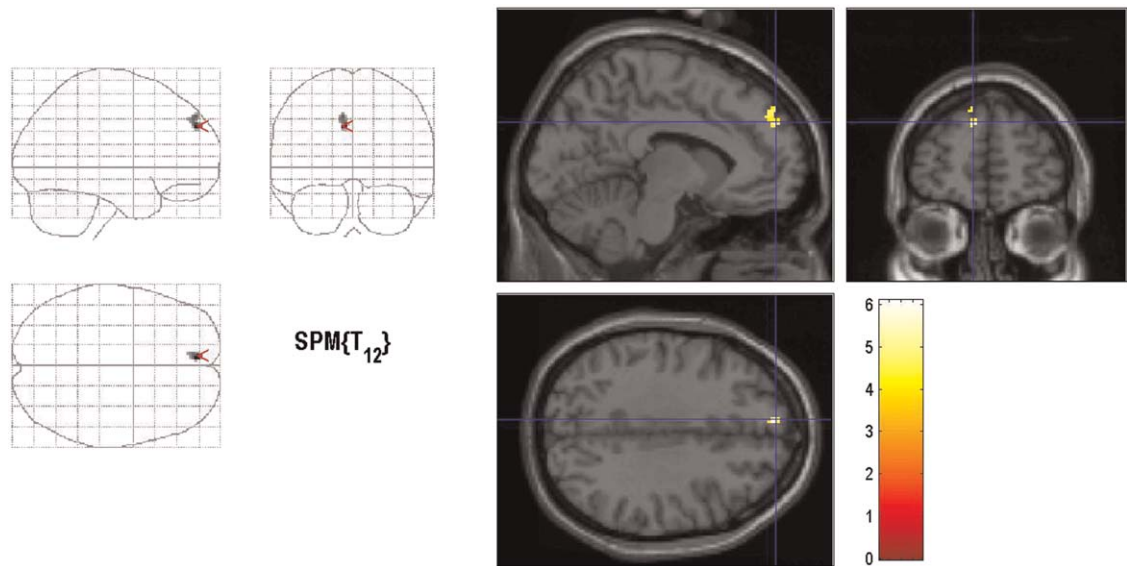


Fig. 1. Brain responses of familiar brands compared to unfamiliar brands. Results revealed activation of the AMPFC for familiar brands. Areas of significant BOLD-signal change are shown as color overlays on the T1-MNI reference brain. The colored bar indicates the T-statistic of the activation. Please see online version of this article for full color figure.



Fig. 2. Examples of familiar brand logos of European car manufacturers presented in the experiment.

their preferences. Hence, one person may favor a specific brand while someone else dislikes it. Thus, in another fMRI study, we aimed to examine the neural representations of favorite brands (Schaefer and Rotte, 2007a). We employed fMRI to measure subjects' brain activity while presenting them logos of different car brands. We hypothesized that brands (and not only generic pictures of status symbols, like sports cars) may function as reward stimuli and therefore modulate the reward circuit. Hence, we assumed that brands with positive connotations to the subjects may be associated with activation of structures related to the reward circuit. Since different subjects prefer

different cultural objects, we hypothesized that only brand subjects *individually* rated as their favorites act as reward stimuli. Subjects were lying in the fMRI scanner and viewed 14 pictures of trademark-logos of well-known European car manufacturers (Fig. 2). All logos contained the name of the brand and were compatible regarding the size of the image. After the experiment, we asked the participants to rate the seen brands according to their personal attractiveness.

