NEUROMARKETING - HYPE OR HOPE?
Are there relevant consequences of the latest results of neuro sciences for media research?

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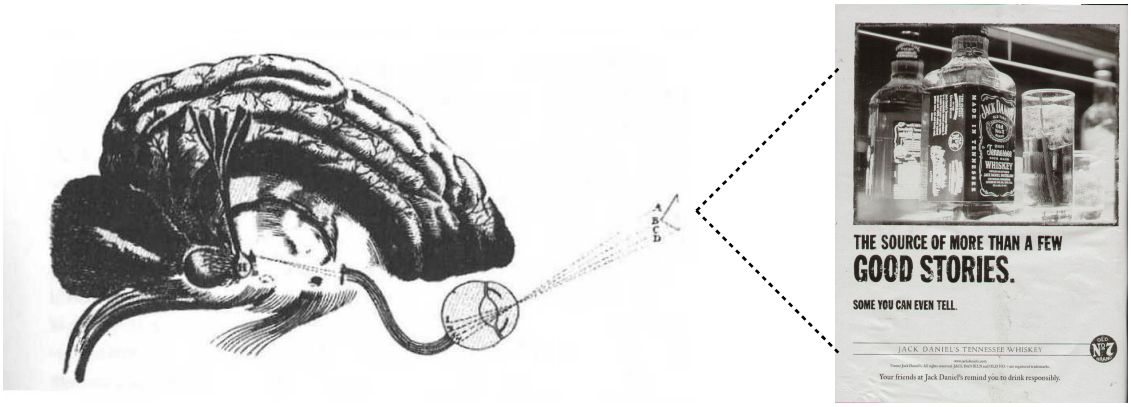
Eleven leading German neuro-scientists introduce their remarkable "Manifest about the Presence and the Future of Brain Sciences"[1)] with the words: *"Considering the enormous progress of brain sciences in the last years the impression may arise that our research is close to snatch its final mysteries from the brain."*

In the media you can find a lot of reports which feed this impression. And more specifically you also can find some market researchers praising the superiority of neuro-economic approaches and methods[2)] over traditional ones.

The subject of this paper is to give an overview of the actual state of neuromarketing research and to discuss some potential consequences for media research. This cannot be an exhaustive or even complete overview because the respective literature is already very comprehensive and referring to several scientific disciplines (neuro physiology, biochemistry, psychology, business economics, statistics, to name only some of them). So I'll give a subjective picture from a media researcher's perspective and rather formulate some hypotheses than draw scientific "conclusions". First of all I'll give a rough impression of how our brain works taking as an example the situation "you see an ad in a magazine". After that the most relevant research techniques (or better - tools) in neuro sciences are briefly presented, followed by some examples and results of this kind of research projects. Finally I'll deal with potential consequences of the finding of neuro sciences for media research.

How comes the ad in your mind?

Imagine you "read or look into" a magazine. And you see an ad (e.g. for "Jack Daniel's"). René Descartes (1596 - 1650) thought that what you see is focused by your eyes and the respective picture is "received" by the retina, transformed to signals which are passed on to the pineal gland. There the physical signal - a "res extensa" - is changed into a "res cogitans": the idea of what your eyes caught. Res extensa are physical, divisible, destroyable - res cogitans are not. They are two completely separated "substantiae" which interact in the pineal gland in a mysterious process created by god.



Left: Drawing of Descartes; right: Contemporary ad-work

As far as that - I suppose - the broad majority of people will follow Descartes even today, perhaps with the modification that "pineal gland" has to be substituted by "our brain". Not only neuro-scientists have contributed (in the last 400 years) to a different and far more developed understanding what's going on in our brain looking at a magazine page with an ad. We for example do know that the human eye - more exactly: two different kinds of specialized cells of the retina - can transform electromagnetic waves in the range of ca. 380 to 780 nanometer into neuronal activity (to make a very complex process very simple). "Rods" and "cones" are only the first of at least 4 kinds of neurons involved on the way between the retina and the visual cortex in the occipital lobe of the brain via the thalamus, the primary processor of visual information.

