The effect of fame as a context

An fMRI study

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Abstract

Over the past decades there has been an increase of celebrities in advertising, but there is still a huge variance in the effectiveness of celebrities in advertising. Previous studies (Klucharev et al., 2006; Rossiter and Smidts, 2006) have shown that memory and attitudes of a product increases when the famous presenter is an expert on the presented product. To study the mechanisms of effective use of famous presenters in advertising we simulated advertising and studied the modulation of memory and attitudes for products with fame as a context. We presented 24 female subjects with photos of products (shoes) coupled to famous and non-famous faces. To contrast effects of presenters' attractiveness and expertise as well as specific item characteristics, we equated attractiveness and used only shoes as stimuli. During this task we recorded brain activity via fMRI. We found a substantial behavioural effect of fame on memory for the products; more products coupled to famous faces were remembered. Turning to the neural underpinnings of this behavioural effect, we found a subsequent memory effect x fame interaction in the thalamus. Moreover, we found a main effect of fame in left frontal and temporal regions, which are commonly seen during semantic processing and a positive emotional encoding context. Celebrities trigger semantic knowledge and can be seen as a positive emotional encoding context. Behaviourally they increase memory for the products presented. It seems that using a celebrity in advertising increases brand awareness and memory of the advertised product by increasing elaboration and positive emotional processing of the advertised product such that brand awareness increases.

Key words: memory encoding, subsequent memory effect, attitude change, subsequent attitude effect, encoding context, fame, celebrities, faces, neuroeconomics.

Introduction

In our everyday life we cannot get around advertisements, they are everywhere; TV, internet, newspapers, magazines and in the streets. Since 1990 until 2002 the U.S. budget for advertising almost doubled from 130 to 240 billion dollars a year (Alexander et al., 2004). This is an enormous amount of money is spent, but the effectiveness of different campaigns varies considerably. Hence there is urgent need to do research in order to increase the effectiveness of the investments made in advertising. Du Plessis (2001) states that an advertisement is effective if it has an effect on memory; either the advertisement is remembered or it has created brand awareness (memory of the brand). According to du Plessis advertisements that are remembered or created brand awareness will consequently increase sales. So you need to make sure that the advertisement is drawing attention so they can be remembered.

Over the past decades there also has been a tremendous increase in the use of celebrities in advertising; in the U.S. 20 years ago about five percent of TV commercials used celebrities (Stewart and Furse, 1986), while nowadays it is estimated that in around 20 percent of all TV commercials in the U.S. a celebrity is present (Praet, 2002). The use of celebrities is of course much more expensive then using non-famous presenters, and although celebrities are used more and more in advertising there is still a major pitfall of using celebrities in advertising. Up to this point, only around 50% of the US commercials using celebrities have proved to be effective in increasing sales (Agrawal and Kamakura, 1995; Lodish et al., 1995). For example Cindy Crawford increased the sales of the clothing company Hennes & Mauritz when she advertised underwear for them (Schreurs, 2001), but the sales of Chrysler automobiles dropped when Celine Dion promoted their cars (Martin, 2004). Consumers just could not believe that she would actually drive such a car. Hence, the question arises when a celebrity does work for advertisements? According to a study by Rossiter and Smidts (2006) the famous presenter must be an expert of the product he/she is endorsing to increase brand attitude and thus the intention for the consumer to buy the product (buying intention). An fMRI study which further looked at the effect of expertise confirmed that expertise increases buying intention (BI) and even memory for the presented product (Klucharev et al., 2006). In that study the presented famous faces were followed by a product. The task for the participant was to respond if the famous person could or could not be considered as an expert of the presented product. Klucharev et al. showed that the effect of expertise on BI is mediated by the caudate nucleus, a structure, which is also involved in learning emotional evaluation outcomes and trust. They also showed that expertise enhanced memory encoding related activity in the medial temporal lobe and consequently improved the memory for the presented products.

Previous studies (Klucharev et al., 2006; Rossiter and Smidts, 2006) investigated only the effect of expertise within a group of celebrities, ignoring a difference between celebrities and non-famous presenters. Because of the increase of celebrities in advertising, and the costs that come along with it. We investigated if celebrities are more effective than non-famous presenters in increasing memory and BI of presented products, and how this effect is modulated by the brain. The products used in this study were all women's shoes and the presenters were attractive famous and non-famous females. This was done to equalize perceived expertise between presenters and to mitigate specific effects of certain product characteristics. We expected that more products coupled to famous faces would be remembered and that products coupled to celebrities would also give a higher BI compared to products coupled to non-famous presenters.

It is suggested by neuropsychological studies that attitudes (in this case BI) and episodic memory are represented separately in the brain (Johnson et al., 1985; Lieberman et al., 2001) and thus these effects were studied separately. To perceive episodic memory we used the "subsequent memory effect" (SME) paradigm to study the neural correlates of memory formation for the 'advertised' products. Previous studies (Paller and Wagner, 2002, Fernandez and Tendolkar, 2001) have shown that for the SME paradigm there will be a higher activation in the medial temporal lobe (MTL) and in prefrontal areas for items later remembered (hits) versus items later forgotten (misses: old items misclassified as new). The SME has been frequently used to study the modulation of memory encoding by context (Erk et al., 2003; Erk et al., 2005; Maratos et al., 2001). Fame (famous or non-famous presenter) can also be considered as a context of product encoding. Therefore, brain activity showing an interaction of the SME and fame would indicate possible mechanisms of memory modulation by fame. We hypothesized that fame could be seen as an emotionally positive encoding context, because according to Turner (2004) a celebrity has charisma and generates a para-social interaction (people create “real” emotional attachments with figures they know only through their representations in the media). Also, the celebrities in this study were all chosen on the basis that they were liked. Therefore, we expected that more items were remembered that were coupled to famous faces and find activations in brain regions previously shown to be activated during a positive emotional encoding context; the prefrontal cortex, the orbitofrontal cortex, the MTL, the anterior temporal lobe, and extra striate visual brain regions (Erk et al., 2003; Erk et al., 2005; Maratos et al., 2001).