The fMRI results demonstrated activation of the ventral striatum (putamen) when subjects saw a personal attractive brand compared with a personal unattractive brand (Fig. 3). Thus, the

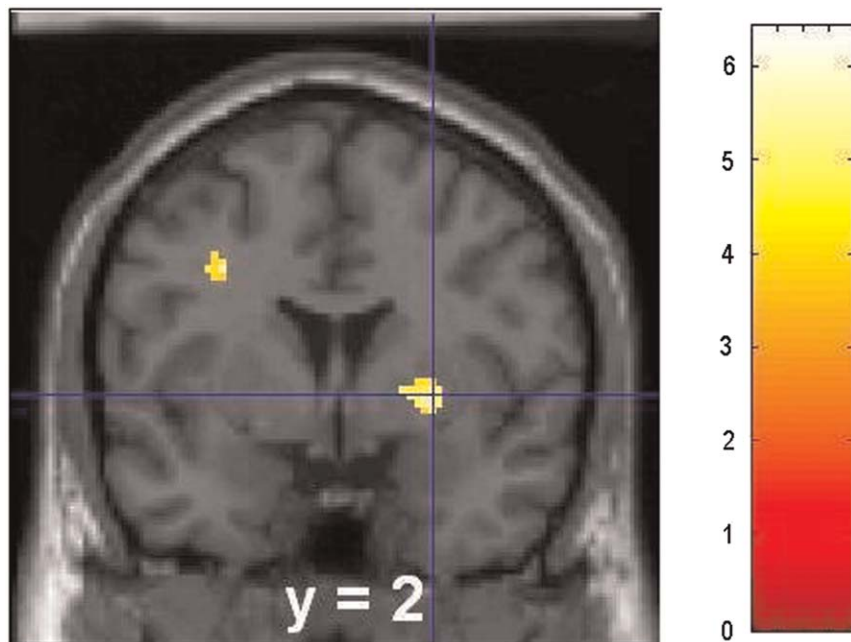


Fig. 3. Neural correlates of favorite brands compared to nonfavorite brands. Results showed activation of the DLPFC and the ventral striatum (putamen). A coronal slice through the ventral striatum is shown.

results demonstrate that the mere imagination of using a product of a favorite brand engages similar reward-related areas than stimuli artificially associated with appetitive rewards due to classical or instrumental conditioning in an experimental context (e.g., O'Doherty et al., 2004a, 2006). This supports the notion that brands may have been associated with rewarding or appetitive stimuli through the process of classical conditioning due to advertising efforts (Gorn, 1982). As a consequence, even the mere perception of a personally preferred brand logo is sufficient to activate structures of the reward circuit.

However, some of the presented car manufacturers never do any advertising at all (e.g., Ferrari, Rolls-Royce). This points to the fact that advertising is only one dimension in the development of people's choices and preference set. Furthermore, as the following paragraphs try to underline, goods can be preferred not only because one likes them personally.

Results of the just-mentioned study also revealed activity in the DLPFC when subjects viewed favorite brands. Activation of this brain

structure is known to reflect aspects of cognitive control and working memory. Several studies suggest that the DLPFC may be important for employing affective information in biasing behavior (Davidson and Irwin, 1999; McClure et al., 2004). Thus, a network of areas in the prefrontal cortex and the striatum seems to be important for the representation of favorite brands.

Secondary inducers of reward: social incentives

When choosing appropriate actions to receive rewards, the brain needs to form associations between external stimuli, action selections, and rewards. Numerous studies have shown that the striatum plays an important role for this kind of learning (Pagnoni et al., 2002; Haruno and Kawato, 2005). The results reported above are in line with recent studies and point to a role of the ventral striatum in maintaining a representation of the subjective value of the associated reward stimulus (e.g., O'Doherty, 2004b, 2006; Samejima et al., 2005). The reported findings even extend

these studies by demonstrating that the mere perception of logos of favorite brands as cultural symbols may modulate regions in the striatum as a function of their characteristics as personal reinforcers.