From now on things get very complex and complicated. You have to consider that it is not like one snapshot with a camera, how you "see" the ad is more like a film, a continuum. But this is already the "final version" which has been carefully processed and "designed" by your brain. In reality your eyes fix different points and regions with a frequency of 2 to 5 fixations and saccades

per second, the eyes deliver slightly different "pictures" to your brain which have to be "interpreted" in some way. And so on and so forth. Even more important: Your brain is not impatiently waiting for the visual information about the Jack Daniel's ad but it is working continuously. As long as you hold your eyes open there is always respective information processed to your visual cortex areas (and even if you close your eyes - for example in a supermarket when "thinking" for a second which brand of whiskey you want to buy - the activity of the visual cortex areas is not zero but thousands of neurons "fire" and are "active" … but this is a story not to be told at this place).

The "visual cortex"[3)] can be separated in the "primary visual cortex" (V1) and the so called "visual association areas" (V2, V3, V4, V5); all these areas again can be differentiated into approximately 30 interconnected visual areas. The first cortical visual area, the one that receives information directly from the retina (relayed by the lateral geniculate nucleus of the thalamus) transmits information to two primary pathways, called the ventral stream and the dorsal stream. The ventral stream consists of several visual areas (V1, V2, V4, areas of the inferior temporal cortex). Each of them contains millions of neurons whose respective fields together represent the entire visual field. The ventral stream is associated with object recognition and form representation. It is also associated with the storage of long-term memory and has strong (neural) connections to the limbic system (which controls/moderates emotions). In addition: All the areas in the ventral stream are (more or less reciprocally) connected with each other as well as with other areas of the cortex (i.e. for example the somato-sensoric cortex, the auditory cortex, the so called limbic cortex areas), and also with other structures in the center of the brain. And the ventral stream is strongly (reciprocally) connected to the dorsal stream.

The dorsal stream (V1, V3, V5 …) is involved in spatial awareness and guidance of actions (e.g. reaching - perhaps to the whiskey in the shelf?). Wikipedia actually describes the function of the dorsal stream by "it has two different functional characteristics - it contains a detailed map of the visual field, and is also good at detecting and analyzing movements". The dorsal stream is like the ventral stream connected to the other cortex regions and to other subcortical brain structures.

All the areas in the visual cortex - as well as all the other cortex regions - are influenced by factors as attention, actual activities in the working memory, by the stimulus salience etc. And last but not least they are influenced by projections of "deeper" (older) brain structures which often are called value systems (dopaminergic system, cholinergic system, noradrenergic system, etc.).

Regarding only a kind of "snapshot" of neural activities while looking into a magazine we can resume that millions of neurons are involved in the process, numerous different functional areas in your brain, and this dynamic "network" is changing and developing in fractions of a second. In the very same instant the other senses also are receiving information and charge your brain with their input. You hear the hammering music from your boy's room, you smell what in the kitchen is prepared for the hopefully speedy dinner (you feel hungry), and you may think of the not yet finished contribution for the next readership symposium. All these perceptions and sensations are prepared by respective and also very complex "networking" of millions and millions of neurons in your brain, and they interact with your visual neural activities.

But what I've described so far is only a small step of the whole process how the ad comes in your mind. So far we can only say "the ad is in your brain". You still are not even aware of it. We (actually physiologists, psychologists, neuro scientists etc.) know precisely how external stimuli - visual stimuli, auditive stimuli, olfactory stimuli, gustatory stimuli, stimuli for the sense of touch, and also stimuli with regard to thermoception, nociception, equilibrioception, proprioception - are received by our body respectively by our brain. We know a lot regarding which areas of the brain deal with/react on these stimuli. Research methods and analytical tools - e.g. functional Magnetic Resonance Imaging, Positron Emmission Tomography, EEG, MEG: see below - have been developed and recently much improved to better understand the "topography" of our brain's activities. But there is more speculation than knowledge about the exact mechanisms how the different neural activities are integrated to consistent "scenes", how these "scenes" become conscious to our "self", how concepts and ideas are stored (short term/long term) and processed, about the neuro-physiology of learning, how exactly an enormous share of our behavior (think of cycling, reading, walking, and perhaps even deciding for one of several brands of whiskey in the shelf …) is automated and by this taken away from our consciousness.