To study attitude changes evoked by fame, we used a recently introduced “subsequent attitude effect” (SAE) (Klucharev et al., 2006). We compared brain responses of later preferred products (high BI) with brain responses to later non-preferred products (low BI). Klucharev et al. found activations in the MTL, the medial frontal gyrus, the cingulate gyrus, the caudate, the insula, the thalamus, the amygdala, and the posterior cingulate for items with a low BI. An interaction of the SAE and fame should reveal the neural correlates of persuasion or attitude change modulated by fame of the presenter. Similar to Petty et al. (1983), we also expected to find a higher BI for products coupled to famous faces, compared to products coupled to non-famous faces.

In this study we presented a face (famous or non-famous) as a context next to a product (shoes). Recent studies have shown that famous faces activate the MTL (Bernard et al., 2004; Dietl et al., 2005; Elfgren et al., 2006; Gorno-Tempini and Price, 2001; Ishai et al., 2002; Ishai et al., 2005; Trautner et al., 2004), the inferior occipital gyrus (Ishai et al., 2002; Ishai et al., 2005), the amygdala (Ishai et al., 2002; Ishai et al., 2005), the inferior frontal gyrus (Ishai et al., 2005), the orbitofrontal cortex (Ishai et al., 2005), the anterior paracingulate cortex (Dietl et al., 2005; Elfgren et al., 2006; Gorno-Tempini and Price, 2001), the calcarine sulcus (Ishai et al., 2002), the precuneus (Ishai et al., 2002), the prefrontal cortex (Bernard et al., 2004), and the caudate (Bernard et al., 2004). We expected to find activations in the above described areas for the main effect of fame (shoes coupled to famous faces vs. shoes coupled to non-famous faces) due to the contextual processing of the faces.

To summarize, we expect to find a main SME in frontal and temporal regions. For the interaction effect of SME x fame we expect to find activations in regions previously found during a positive emotional encoding context; the prefrontal cortex, the orbitofrontal cortex, the MTL, the anterior temporal lobe, and extra striate visual brain regions (Erk et al., 2003; Erk et al., 2005; Maratos et al., 2001).

For the main SAE we expect to find activations to products with a low BI as in Klucharev et al. (2006). Also we expected to find activations to products with high BI in the caudate body and the superior frontal gyrus; Klucharev et al. found activations in these regions for the interaction between BI and expertise. Because our presenters can all be seen as experts on shoes we also expected to find these activations for high BI. It is hard to speculate what to expect for SAE x fame interaction, because no previous studies have dealt with this.

Of course we also expected to find a main effect of fame as describe above.

Methods

Subjects

Twenty-six healthy right-handed females (mean age 20.63 years, ± 1.79) with an interest in fashion and celebrities participated in the experiment. Subjects were selected using a specially designed questionnaire screening their interests and shopping behaviour. Only subjects that reported high familiarity with celebrities and high interest in shopping were selected for the study to homogenize group responses. None of the subjects used any medication, had a history of drug abuse, head trauma, or neurological or psychiatric illness. Written informed consent was obtained according to requirements of the local medical ethics committee.

Stimuli

Twenty digital photos of faces of international and Dutch female celebrities (music-, TV-, and movie stars) and 20 digital photos of faces of non-famous females (see Appendix 1), and 480 digital photos of shoes were collected from publicly available internet sources. The photos of the famous and non-famous faces were matched according to attractiveness (based on pilot study, see Appendix 2). All pictures were matched for visual complexity and brightness. The pictures all had the same pixel width, the pixel height varied for the pictures of the shoes due to length of the shoes, e.g. boots gave longer pixel height than flat shoes. Shoes were chosen as products because shoes are seen as highly significant articles of clothing that are regarded as expressing the wearer’s personality (Belk, 2006). We choose to only use one type of products so all the female presenters would be regarded as equal experts on this category and to decrease possible confounding effects due to variability of the products.

Task

Subjects performed in total three tasks, all performed successively in one day, the total duration was around three hours. The first task (encoding) was executed in the fMRI scanner followed with a short break of about ten minutes before performing the remaining two tasks behind a computer.

Task 1: Encoding

The encoding task was executed in the fMRI scanner, during this task participants were shown 40 pictures of faces (20 famous and 20 non-famous, see Appendix 1), each face appeared randomly on the right or left side of a fixation cross. After the face onset the name of the person (real or a made up name for the non-famous person, see Appendix 1) appeared next to it for 1000 ms (Figure 1). After an inter stimulus interval (ISI) a shoe appeared (at the same place the name was previously presented) next to the face for 1000 ms (mean ISI = 10000 ms; range 7000 – 13000 ms). Next to each face a total of six different shoes appeared within a mini-block. The subject was asked to press “yes” if she thought the shoe belonged to the person presented next to the shoe or to press “no” if she thought the shoe did not belong to the person presented next to the shoe. Beforehand the subjects were told that 50 percent of the shoes did belong to the person next to the shoe and 50 percent did not. In addition the subjects were instructed to memorize the shoes. After an inter trial interval (ITI) the next mini-block with a new face appeared on the screen (mean ITI = 10000 ms; range 7000 – 13000 ms). All shoes were randomized across subjects such that each participant received different face-shoe associations. The task lasted approximately 55 minutes, in total 240 shoes appeared. Pictures of shoes used during the encoding task and pictures used as new stimuli during the retrieval task were counterbalanced across subjects in order to avoid effects related to specific stimuli.