However, brands are complex cultural objects and people use brands for different purposes. A post hoc covariate analysis between the magnitude of the BOLD signal and behavioral results revealed that activity in the ventral striatum was positively correlated with the attributed sports and luxury characteristics of the chosen favorite brands, but showed a negative linear relationship with the attributed rationality (see Fig. 4). Thus, the reward-related areas showed higher activation when personal favorite brands were rated by all participants as sporty or luxury and lower when they assessed them more as cars of rational choice (or a value car). Hence, not only primary inducers (the personal attractiveness) but also secondary inducers of reward mechanisms based on *social* cognitions and associations seem to modulate reward-related brain areas. Thus, we speculate that there might be primary and secondary inducers of reward. The former may signal fast anticipation of “primary” needs, while the latter

may point to satisfaction of more complex desires. When we decide to buy a product, we not only think about personal need satisfaction but also consider what others may think about our decision to buy a car of this brand. Sometimes these thoughts may advise us against our wish and sometimes they may encourage us to do so. For example, a sports car may lead to feelings of enviousness for others. In contrast, a very old and cheap car may put us in a bad light for others. Another example is buying a hybrid car, which may enhance the prestige of the buyer. Thus, there are not only hedonistic primary reasons that influence our decision for a product but also social reasons (at least for non-fast-moving consumer goods). One cortical region where both primary and secondary inducers of reward may interact might be the striatum. However, further research is necessary to validate this speculation.

Brain responses to luxury brands

Previous research has demonstrated that when we see a preferred brand, we seem to anticipate the reward of owning this object of desire

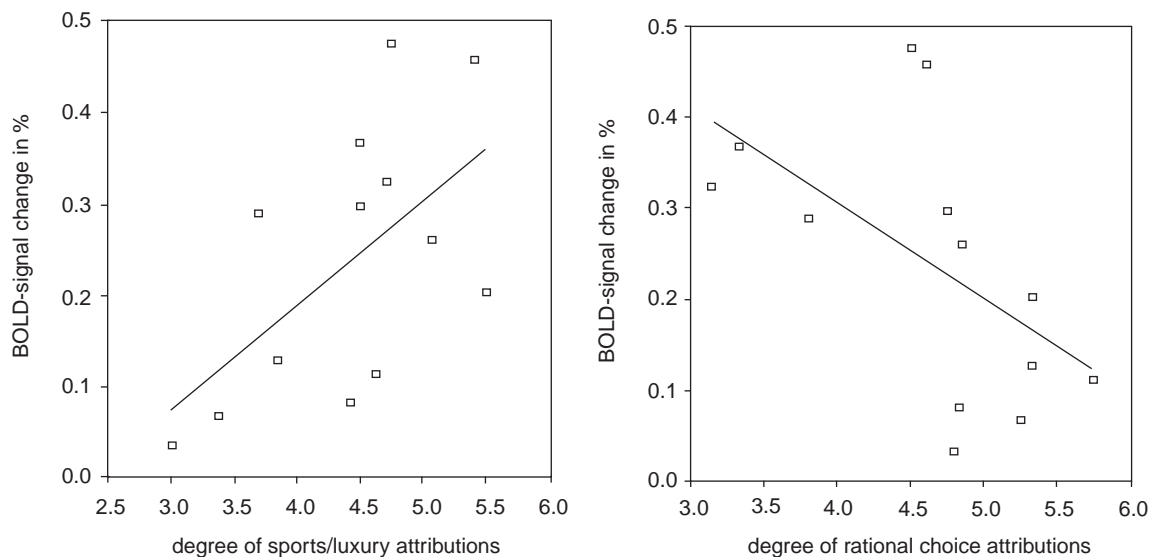


Fig. 4. Scatter plots showing activity in the ventral striatum (putamen) as a linear function of attributed sports and luxury characteristics ($r = 0.59$, $p < 0.03$) and as a negative linear function of attributed rational choice characteristic ($r = -0.67$, $p = 0.01$, Spearman's rho).