I concede that with regard to all of these questions there are interesting, sometimes fascinating approaches and contributions[4)]. But there is no generally accepted theory of "how the brain works", or a concept of how consciousness comes into our brain (or "self"?), or at least a solution of the "binding problem" *("... the problem of how the unity of conscious perception is brought about by the distributed activities of the central nervous system"*, Revonsuo and Newman, 1999).[5)]

In their "manifest"[6)] the German neuroscientists describe the actual state of research as follows: *"Basically the neuro-biological analysis of the brain sets in at three different levels. The highest explains the function of major regions of the brain, e.g. special functions of various areas of the cortex, of the amygdala or of the basal ganglia. The middle level describes what is going on in formations of hundreds or thousands of cells. And the deepest level comprises the processes at the level of single cells or molecules. So far we have made great strides only with respect to the highest level and to the deepest level but not at the middle level."* They explain that the progress at the upper level is mainly due to new methods like fMRI and PET. *"Our knowledge about what's happening at the middle level - ... which finally is the base of the processes at the upper level - is terribly poor ... It is completely unknown what's going on when hundreds of millions or even billions of neural cells "speak" with each other ... We have not even an idea of the rules how the brain works, how it represents the world in a way that actual perception fuses with former experience, how it experiences its inner activities as its own activity and how it plans future actions. Even worse: It is not at all clear how to research into this with the help of the actually available methods".*

With respect to the future potential of neurosciences the "brain researchers" declare in their "manifest": "*In foreseeable future, i.e. in the next 20 to 30 years, neuroscience will be able to explain the connection between on the one hand neuro-electric and neuro-chemical processes and on the other hand perceptive, cognitive, mental and motor performances in a way that predictions of these connections (in both ways) are feasible with a high degree of likelihood. This means that one will consistently accept mind, consciousness, feelings, acts of volition, and freedom of action as natural processes because they are based on biological processes.*

Nevertheless we'll not achieve a complete explanation of how the human brain works, i.e. a general deciphering at the cellular or even at the molecular level. Particularly there will be very limited success in completely describing an individual brain and so making predictions of the behavior of a particular person. This is due to the fact that individual brains organize themselves on the base of genetic differences and not reproducible imprinting by environmental effects - in greatly varying ways following individual needs and an individual system of values. This makes it generally not feasible to conclude from recorded brain activities to the resulting mental process of a specific individual".

So the provisional answer to the question "how comes the ad in your mind?" is: We don't know. We do know a lot about how it comes in your brain and with the help of new neuroscientific methods we have identified a lot of regions and structures in the brain which are involved in what happens in your brain when you open a page of a magazine with an ad. And we know that what happens in this situation in your brain may be quite different of what happens in the brain of another individual in the same situation. But we know not much what really happens in your brain or the other individual's brain. The only thing we are sure about is that what happens is very, very complex - and that by the way also implies that it is extremely naïve to believe that neuroscientists (albeit with the help of market researchers) can find the "buy-button" in the brain which could be addressed by advertisers. Wolf Singer, one of Germany's most prominent brain researchers has put it into the following words in an interview with the SPIEGEL: *"Today we can measure brain activities - and nowhere a center of final evaluation could be discovered. Obviously there is no single place where all information gathers, where consistent representations of the world are built from the different signals of all senses, where decisions are made, where the self says "I". Instead we are confronted with an extremely decentralized organized system, where at many places simultaneously visual, auditive and motor-related results are produced. And the brain coordinates all this in a mysterious way to a coherent interpretation of world".*[7)]

The most relevant neuroscientific research techniques

I'll limit the following short description of neuroscientific techniques to those directly measuring brain activities. But I want at least mention that there are some more methods and techniques which are related to activities of the nervous system ("neuro…"!), e.g. methods of measuring galvanic skin response, muscle tension, blood pressure, etc.

The most important neuroscientific techniques can be grouped into two categories:

a) **Methods of measuring electrical activities** respectively changes of electric currents in the brain (directly related to neural activities):
- Electroencephalography (EEG)
- Magnetoencephalography (MEG)

b) **Methods of measuring changes of neural metabolism processes**:
- Positron Emmission Tomography (PET)
- Functional Magnetic Resonance Imaging (fMRI)

EEG
The first human EEG was already recorded in 1924 and published in 1929 by Hans Berger in Jena. For taking an EEG (normally about 20) electrodes are placed on the skin of the test person. In order to reduce the bias by impedance you should prepare the scalp area by light abrasion and application of a conductive gel.