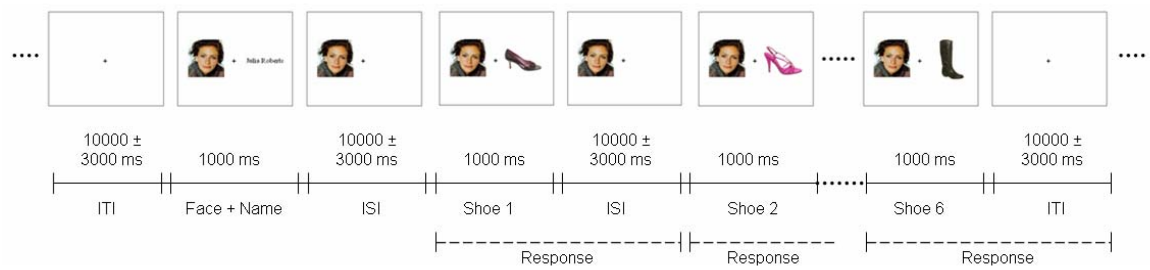

Figure 1. Example of a mini-block of the encoding task.
Presentation of the last stimuli (Shoe 6) followed by a new mini-block.
ISI – inter stimuli interval, ITI – inter trial interval, response – time window for the response

Task 2: retrieval

In the retrieval task the participant was shown a shoe for 1000 ms and was offered three response options: (i) picture seen before with high confidence, (ii) picture not certain to be seen before or not (iii) picture not seen before with high confidence. After this the shoe reappeared for another 1000 ms and the BI was evaluated using the following statement: “The percentage of Dutch university students that would try this shoe is…” the participant was shown a rating on a percentage scale between 0 and 100 percent, with intervals of 10 percent, and was asked to respond. Beforehand the subjects were instructed that we had female university students rate all the shoes in advance and that we selected 480 shoes so that on average these university students would buy 50 percent of the shoes. The BI measure was also interpreted as indicating the participant’s own purchase probability, that is, purchase intent. It doesn’t seem that everyone would truthfully admit that a celebrity led them to try or buy a product. We therefore applied a projective measure, which is the most practical method for avoiding suspected social desirability bias. In total 480 shoes were presented; 240 from the encoding task en 240 shoes not seen before in the encoding task.

Task 3: face evaluation

In this task the participants evaluated the faces from the encoding task on attractiveness (from 0 to 100% in steps of 10%), familiarity (famous, non-famous) and likeability (only for the famous faces; responses were 0, 30, 50, 70, and 100%). For each question the picture of the face was shown for 1000 ms.

All trials in Task 2 and 3 were presented in a self-paced manner.

MRI data acquisition

fMRI scanning was performed with ascending slice acquisition and a T2*-weighted echo-planar imaging sequence (Sonata 1.5 T, Siemens, Erlangen; 33 axial slices; volume repetition time (TR), 2.29 s; echo time (TE), 30 ms; 90° flip angle; slice matrix, 64 x 64; slice thickness, 3.0 mm; slice gap, 0.5 mm; field of view, 224 mm). For structural MRI, we acquired a T1-weighted MP-RAGE sequence (176 sagittal slices; volume TR, 2.250ms; TE, 3.93 ms; 15° flip angle; slice matrix, 256 x 256; slice thickness, 1.0 mm; no gap; field of view, 256 mm)

MRI data analysis

Image pre-processing and statistical analysis were performed using Brainvoyager QX, v 1.7 software (www.brainvoyager.com). Functional images were corrected for motion and slice scan time acquisition. Due to movement artefacts during MRI-scanning two out of the 26 participants had to be excluded from the data analysis. Data were temporally smoothed with a high-pass filter removing frequencies below 3 cycles per time course. Functional images were co-registered with the anatomical scan and transformed to Talairach coordinate space (Talairach and Tournoux, 1988) using the nine-parameter landmark Brainvoyager method of Talairach and Tournoux. Images were spatially smoothed with a full-width at half-maximum (FWHM) Gaussian kernel of 10 mm. The fMRI data were statistically analyzed using the general linear model, for all analysis we used a random effects analysis. For the statistical analysis, relevant contrast parameter images were subjected to a random effects analysis. To minimize the risk of false-positive findings, a minimal cluster size of 60 pixels was postulated. For the timing we used the first two second after stimulus onset. We used an event-related design; the presentation of each shoe represented a trial.

Apart from the main effect of memory, fame, BI and match (shoes “owned” or “not-owned” by female) the following 2x2 factorial designs were used:

- memory (hits vs. misses) and fame of presenter (famous vs. non-famous).
- BI (low vs. high) and fame of presenter (famous vs. non-famous).
- BI (high vs. low) and match (“owned” vs. “not-owned”).