(Erk et al., 2002; Schaefer and Rotte, 2007a; Koeneke et al., 2008). However, brands have different and complex meanings far beyond representing objects of desire. Another important function of brands seems to mark the social rank of the owner. In particular, luxury goods often seem to have this function. Whereas in the medieval times the powerful class used valuable clothes and jewelry to show its position in society (Veblen, 1899), at the end of the 18th century the aristocratic system vanished and the attitude toward luxury goods changed. More and more people were working as employees in offices, wearing very similar clothes. Although luxury goods still had the function to mark the position in society, the way to deal with these goods changed. Nowadays, luxury often is more subtle and interacts with behavior and attitudes in defining the position of somebody in society (the *habitus*, Bourdieu, 1979). Moreover, luxury often seems to be coded by certain brands. In contrast to older times when people were fixed to their position in society, today many people can buy products of luxury brands, allowing the owner to pretend a certain social rank. Marketing experts are familiar with this phenomenon and assure that luxury brands retain their image as being a brand for rich and wealthy people, although they also (or in particular) expect few wealthy people to buy those products.

Given this background, we assumed that the neural representation of luxury brands is different from that of brands representing more value products. To test this hypothesis, we examined brain responses to both kinds of brands in an fMRI paradigm (Schaefer and Rotte, 2007b). During fMRI, scanning participants viewed different logos of familiar car brands that were representative for either luxury goods or value products. Based on previous studies, we expected a different engagement of the prefrontal cortex for the perception of luxury brands compared with brands representative for value products. Several recent studies suggested similar functional dissociations in the frontal lobe for the perception of different kinds of brands. For example, McClure et al. (2004) proposed two separate prefrontal sites in biasing preference judgments as

a function of either sensory or cultural information. Whereas the former seems to be based on activations in the VMPFC, the latter is supposed to be affected by the DLPFC. Goel and Dolan (2003) demonstrated reciprocal neural responses in the prefrontal cortex during emotionally neutral (“cold”) and emotionally salient (“hot”) reasoning. “Cold” reasoning enhanced activity in lateral and dorsolateral prefrontal cortex and suppressed activation in the VMPFC, whereas “hot” reasoning resulted in suppression of activation in lateral and dorsolateral prefrontal cortex and enhanced activation of the VMPFC (as similar in Gilbert and Fiez, 2004; Krain et al., 2006). Based on these studies, we hypothesized that different categories of brands may activate different cortical networks in the prefrontal cortex (Schaefer and Rotte, 2007b). In particular, the perception of brands that are related to high “social dominance” (luxury brands) should be accompanied by an active network including the VMPFC and other reward-related areas (affective “hot” processes). Value or pragmatic brands, which do not signal social dominance, should activate cortical structures known to be important for cognitive control (in particular the DLPFC), but no regions known to be involved in reward expectations.

Results revealed an active network of bilateral superior frontal gyri, hippocampus, and posterior cingulate, which was related to familiar brands in general. Brain responses to luxury brands showed activations in the AMPFC and the precuneus. In contrast, brands rated as value products activated the left superior frontal gyrus and the anterior cingulate cortex (see Figs. 5 and 6).

Thus, luxury brands (known as social reinforcers and supposedly representing cultural symbols linked to emotional salience or “hot” reasoning) failed to show activity in the VMPFC, a region associated with the processing of affective “hot” stimuli. In contrast, luxury brands elicited activation in the AMPFC and the precuneus. The AMPFC is known to be related to self-centered cognitions, self-reflection, and self-relevant processing (Ochsner et al., 2004; Schmitz et al., 2004; Seger et al., 2004; Moran et al., 2006). For example, Johnson et al. (2002) asked subjects to