The EEG shows the so called brainwaves and how they vary during lab experiments. The temporal resolution is high (in the area of sub-milliseconds). So this method is interesting with regard to the analysis of the sequence of brain activities. However it has limited anatomical specifity and the results can only be related to the surface of the brain (spatial resolution of about 3 cm).

MEG
The MEG is the measurement of the magnetic fields produced by electrical activity in the brain. It is very sensitive, without any time lag and not limited to the electrical activities of the surface of the brain. So this technology can provide an image of the entire brain activity at a certain moment (and of sequences of moments). But the spatial resolution is a problem because of interferences between the measuring machine and the objects of the measurement.

The "machine" is a system of about 300 superconducting spools situated in a kind of helmet around the head. You need a magnetically shielded room for this machine and about 400 l liquid helium per month. The machine is expensive. The machine is able to measure the combined fields from a region of about 50.000 active neurons. Combined with fMRI and with help of sophisticated computer programs you can drive the spatial resolution of MEG to millimeters.

The strength of this technique is its ability to analyze the temporal structure of (changes of) brain activities. An example gives the quote from a brand-choice study conducted by Bräutigam et al in 2001:

"*Choosing among different brands of closely related products activated a robust sequence of signals within the first seconds after the presentation of the choice images. This sequence engaged first the visual cortex (80 - 100 ms), then as the images were analyzed, predominantly the left temporal regions (310 - 340 ms). At longer latency, characteristic neural activation was found in motor speech areas (500 - 520 ms) for images requiring low salience choices with respect to previous (brand) memory, and in the right parietal cortex for high salience choices (850 - 920 ms).*"[8)]

PET
PET is a nuclear medicine technology which can provide a three dimensional image or map of functional processes in the brain. "PET scanning is invasive, in that radioactive material is injected into the subject. However the total dose of radiation is small, usually around 7 mSv. This can be compared to … 2 - 6 mSv per annum for aircrews and 7,8 mSv per annum background exposure in Cornwall"(!).[9)]
You need a cyclotron (in the same building as the scanner). It is offered only by a few hospitals and universities. "PET brain mapping is based on the assumption that areas of high radioactivity are associated with brain activity. What is actually measured indirectly is the flow of blood of different parts of the brain, which is generally believed to be correlated, and usually measured using the tracer oxygen (^{15}O)."[10)] Its spatial resolution is brilliant (below 1 mm), the temporal resolution is poor (up to 5 seconds you have to correct it for the computer analysis).