The BI x fame interaction only yielded 19 out of the 24 participants, because 5 out of the 24 participants had less than 17 responses in one of the four categories (high BI famous, high BI non-famous, low BI famous, low BI non-famous).

The BI x match interaction yielded only 16 out of the 24 participants; we did not have the match data of two subjects due to problems with registration of the responses during the encoding task. Another 6 subjects were removed from the data analysis because they had less than 17 responses in one of the four categories (high BI match, high BI no match, low BI match, low BI no match).

Results

Although the pictures of faces were matched on attractiveness based on pilot studies, famous faces (63,65 % ± 7,48) were rated as more attractive than non-famous faces (60,38% ±7,30) ($t(23,1)=2.176$, $p<0.05$) by the participants of the current study. To make sure that this was not a confounding factor the famous face rated as most attractive (Catherina Zeta Jones; attractiveness: 72%, fame: 87.5 %, likeability: 56.25 %) and the non-famous faces rated a least attractive (Non-famous 289; attractiveness: 53 %, fame: 8%) were removed from the data analysis resulting in equal attractiveness of the face ($t(23,1)=1.624$, $p=0.118$, see also Table 1). This resulted in exclusion of 12 shoes (per participant) presented within the mini-blocks with the removed faces. Due to randomization different shoes were removed for each participant.

Behavioural results

We found a strong effect of fame on memory ($t(23,1)=4.703$, $p<0.001$): subjects had a higher recognition performance (RP: % hits - % false alarms) for shoes that were coupled to famous faces (RP=0.28) compared to shoes coupled to non-famous faces (RP=0.20).

We found no effect of BI on fame ($t(23,1)=0.658$, $p=0.517$): there was no significant difference in BI of shoes coupled to famous faces (BI = 40.75 %) compared to shoes coupled to non-famous faces (BI = 40.38%).

Participants also rated the faces on attractiveness, fame, and likeability (only for famous faces, see Table 1). On average 94% of the famous faces were recognized on being famous, and only 2.85% of the non-famous faces were recognized as being famous. The likeability of the famous faces was rated above 50% ($t(18,1)=7.661$, $p<.001$), (mean 65.5%, (48 - 78%)), so no activations due to aversive reaction (e.g. disgust) were expected.

Table 1
Mean in % (SD), t-, p-values for face evaluation.

	Famous faces	**Non-famous faces**	**t**	**p**
Attractiveness	63.53 (7.41)	60.88 (7.29)	1.624	.118
Fame	94.08 (7.26)	2.85 (4.82)	45.329	<.001
Likeability	65.46 (8.80)			

To see if we could replicate the results of Klucharev et al. (2006) we also looked at the responses the participants had to give during the encoding task; yes, shoe “owned” by person in the picture vs. no, “not-owned”. We assumed that if a shoe was matched to a face the female presented could in a way also be seen as an expert of the product. So we expected a higher BI for shoes that were “owned”. We did not have the match data of two subjects, due to a problem with the registration of the responses during encoding, so data of 22 subjects were calculated. Our behavioural results showed an effect of match; shoes that were “owned” (44,90% ±8,24) had a higher BI than shoes that were “not-owned” (35,80% ±8,70) ($F(21,1)=95,208$, $p<.001$, see also Table 2). No effect of fame on BI was found ($F(21,1)=3,982$, $p=.059$), and also no interaction between match and fame on BI ($F(21,1)=.168$, $p=.686$).

Table 2
Mean BI in %(SD) for expertise and fame.

	Famous faces	**Non-famous faces**
“Owned” shoes	45.39 (8.04)	44.40 (8.60)
“Not-owned” shoes	36.49 (8.45)	35.12 (9.08)

MRI results

Tables 3 and 4 show regions of activity associated with the studied effects. We found a subsequent memory effect (SME) in the superior frontal gyrus and the lentiform nucleus (Table 3).

We found a widespread set of brain regions that were selectively activated by shoes coupled to famous faces in comparison to shoes coupled to non-famous faces (Table 3). Anteriorly it comprised the middle frontal gyrus, the medial frontal gyrus, the inferior frontal gyrus, the cingulate gyrus, and the precentral gyrus. In the MTL the parahippocampal gyrus, hippocampus and

the insula were activated. Posteriorly, the set of activations included the superior temporal gyrus, the posterior cingulate, and the precuneus. Subcortically, the caudate nucleus, the lateral globus pallidus, and the thalamus were also activated to shoes coupled to famous faces.
We also found a small interaction effect of fame x SME in the left thalamus (Table 3).

The main effect of BI showed an increase for shoes with a high BI (≥60%) compared to low BI (≤40%) in the fusiform gyrus, the medial frontal gyrus, and the hypothalamus (see Table 4). Again, we found a widespread set of brain regions that were selectively activated by shoes coupled to famous faces in comparison to shoes coupled to non-famous faces (Table 4). Anteriorly it comprised the middle frontal gyrus, the inferior frontal gyrus, the cingulate gyrus, the anterior and the posterior cingulate. In the MTL the parahippocampal gyrus, the hippocampus, the middle temporal gyrus, and the inferior temporal gyrus were activated. Subcortically, the lentiform nucleus was also activated to shoes coupled to famous faces.
We also found a negative interaction effect for SAE x fame (Table 4). Anteriorly it compromised of the middle frontal gyrus, the inferior frontal gyrus, and the superior frontal gyrus. In the MTL, the insula, and the fusiform gyrus were activated. Parietally, the precentral gyrus, and the postcentral gyrus we also activated by the interaction.