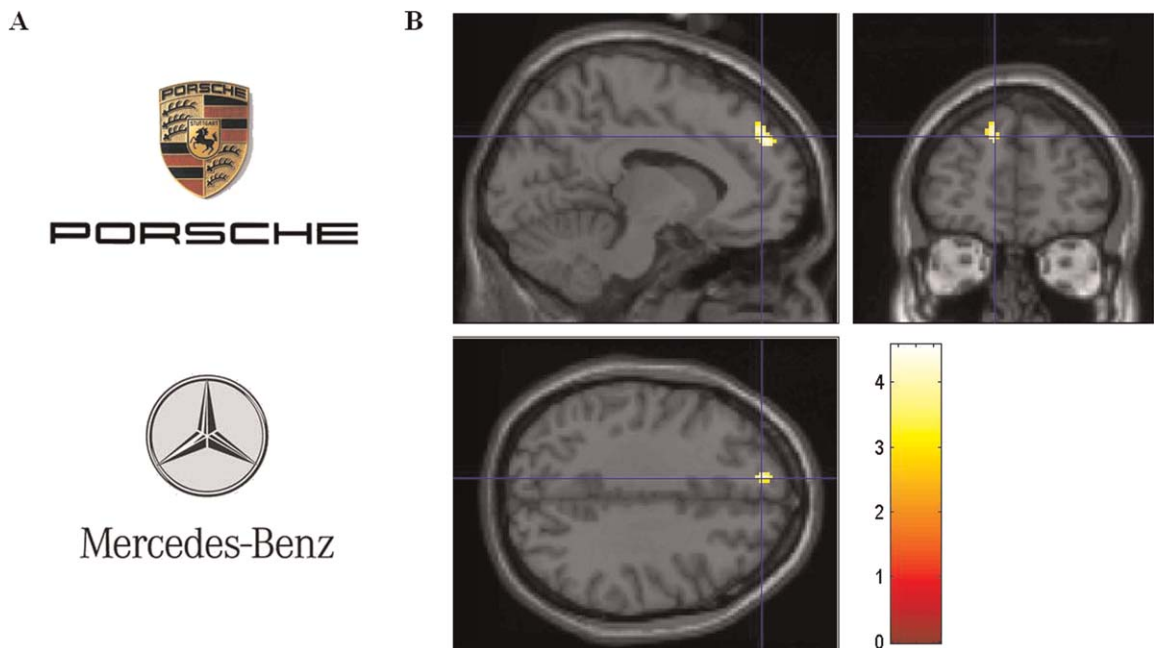


Fig. 5. Brain responses to luxury brands. (A) Two examples of luxury brand logos. (B) Activation of the AMPFC elicited by the presentation of luxury brands as compared to unfamiliar brands.

respond to different statements requiring knowledge of and reflection on their own abilities, traits, and attitudes while scanning their brain activity. Compared to statements about basic semantic knowledge, self-related statements revealed activations in the AMPFC and posterior cingulate. Furthermore, it has been suggested that the precuneus plays a central role for episodic memory retrieval and self-processing operations (Cavanna and Trimble, 2006). Hence, we speculated that luxury brands, which are related to high social values, may have evoked increased self-relevant thoughts in our subjects. Since the randomly chosen set of stimuli in our first study (Schaefer et al., 2006, see above) consisted mainly of luxury brands, the activation of the AMPFC in this earlier study can be related to the luxury characteristic of the presented familiar brands.

Why is the perception of luxury brands associated with cortical activations related to self-centered cognitions? Subjects in our study imagined using a product of the shown luxury brands. We speculate that they might have imagined possessing one of these luxury goods

and pictured mentally the situations in which others would see them with these products. Thus, the participants may have imagined being in a more superior position in society than they actually are. These results would confirm earlier theories on the fetish character of goods (Marx, 1867; Lukács, 1972). For instance, Marx (1867) assumed that people in capitalism have an attitude toward goods that is comparable to a fetish in archaic societies. In his theory, he used the term commodity fetishism to describe the belief in capitalist-market-based societies that value inheres in commodities (instead of being added to them through labor).

Ethical aspects

Recent advances in neuroeconomics have been accompanied by a great interest of mass media (Murphy et al., 2008). Although only few peer-reviewed studies on neuroeconomics have been published so far, newspapers and mass media are constantly reporting about any progress in this