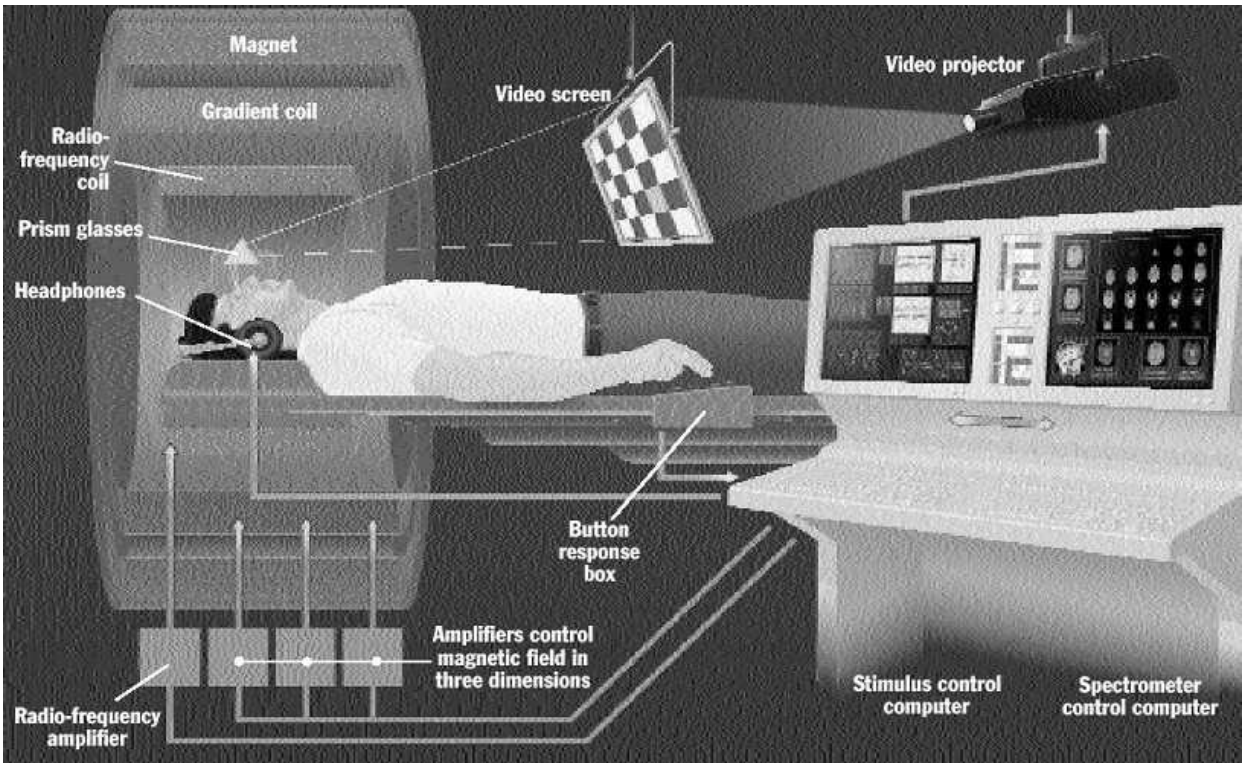
FMRI
FMRI is by far the most "popular" neuroscientific technique. It is based on the already long known correlation of hemodynamic activity in the brain and neural activity in the brain: Active nerve cells consume oxygen supplied by local capillaries. Approximately 4 to 6 seconds after a burst of neural activity, a hemodynamic response occurs and that region of the brain is infused with oxygen-rich blood. Because of the magnetic characteristics of oxygen the magnetic resonance signal of blood is slightly different depending on the level of oxygenation (⇨ "Blood Oxygenation Level Dependant signal = BOLD). An MR scanner can be used to detect the BOLD contrast.

For those who want to go into detail I recommend "fMRI for Dummies" (www.med.uwo.ca/neuroscience/gap/faculty.htm ⇨ Jody Culham). I can't here describe in detail the process of conducting a fFMRI study. But I want to emphasize two points:

1) In order to produce these well known pictures where some regions of the brain are "lit up" in yellow and red and others are not
- you have to work out suitable hypotheses which special regions in the brain ("ROI" = regions of interest) will react in which way to your stimulus/task,
- you have to recruit right handed test persons according to your test design (who mustn't have metal implants, pacemakers, aneurysm clips, inter uterine devices, some dental work, piercings, but must wear earplugs in the scanner),
- you have to take numerous scans,
- you have to compare these scans by computer programs and have to take a lot of decisions about the statistical methods to be applied,
- you have to decide on the analysis program,
- and you have to carefully measure out each test person's brain and standardize it for the cumulative analysis: each test person is different and the same coordinates in the scan may define different functional areas in different brains.

Be aware of what is measured and shown by the pictures which build your survey report: Differences in the cerebral blood flow over time and/or compared to a situation with other stimuli (because the brain doesn't have a situation with no stimulus!).

2) The precise relationship between neural signals and BOLD is not (yet) known. No one really understands how neurons - or as it is relevant here: Groups/clusters of some 10000 neurons - trigger increased blood flow. As a consequence one can at least not be sure to detect all relevant brain regions/spots of neural activity-changes by measuring cerebral blood flow differences.



In spite of all these potential bugs and problems: fMRI is the most preferred technique of neuroscientists. The spatial resolution is moderate (can be boosted down to ca. 1 mm esp. when focusing a single very special "region of interest") and the temporal resolution as well (remember the time lag of 4 - 6 seconds).

But it is "not invasive", you don't need to inject radioactive material in your test persons. (You may judge whether it is "biotic" to be asked to lie still, usually restraint with soft pads in order to avoid disturbing movements of the head, and to be pushed into a narrow tube where you have to wear earmuffs against the terrible noise of up to 120 dB).