Table 3

Significant activation clusters for subsequent memory and fame effects.

Brain region	HEM	x	y	z	Nr Of Voxels	Z (max)
Memory (SME)						
Superior frontal gyrus	L	-13	25	48	88	3.7*
Lentiform nucleus, putamen	R	21	5	-5	244	3.3**
Fame						
Middle temporal gyrus, BA 39	R	35	-62	27	4444	7.1
Posterior cingulate, BA 30	R/L	-3	-50	16	10114	6.9
Middle frontal gyrus, BA 10	L	-32	41	9	5030	6.8
Medial frontal gyrus, BA 6	R	12	28	36	5660	6.8
Inferior frontal gyrus, BA 9	R	52	10	29	4343	6.6
Insula, BA 13	L	-31	22	3	5978	6.6
Caudate tail	L	-31	-31	1	2152	6.4
Middle frontal gyrus, BA 46	R	39	44	6	8385	6.3
Medial frontal gyrus, BA 8	L	-7	27	39	4680	6.1
Lateral globus pallidus	L	-21	-12	-1	4794	6.1
Caudate tail	R	34	-40	5	1650	6.0
Superior temporal gyrus, BA 22	L	-57	-7	0	531	6.0
Precuneus	R	23	-53	40	3329	5.9
Superior temporal gyrus, BA 47	R	49	17	-9	1567	5.7
Temporal lobe, BA 37	R	48	-48	-6	508	5.5
Thalamus	R/L	5	-11	7	2821	5.3
Thalamus	R	14	-17	-1	3204	5.3
Middle frontal gyrus, BA 9	L	-39	19	28	444	4.9
Hippocampus	R	33	-28	-7	284	4.9
Insula	R	43	-31	11	1125	4.9
Precentral gyrus, BA 6	L	-45	-7	33	473	4.8
Medial frontal gyrus, BA 9	R	12	46	25	847	4.7
Parahippocampal gyrus, BA 27	R	19	-31	-6	334	4.7
Cingulate gyrus, BA 24	L	-14	-5	36	224	4.4
Parahippocampal gyrus, BA 28	L	-19	-28	-6	178	4.3
Fame x memory						
Thalamus	L	-2	-16	3	564	3.3***

p<.0002 (corrected for multiple comparisons, q(FDR)<.001)
* p<.001 (corrected for multiple comparisons, q(FDR)<.05)
** p<.004 (corrected for multiple comparisons, q(FDR)<.1)
*** p<.008
N=24

Table 4
Significant activation clusters for subsequent attitude and fame effects.

Brain region	HEM	x	y	z	Nr Of Voxels	Z (max)
Buying intention (SAE)						
Fusiform gyrus, BA 37	R	50	-47	-19	2495	5.55*
Medial frontal gyrus, BA10	L/R	-1	55	6	3129	4.97*
Fusiform gyrus, BA 37	L	-45	-54	-13	1458	4.59*
Hypothalamus	R	8	-3	-2	305	4.28*
Fame						
Anterior cingulate, BA 32	L/R	6	47	5	3792	6.95
Inferior frontal gyrus	L	-40	26	-13	2356	6.67
Posterior cingulate	L/R	-2	-48	8	7483	6.61
Parahippocampal gyrus	R	24	-25	-8	5439	6.41
Middle frontal gyrus	L	-30	43	9	2415	6.28
Middle temporal gyrus, BA 39	R	34	-58	26	2829	6.26
Hippocampus	L	-29	-28	-3	4841	6.17
Cingulate gyrus, BA 32	R	17	22	30	3604	5.96
Inferior temporal gyrus, BA 20	R	53	-52	-10	1694	5.81
Inferior frontal gyrus, BA 46	L	-36	34	12	965	5.70
Cingulate gyrus, BA 32	L	-18	21	35	1213	5.40
Lentiform nucleus	L	-23	-9	-6	1615	4.79
Middle frontal gyrus	R	32	44	7	756	4.76
Inferior frontal gyrus, BA 13	R	41	22	11	64	4.55
Buying intention (SAE) x Fame						
Precentral gyrus, BA 9	L	-40	18	31	2921	-4.96**
Insula	R	60	-19	13	3791	-4.71**
Precentral gyrus, BA 6	R	60	-1	7	2510	-4.52**
Middle frontal gyrus, BA 46	R	49	28	23	1388	-4,50**
Superior frontal gyrus, BA 6	L	-16	-5	64	681	-4.28**
Middle frontal gyrus, BA 6	L	-42	2	41	2046	-4.20**
Fusiform gyrus, BA 20	L	-51	-40	-23	217	-3.89**
Superior frontal gyrus, BA 9	L	-19	58	30	724	-3.80**
Inferior frontal gyrus, BA 45	R	44	17	3	203	-3.65**
Postcentral gyrus	L	-48	-19	24	140	-3.56**

p<.00005 (corrected for multiple comparisons, q(FDR)<.001)
* p<.0004 (corrected for multiple comparisons, q(FDR)<.05)
** p<.001 (corrected for multiple comparisons, q(FDR)<.07)
N=19

To see if we could replicate the findings of expertise of Klucharev et al. (2006) we looked at match (“owned” vs. “not-owned”) and high versus low BI (see Table 5). Because some subjects did not have enough responses in each category we calculated the data for 16 participants (see Table 5). The main effect of the factor match revealed activity increase in the lentiform nucleus for shoes that were “owned” compared to shoes that were “not-owned”. However, we identified a widespread set of brain regions that were selectively activated by shoes that were rated as being “not-owned” by the presented face (Table 5). Anteriorly, it comprised the medial frontal gyrus. In the MTL the parahippocampal gyrus was activated. Parietally the set of activations included the supramarginal gyrus and the postcentral gyrus. For the main effect of BI the superior frontal gyrus was activated. We also found a negative interaction effect for match and BI in the insula, superior temporal gyrus, and the cingulate gyrus (see Figure 2).