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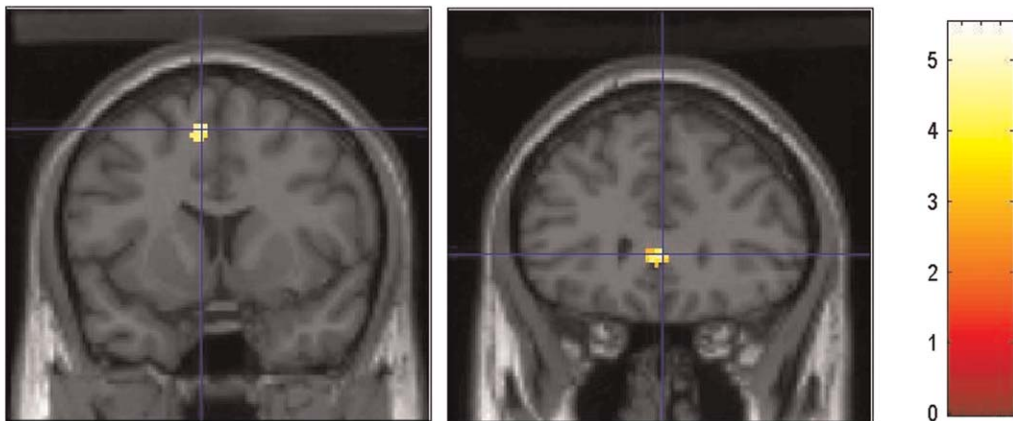


Fig. 6. Brain responses to the perception of value brands. (A) Typical examples of value brands. (B) Activations of the DLPFC and the anterior cingulate cortex elicited by the presentation of value brands as compared to unfamiliar brands logos.

area of research. Why is this issue so much more interesting for many people than other topics in cognitive neuroscience? And why is this research so intensively discussed?

The major reason for the high resonance of this research arises from the possible relevance for economic purposes. Many people criticize neuroeconomics by arguing that techniques that are invented for medical purposes (in particular fMRI) are now misused to learn about more effective marketing efforts and develop strategies making companies more profitable. In particular, people are afraid that by using the new “brain scanner”, companies may “manipulate” the consumer.

However, the brain is an extremely complex system. So far, knowledge about the neural representation of brands and about brand-related behavior is very limited. Hence, ideas about “manipulation” are far away from real

possibilities of neuroeconomics. Further, fMRI or other neuroimaging approaches cannot simply tell what a company has to do to make the potential customer buy their products. Together with established methods of marketing research, neuroeconomics might be able to help companies to identify products the customer might like. Thus, new brain imaging approaches might supplement established methods, but they will not replace them. Hence, neuroeconomics is just one approach among others. However, a new dimension is reached when we can see that neural activations differ just because of the perception of different brands. Nevertheless, what we see as activations in the brain are the *results* of marketing efforts for years; the new brain imaging methods did not “manipulate” anything.

We believe that economic or brand-related behavior is an important topic for current research in cognitive neuroscience. Understanding how

people behave in economic situations is extremely important for both concrete purposes (e.g., understanding economic crisis) as well as basic research. However, it is also essential to keep ethical objections in mind and discuss these issues in a thorough way.

Conclusion and future directions

This chapter outlined first preliminary results showing how brands as complex cultural symbols seem to be represented in the brain and affect brand-related behavior. First studies have shown that the perception of personally favorite brands is accompanied by activations of the reward circuit. Thus, when we view a brand, we seem to anticipate the rewards promised by the brand. Further, recent research has demonstrated that brands are differentially processed in the prefrontal cortex depending on the attributed characteristics of the brand. For instance, luxury brands seem to elicit activation in the AMPFC, a region known to be involved in self-centered cognitions.

These results demonstrate that even complex cultural symbols can be successfully investigated with neuroimaging approaches. Furthermore, studies have shown that neuroeconomics is much more than just telling us that emotion is important in economic decisions. Thus, combined with advanced cultural theories, neuroeconomics may be eligible to show us new ways of thinking about brands and their impact on our behavior. Future directions may focus more on brand-related behavior. In particular, further studies might investigate how different brand representations in the brain interact in economic situations, for example, when finally buying a good or after buying a product (Festinger, 1957). Further, since cultural symbols can also be described as cognitive schemes, using theories focusing on those research topics may be very promising to understand brand-related behavior (e.g., Heider, 1958).

Acknowledgments

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