Some examples of neuroeconomic research projects

Though the number of marketing related neuroscientific studies seems to be limited I'm sure that only a fraction of these projects has been published. So any overview may be biased in favour of (more) academic projects. Peter Kenning and his group at the University of Münster have given an overview of relevant resp. typical neuroeconomic studies in the recently published "FOCUS Jahrbuch 2005" to which I refer in the following section. This is nothing but a translation of this publication:

Author/Country	Research Background	Research Problem	Research Technique	Main Result(s) (as reported)
Rossiter et al. (2001), Australia	Advertising effects of commercials	Neural activity produced by viewing commercials	SSPT on the base of EEG	Emotional advertising is better recalled than fact-related
Breiter et al. (2001), USA	Prospect Theory [game theory]*	Neural reactions to anticipation and to experience of gains and losses	fMRI	Partly differing and partly identical brain areas are involved when monetary incentives are expected or factually paid off. The brain areas involved in both cases overlap with regions which are active in reaction to gustatory stimuli and to drugs triggering euphory.
Lo/Repin (2001), USA	Decisions of stock brokers	Role of emotions in real-life-decision-making of stock brokers	EEG/EDR	Different states of activation depending on the volatility of the decision-related market and on the experience of the broker
McCabe et al. (2001), USA	Game theory, with special regard to the aspects of trust and willingness to cooperate	Determination of neural correlates of cooperative behavior	fMRI	Trust and willingness to cooperate are connected with activity in brain areas which are responsible for emotional processes and their integration in decision making
Erk et al. (2002), Germany	Choice decision regarding different cultural objects (cars)	Investigation of the neural representations of social incentives	fMRI	Viewing products which stand for wealth and high status triggers an increase of activities in brain areas responsible for rewardings
Smith et al. (2002), USA	Game theory, in particular choice under ambiguity, risk, gains and losses	Neural substrates of attitudes towards monetary payments (gains/losses) and assumptions about possible results (ambiguity/risk)	PET	Attitudes towards payments and assumptions about the likelihood of game results are independent in terms of representation by (different) neural systems.
Paulus/Frank (2003), USA	Choice of preference among consumers	Relationship to preference and brain activity	fMRI	Measured preferences and observed brain activities are correlated
Sanfey et al. (2003), USA	Game theory, in particular ultimatum game	Investigation of the neural substrates of cognitive and emotional decision making processes during playing the ultimatum game	fMRI	There is a correlation between reactions to fair offers and brain areas representing positive emotional states resp. unfair offers and brain areas representing negative emotional states. The same is true for the accept/reject decision.
Ambler et al. (2004), UK	Buying behavior	Comparison of reaction times to complicated (several brands) buying decisions and to simple buying decisions (same product, different package sizes)	MEG	Positive correlation between brand awareness and reaction time for decision, negative correlation between simple buying decision and reaction time [?*]
De Quervain et al. (2004), CH	Altruism, cooperation	Investigation of the neural base of "altruistic punishment"	PET	Sanctions against defectors activate reward related brain regions
Knutson/Peterson (2004), USA	Decision making under uncertainty, in particular with respect to investor behavior	Identifying neural correlates of expected utility	fMRI	The neural reconstruction of expected utility shows: Emotions play a significant role in the anticipation of benefits
Deppe et al. (2005), Germany	Preference decisions of consumers with respect to brands	Neural correlates of brand stimuli in decision process	fMRI	(Subjectively) strong brands relieve brain areas responsible for rational processes and trigger increased activity of areas responsible for emotional judgment

* Addition/comment by the author

There are some further studies worth to be mentioned here:

- **The cortical relief effect: unconscious advertising effects**
  In a series of fMRI-studies the team of **Peter Kenning** at the University of Münster (Germany) found consistently for different categories of consumer goods and services (e.g. coffee, travel services, financial services, beer, energy-drinks): The higher the brand familiarity the more pronounced the so called "cortical relief effect" in a choice decision situation. This effect means that - regarding a choice decision situation - in case of the involvement of the own favorite brand a reduction of the neural activities of the working-memory-related cortex areas can be observed whilst in the same time deeper brain areas were more active which are related to affective behavior and self perception. Including some further analyses Peter Kenning summarizes:

  "1. Strong brands trigger a relief in the decision making process.
  2. Strong brands are able to integrate emotions in the decision marking process.
  3. The difference between the first, second and third ranking place of brands is not linear [related to an individual: note of the author].
  4. The economic interpretation of the theory of brain hemispheres should be revised.
  5. Brands can be defined as stimuli which partly modulate decision making processes in a subconscious way."[12)]

- **The credibility transfer of magazines**
  Again a joint **team of three departments of the University of Münster** conducted a fMRI study which revealed how strong magazine brands influence the credibility of news. In their abstract the scientists describe this study as follows:

  "Background:
  ... Phylogenetically, it was important for the individual to assess the relevance of all kinds of environmental stimuli in order to adapt behavior in a flexible manner. Consequently, we can in principle not exclude that environmental information covertly influences the evaluation of actually decision relevant facts ("framing effect").