Table 5

Significant activation clusters for BI and match effects.

Brain region	HEM	x	y	z	Nr Of Voxels	Z (max)
Buying intention (SAE)						
Superior frontal gyrus, BA 6	L	-1	6	50	124	3,6*
Match						
Supramarginal gyrus	R	50	-53	26	482	-3,9**
Parahippocampal gyrus	R	35	-50	-2	186	-3,7**
Medial frontal gyrus, BA 6	L	-5	-6	52	117	-3,7**
Superior frontal gyrus, BA 6	L	-2	8	51	139	-3,6**
Postcentral gyrus, BA 2	L	-58	-27	38	238	-3,5**
Lentiform nucleus	R	14	-2	1	343	3,3***
Buying intention (SAE) x Match						
Insula	L	-47	11	2	1545	-4,9
Superior temporal gyrus, BA 22	L	-62	-33	11	671	-4,6
Insula, BA 13	L	-43	-12	5	940	-4,2
Cingulate gyrus	L	-23	-47	24	123	-4,2

p<.0002 (corrected for multiple comparisons, q(FDR)<.05)
* p<.0009
** p<.002
*** p<.006
N=16

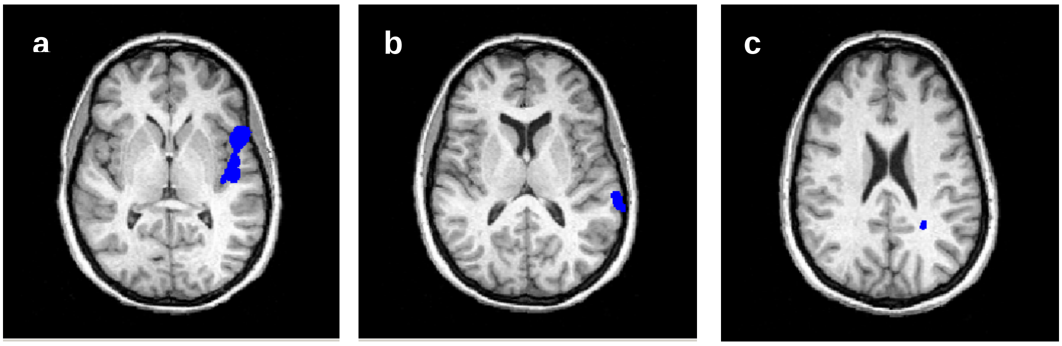

Figure 2. Negative interaction effect SAE x match. a) insula b) superior temporal gyrus c) cingulate gyrus

Discussion

In this study we sought so investigate the effect of a famous presenter as a context on memory and buying intention on presented products and their neural correlates, because over the past decades there has been an increase of celebrities in advertising, but there is still a huge variance in the effectiveness of celebrities in advertising. Previous studies (Klucharev, 2006; Rossiter and Smidts, 2006) have shown that memory and attitudes of products increase when the famous presenter is an expert on the presented product. To study the mechanisms of effective use of famous presenters in advertising we simulated advertising; we presented 24 female subjects with photos of products (shoes) coupled to famous and non-famous faces.

For memory we found a clear behavioural effect; significantly more shoes coupled to famous faces were remembered compared to shoes coupled to non-famous faces. For BI we did not find a behavioural difference for shoes coupled to famous faces compared to non-famous faces. We also replicated the behavioural expertise results of Klucharev et al. (2006) and Rossiter and Smidts (2006); shoes that were “owned” had a higher BI than shoes that were “not-owned”. For shoes that were “owned” we can say that this reflects a higher expertise by the presented female for the presented shoes, compared to shoes that are “not-owned”.

We found a main SME in the superior frontal gyrus and the lentiform nucleus. Activation of the superior frontal gyrus is commonly found during studies of SME (Paller and Wagner, 2002, Fernandez and Tendolkar, 2001), and activation of the lentiform nucleus (putamen) has been found during working memory tasks (Giroud et al., 1997). Previous studies have found a more robust SME (Erk et al., 2003; Erk et al., 2005; Maratos et al., 2001; Paller and Wagner, 2002), but in their studies more complex stimuli were used, which were more distinct. It could also be the case that the subjects were too engaged in the matching-task, so the memory processing of the shoes was limited.

We found a prominent main effect of fame on the processing of associated shoes in several brain regions (see Table 3 and 4). The difference between the results of the main effect of faces between SME and fame and SAE and fame can be explained by the effect that the analysis of SAE and fame contained less participants (19 compared to 24) and that some trials were removed which had a BI of 50%. The regions that were found are common to the processing of famous faces directly. Previous studies have shown that processing of famous faces activate frontal and temporal regions, and the cingulate gyrus (Dietl et al., 2005; Elfgren et al., 2006; Gorno-Tempini and Price, 2001; Ishai et al., 2002; Ishai et al., 2005). Gobbini et al. (2004) found among other activation in the lentiform nucleus for personally familiar famous compared to non-familiar faces. Bernard et al. (2004) found among other activations also activation of the caudate when processing famous faces. The activations of the insula and posterior cingulate might be explained by the fact that these regions are also activated by learned faces, which were first unknown. Paller et al. (2003) found insula activation for non-famous faces that were learned, Kosaka et al. (2003) found an increase in the posterior cingulate when faces became familiar. In a way of course famous faces can also be seen as being learned, because they were also once non-famous. In a study of Ishai et al. (2002) the precuneus was also activated when subjects had to visually imagine famous faces.