  Objective:
  To test the hypothesis that the medial prefrontal cortex is involved into a framing effect we employed functional magnetic resonance imaging (fMRI) during a binary credibility judgment task.

  Methods:
  Twenty-one subjects were asked to judge 30 normalized news magazine headlines by forced answers as "true" or "false". To confound the judgments by formally irrelevant framing information we presented each of the headlines in four different news magazines characterized by varying credibility. For each subject the susceptibility to the judgment confounder (framing information) was assessed by magazine-specific modifications of the answers given.

  Results:
  We could show that individual activity changes of the ventromedial prefrontal cortex during the judgments correlate with the degree of an individual's susceptibility to the framing information.

  Conclusion:
  We found (i) a neural correlate of a framing effect as postulated by behavioral decision theorists that (ii) reflects interindividual differences in the degree of the susceptibility to framing information."[13)]

- **The Shop Consult study**
  "With neurons to millions" is the headline of the commercial presentation of the study "The neural effect of motivational pictorial communication and its application in shop- and product-image concepts" (not translated by the author!)

  The study has been conducted in 2001 by Shop Consult by Umdasch in Amstetten (A) and the Ludwig-Boltemann-Institute in Vienna (A). 600 pictures of goods in the areas of lingerie and "living" (each surrounded by "emotionally loaded pictures") were presented to 40 test persons during their 3-hours-session under the MEG. Shop Consult gives the following summary:

  "1. The higher the emotional charging of the presentation of the goods - the significantly higher the neuromagnetic activity.
  2. The higher the neural activity - the higher the focused willingness to decide. [in German: "… desto höher die gerichtete Entscheidungsbereitschaft"]
  3. Significantly different sequence of activation of brain activities (activation potentials) of men and women.
  4. Differences of the neural pattern between men and women during the presentation of the respective pictures.
  5. Significant difference of the neuromagnetic activity between the two product categories "lingerie" and "living".
  6. The early brain activity during visual perception is measured in the phylogenetic older, deeper brain structures ... only ... from 200 ms the maps of neural activities in the neo-cortex area take place.
  7. With increasing age the neural activity decreases."[14)]

Are there relevant consequences of the neuroscientific insights for media researchers?

Apart from the specific neuroscientific findings - mainly related to the brain's topography - there's not really a lot of news for market and media researchers. All the marketing related "findings" more or less trigger a déjà vu. The methodological set up of all these fMRI/MEG/PET-studies may be suited for neuroscientific basic research but seem not (yet) feasible for the meanwhile rather subtle research questions of media researchers.

Nevertheless this new research approach is fascinating also for media researchers because it opens a totally new perspective of our basic assumptions how media are "consumed" respectively what of the inner and the outer world human beings can perceive, how this works. And perhaps even why sometimes the information given in an interview may be wrong but not a lie. And hopefully we can learn something from the neuroscientists in order to improve the wording and the design of our questionnaires. And perhaps we can better understand the specific strengths and weaknesses of different interviewing modes (CAPI, CASI, CAWI, by phone …).

Before writing this paper I listed some questions derived from discussions with media researchers hoping neuroscientific approaches could contribute to find answers. I'll list here these questions again and try to give a very short answer to each in the light of what I actually know about the state of neuro sciences:

- *Will neuro sciences revolutionize our understanding of how advertising works?*
  Basically yes, we'll understand a lot more of human perceptions and how they are processed in our brain, what else is involved etc. But this will not cause revolutionary changes at the macro level of the daily media business. In a foreseeable future!

- *Can neuro sciences enlighten our understanding of the different ways how print ads and tv commercials work?*
  We'll have some new insights with this respect. But I think they rather will be of academic interest. We can stick to what we have learned until now.