Gorno-Tempini and Price (2001) state that famous faces can be seen as ‘semantically unique items’; they carry unique semantic associations that are not shared by other perceptually similar category members. We found activations in the MTL and according to Dietl et al. (2005) and Trautner et al. (2004) famous faces activate semantic memory processes in the MTL. The anterior temporal cortex and the left parahippocampal gyrus have been previously linked (Haxby et al., 2000; Turk et al., 2005) to accessing semantic information about a famous person. It therefore seems that participants in our study accessed semantic information when processing the famous faces.

According to Ochsner et al. (2004) the posterior cingulate gyrus also responds to judgement about others, so it might have been easier to judge the famous faces, because subjects had background knowledge about the celebrities. We also found an activation in the precuneus for famous faces that might be explained due to episodic memory retrieval, source memory and contextual associations (Cavanna and Trimble, 2006; Lundstrom et al., 2005). Therefore, famous faces triggered episodic knowledge about the celebrity and contextual associations, because the subject was instructed to judge whether the shoe does or does not belong to the person, and for the non-famous faces they do not have any semantic information available. It could be that judging famous persons on owning a shoe or not gave a higher elaboration due to knowledge about the famous person compared to the non-famous faces. Activation of the insula and caudate have been associated with deliberative and implicit social judgements (Aharon et al., 2001; O'Doherty et al., 2003; Singer et al., 2004; Winston et al., 2002). Also the insula and MTL are activated when automatically retrieving person-specific information of learned faces (Paller et al., 2006).

We expected that famous faces could be seen as an emotionally positive encoding context; Maratos et al. (2001) and Erk et al. (2003, 2005) found activations in the MTL and frontal regions for a SME with a positive emotional encoding context. According to Erk et al. the main effect of positive encoding context revealed activations in the right anterior cingulate, and the bilateral fusiform gyrus. Although we did not find activations in the fusiform gyrus but we did find activations of the MTL, frontal regions and the cingulate gyrus; so it seems that faces are indeed seen as a positive emotional encoding context.

Also activity in the posterior cingulate is elicited by perception of emotional salient stimuli (Maddock, 1999). The posterior cingulate was also activated when subjects watched affective advertisements compared to non-affective advertisements (Ioannides et al., 2000). We also found activation of the thalamus for the effect of fame, previous studies showed that the thalamus is activated when positive and negative moods are induced (Britton et al., 2006; Lane et al., 1997a) or when positive or negative pictures are shown (Lane et al., 1997b), it could be that the famous faces induced some kind of positive mood, because celebrities can be seen as a positive context.

Apart from finding a clear behavioural effect for memory, we also found an effect in the thalamus for the memory x fame interaction in the brain. Previous studies have shown that the thalamus is involved in long-term memory processes (Aggleton and Brown, 1999), and semantic memory retrieval (Kraut et al., 2002a; Kraut et al., 2002b; Schmahmann, 2003; Segal et al., 2003; Slotnick et al., 2002). Because our task during encoding is very semantically driven our interaction effect of SME x fame can be explained, because fame further increases activation of semantic memory.

We found a main SAE in the superior frontal gyrus, the medial frontal gyrus, the fusiform gyrus, and the hypothalamus. We did not find any negative activations related to for example disgust as was found in the study of Klucharev et al. (2006). The activation of the medial frontal gyrus can be explained by the fact that it is activated during preference judgement (Paulus and Frank, 2003) and during self relatedness (Phan et al, 2004). Thus, it seems that shoes with a high BI reflects the personal choice of the subject to actually want to wear the shoe and so relates to self. The activation of the superior frontal gyrus can be explained by the fact that our faces can all be perceived as experts on the presented shoes. Klucharev et al. found activation in the superior frontal gyrus for products rated with a high BI coupled to experts. Also, previous studies have shown that the superior frontal gyrus is activated when subjects watched amusing films compared to neutral films (Goldin et al., 2005) and the hypothalamus is activated by pleasant compared to neutral emotions (Lane et al., 1997b).

We found a negative interaction effect of SAE x fame in the precentral gyrus, the postcentral gyrus, the insula, the fusiform gyrus, the inferior frontal gyrus, the middle frontal gyrus, and the superior frontal gyrus. Klucharev et al. (2006) found activations in the middle frontal gyrus and the insula for products with a low BI, in their study only famous faces were used. Our interaction yielded a negative interaction of the middle frontal lobe, this result could thus be explained because famous faces as a context on BI will give an activation of the middle frontal gyrus for products with low BI. Also, the superior frontal gyrus and the middle frontal gyrus are activated by negative attitude activation (Wood et al., 2005). Broadmann area 9 (which we found activated in the precentral and the superior frontal gyrus is activated by unpleasant emotion (Lane et al., 1997). Broadmann area 6 (which we found activated in the precentral gyrus, the superior frontal gyrus, and the middle frontal gyrus) and the insula are activated during inducing sadness (Goldin et al., 2005). The fusiform gyrus, the insula, the inferior frontal gyrus, the middle frontal gyrus, the superior frontal gyrus, and the precentral gyrus have been activated by disgust (Calder et al., 2000; Schienle et al., 2005; Wicker et al., 2003). Habel et al. (2005) showed that the insula is also activated by induced sadness. So in all, our negative SAE x fame interaction could be explained due to the fact that shoes with a low BI induce negative emotional processes which drive the negative interaction with fame.