- *To what extent will neuro sciences improve our understanding of reading/readers?*
  There are no specific improvements to be expected.

- *To what extent will neuro sciences influence readership research?*
  There could be some impact with regard to interviewing methods and wording of our standard questionnaires. This is new fuel for the everlasting race for truth in establishing readership figures.

- *How can advertisers better address (or influence?) - if not the "buy button" in the customer's brain - the relevant decision making structures in the potential buyer's brain?*
  There is no buy button. One of the secured findings of neuroeconomic research is "that regarding economic decisions we can usually observe polycentric networks of neural activity" (P. Kenning et al.).[15)]

- *Are there respective (and "actionable") differences between different magazines and their readerships?*
  No, at least no differences of which we are not yet aware.

The dance of science continues.[16)]

[1] In "Gehirn & Geist" 6/2004, p. 30 (translation by the author)

[2] E.g.:
- "Now the latest results of brain research bring us clearly closer to the goal of finding out the most secret wishes of the customers", Hans-Georg Häusel in marketing journal 9/2004, p. 6 (translation by the author)
- "If you look at traditional research, that's biased by self-reporting biases, peoples' ability to articulate of the difference between conscious and unconscious thought … We have been able to actually get beyond all those biases, to have very pure information of how a customer would respond to a product or to a brand" - Adam Koval, COO of Thought Sciences, see CBC News, "What is neuromarketing", broadcast Dec. 2, 2002.

[3] For this section see among other sources: http://en.wikipedia.org the items "Visual Cortex", "Thalamus", "Ventral stream" etc.

[4] Literature which I can recommend for interested people without a degree in medicine/psychology/bio-chemistry:

- Antonio Damasio: The Feeling of What Happens. Body and Emotion in the Making of Consciousness, 1999 (Deutsch: Ich fühle also bin ich, München 2000)
- Mark Solms, Oliver Turnbull: The Brain and the Inner World. An introduction to the neuroscience of subjective experience, 2002 (Deutsch: Das Gehirn und die innere Welt. Neurowissenschaft und Psychoanalyse, 2004)
- Gerald M. Edelmann, Giulio Tononi: A Universe of Consciousness. How Matter becomes Imagination, 2000 (Deutsch: Gehirn und Geist. Wie aus Materie Bewusstsein entsteht, 2002)
- Gerald M. Edelmann: Wider than the Sky. The phenomenal gift of consciousness, 2004 (Deutsch: Das Licht des Geistes. Wie Bewusstsein entsteht, 2004)
- Ernst Pöppel: Grenzen des Bewusstseins. Wie kommen wir zur Zeit und wie entsteht Wirklichkeit? 2000

[5] See www.wikipedia.org: "Binding Problem"

[6] "Gehirn & Geist" 6/2004, p. 30 cont. (translation by the author)

[7] Wolf Singer in SPIEGEL special 4/2003

[8] Bräutigam/Stins/Rose/Swithenby/Ambler (2001): Magnetoencephalographic signals identify stages in real-life decision processes (in "Neural Plasticity", Vol. 8 (No. 4), p. 241)

[9] http://en.wikipedia.org/wiki/positron_emission_tomography

[10] ibid.

[11] Peter Kenning, Harald Kugel, Michael Deppe, Hilke Plassmann, Wolfram Schwindt: "Neuroökonomie: Begriff, Grundlagen, Methoden und erste Ergebnisse" in: Focus Jahrbuch 2005, p. 144/145

[12] Peter Kenning: Neuronale Wirkungszentren der Marke" in: Neue Ansätze in Markenforschung und Markenführung, published by brandsboard and the journal Planung & Analyse, 2005 (translation by the author)

[13] see www.sciencedirect.com, the abstract of the article "Evidence for a neural correlate of a framing effect: Bias-specific activity in the ventromedial prefrontal cortex during credibility judgments" by M. Deppe, W. Schwindt, J. Krämer, H. Plassmann, P. Kenning, E. B. Ringelstein, 2005
A more detailed summary is available at www.connecs.org, see "agenda"

[14] See www.shopconsult.at. The summary actually is not more available at this site. Translation by the author.

[15] Peter Kenning et al., ibid., p. 147

[16] This is taken from a draft paper by Brian Knutson and Richard Peterson from the Stanford University, CA: "Neurally reconstructing expected utility", 2004