We found a main effect of match in the supramarginal gyrus, the parahippocampal gyrus, the medial frontal gyrus, the superior frontal gyrus, and the postcentral gyrus for products that were “not-owned”. We also found an activation in the lentiform nucleus for products that were “owned”. A study by Rossel et al. (2001) has shown activations in the supramarginal gyrus, and parahippocampal gyrus for semantically unrelated prime target pairs. It seems that the activations found for non matching face-shoe pairs resembles activations due to semantically unrelated items. We found a positive effect of match in the lentiform nucleus, a study by Warren et al. (2000) has shown that the lentiform nucleus is involved in interpretation of complex semantic relationships.

We also found a negative interaction effect for SAE x match in the insula, the superior temporal gyrus, and the cingulate gyrus (see Figure 2). Klucharev et al. (2006) found activations in these regions for products with a low BI, so it could be that this interaction effect is driven by products with a low BI.

Our study has shown that contextual presentation of famous faces has a strong impact on item processing. The activations evoked by fame as a context can be explained by the fact that famous faces as a context triggers semantic knowledge about the person and that these faces can be seen as a positive emotional encoding context. Thus the activations found by fame as a context can be seen as the neural correlates of emotional and semantic context effects on memory encoding. Famous faces also have a positive impact on memory. It seems that using a celebrity in advertising increases brand awareness and memory of the advertised product by increasing elaboration and positive emotional processing of the advertised product such that brand awareness increases. This effect might be so large as to warrant the extra investment.

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Appendix 1: Photo's of faces

Famous faces:


Famous 1:
Alexis Bledel


Famous 2:
Bridget Maasland


Famous 3:
Caroline de Bruijn


Famous 4:
Catherina Zeta-Jones


Famous 5:
Cynthia Nixon


Famous 6:
Katja Schuurman


Famous 7:
Jennifer Aniston


Famous 8:
Julia Roberts


Famous 9:
Kristin Davis


Famous 10:
Kylie Minogue


Famous 11:
Lauren Graham


Famous 12:
Maxima Zorroguieta


Famous 13:
Sandra Bullock


Famous 14:
Shakira


Famous 15:
Wendy van Dijk


Famous 16:
Yvon Jaspers


Famous 17:
Gwyneth Paltrow


Famous 18:
Daphne Bunskoek


Famous 19:
Beyonce Knowles


Famous 20:
Cameron Diaz

Non-famous faces (with made-up names):


Non-famous 1:
Jolanda Peters


Non-famous 2:
Sarah Snare


Non-famous 3:
Judith Frijlink


Non-famous 4:
Linda Fleeting


Non-famous 5:
Ellen van de Streek


Non-famous 6:
Faye White


Non-famous 7:
Casey Stoney


Non-famous 8:
Pauline Cope


Non-famous 9:
Rachel McArthur


Non-famous 10:
Mary Phillip


Non-famous 11:
Sabrina Wesselkamp


Non-famous 12:
Jane Ludlow


Non-famous 13:
Karen Hills


Non-famous 14:
Georgia Adams


Non-famous 15:
Christy Bruijsters


Non-famous 16:
Marloes Vos


Non-famous 17:
Ilse Rigter


Non-famous 18:
Karin Blinksma


Non-famous 19:
Kelly Smith


Non-famous 20:
Leanne Champ

Appendix 2: Attractiveness ratings pilot study

Famous	Name	Attractiveness in %	Non-famous	Name (made up)	Attractiveness in %
1	Alexis Bledel	63,33	1	Jolanda Peters	65
2	Beyonce Knowles	61,67	2	Sarah Snare	70
3	Bridget Maasland	70	3	Judith Frijlink	65
4	Cameron Diaz	71,67	4	Linda Fleeting	75
5	Caroline de Bruijn	46,67	5	Ellen van de Streek	70
6	Catherine Zeta Jones	73,33	6	Faye White	71,67
7	Cynthia Nixon	78,33	7	Casey Stoney	65
8	Daphne Bunskoek	75	8	Pauline Cope	71,67
9	Gwyneth Paltrow	66,67	9	Rachel McArthur	70
10	Jennifer Aniston	73,33	10	Mary Phillip	66,67
11	Julia Roberts	56,67	11	Sabrina Wesselkamp	66,67
12	Katja Schuurman	60	12	Jane Ludlow	63,33
13	Kristin Davis	75	13	Karen Hills	70
14	Kylie Minogue	71,67	14	Georgia Adams	68,33
15	Lauren Graham	63,33	15	Christy Bruijsters	75
16	Maxima	55	16	Marloes Vos	71,67
17	Sandra Bullock	75	17	Ilse Rigter	61,67
18	Shakira	66,67	18	Karin Blinksma	66,67
19	Wendy van Dijk	70	19	Kelly Smith	63,33
20	Yvon Jaspers	73,33	20	Leanne Champ	63,33
	mean	67,33		**mean**	68,00

N=6

One-way ANOVA: $F(38,1)=.108$, $p=.744$