# CHAPTER 4

# Consumer neuroscience a new tool for prevention in public health

**Olivier Oullier**[1] and **Sarah Sauneron**[2]

As an extension of behavioural economics and social psychology, *neuroeconomics*[3] offers a better understanding of the neural dynamics underlying economic and financial decision making. This field of research gave rise to a sub-field: consumer neuroscience, which studies the actions that govern the daily life of *homo consommatus,* from his domestic practices to his purchase decisions, opening a hitherto new "window" on certain mental processes that come into play when making consumer decisions.

Thus, among the novel methods and theories explored by publicity and marketing specialists with the purpose of improving the effectiveness of their communication strategies, **consumer neuroscience have undergone an exponential growth.** In fact, while brain sciences do not constitute a miraculous formula making it possible to guarantee the optimal impact of a campaign as some claim, it constitutes nevertheless **a complementary methodology to the traditional tools used in communication**. In view of the development of consumer neuroscience and the unceasingly increasing use of behavioural and brain sciences by the private sector, it is advisable today to consider the use of this discipline for public health prevention strategies.

## 1. Inside the customer's head?

### 1.1. The appeal of neuroimaging should not hide its limitations

Consumer neuroscience only started to advance with true great strides at the end of the 1990s when neuroimaging methods were developed (and mediatised), especially **magnetic resonance imagering** (MRI). This technique makes it possible, in its anatomical version, to map the structures of the brain with precision. Its functional

[1] Scientific adviser, Department of Social Affairs, Centre for Strategic Analysis and Associate Professor of Neuroscience, Cognitive Psychology Laboratory (UMR 6146), University of Provence (France).
[2] Project manager, Department of Social Affairs, Centre for Strategic Analysis.
[3] Gironde S. (2008), *La Neuroeconomie: comment le cerveau gère mes intérêts (Neuroeconomics: how the brain manages my interests),* Paris, Plon ; Zweig J. (2007), *Your Money and your Brain*, New-York Simon & Schuters; Schmidt C. (2010), *Neuroéconomie: comment les neurosciences transforment l'analyse économique*, (*Neuroeconomics: how neuroscience transforms economic analysis)*, Paris, Odile Jacob.

variation, or fMRI, is aimed at estimating the variations of blood flow in brain areas. Whether or not carrying out a task is accompanied by a significant increase in the activity in certain cerebral parts can be deduced from this. However, the colouring of one area does not mean that the remainder of the brain is not functioning [1]. This only means that the part in question has reached the statistical threshold of change of activity in relation to a control condition, contrary to the others.

This technique is the best known today by the general public, in particular because it offers fancy 3D images which scientists, the media and the public love. But neuroscience are not limited to fMRI. For example, **positron emission tomography** (PET scan)[2] makes it possible to explore the pathway followed by certain substances in the brain with a high degree of spatial accuracy. **Electro-encephalography and magneto-encephalography**, EEG and MEG respectively, for their part record the activity of groups of neurons in the cerebral cortex with a lower spatial definition but a much better temporal resolution [3].

However, **the potential of cerebral imagery still encounters certain technical and methodological constraints**. It is thus advisable to combine these various tools (for example to carry out fMRI with EEG) to overcome their respective deficiencies and obtain a better spatial and temporal resolution [4]. Moreover, the lack of mobility and portability of the equipment confine the experiments to the laboratory [5]. This not only limits the ecological validity of the results but also the industrial use of these techniques.

Lastly, the extreme sensitivity of the data to the movement of the head makes it currently impossible to carry out a neuroimaging experiment without the consent of an individual. Total co-operation of the subject is necessary, with the need for obtaining the agreement of ethics committees, this being likely to reassure those who are concerned about the risks of "cerebral intrusion" or of "mind manipulation"[6].

It is possible to be freed from some of the constraints of neuroimagery **by focusing** not only on brain activity *per se* but also on **its peripheral manifestations**: the trajectory of a glance, eye movements, heartbeats, electrodermal response (also known as skin conductance measure) or changes in hormonal concentration thanks to saliva samples [7].

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[1] Actually, the brain as a whole functions all the time.

[2] This technique requires the injection of radioactive isotopes into the body.

[3] This resolution is in the order of a millisecond, which is much more realistic with regard to the transmission speed of neural messages than the half-second offered by fMRI for example.

[4] For a detailed presentation of the imagery and cerebral stimulation techniques within the framework of neuroeconomy experiments, see Charron S., Fuchs A. and Oullier O. (2008), "Exploring brain dynamics in neuroeconomics", *Revue d'Économie Politique*, n° 118, p. 97-124.

[5] And this despite the claims of certain self-proclaimed neuromarketing specialists who claim to record the cerebral activity of consumers in supermarket alleys. Admittedly, they obtain recordings by EEG in particular, but their data makes little sense because it is affected by a lot of "noise" from the electromagnetic environment (neon signs for example) and the movement of the customer.

[6] Experiments on humans (in particular cerebral imagery, but not only this) cannot be carried out in our country without prior agreement by a People Protection Committee (CPP) and of the French Agency for the Safety of Health Products (AFSSAPS). They are similar to local and national IRBs in the US for example.

[7] This technique was used on traders in the City of London to study and correlate their endocrine reactions with the volatility of the market and their financial decisions. Coates J. M. and Herbert J.

Another method for doing research on the central nervous system consists in **temporarily modifying the activity by administering hormones externally** (intravenous or nasal). The latter will be transported by the blood, to go and act upon specific receptors in the body, including the brain. For example, during experiments in neuroeconomics, oxytocin [1] diffused in the nose lead to a modification of the behaviour of an investor by making him more trustful [2] and more generous [3] towards a person with whom he was participating to an economic exchange.

Lastly, another way of modifying the functioning of the brain is to **excite or inhibit certain parts by electromagnetic impulses thanks to transcranial magnetic stimulation (TMS)**. This technique makes it possible to temporarily simulate the effects of cerebral lesions and constitutes an experimental version of neuropsychology that links brain leasions to behavioural changes.

However, these methods should not be interpreted in a reductive and deterministic way. If the functions of an area of the cortex are disturbed and a behavioural modification ensues, that does not mean therefore that this particular brain area is "responsible" for the altered behaviour. At the most, one can conclude that this portion of the brain plays a part within the complex network that underlies the aforementioned behaviour[4].

This constitutes the major challenge for work in functional connectivity, whose goal is to better understand how areas of the brain "communicate" among each other. As frequently stated in neuroscience books and talks "neurons that fire together wire together". Functional connectivity makes it possible to go beyond just locating areas of the brain and to better understand the complex dynamics of information exchanges within the brain.

## 1.2. Going beyond verbalisation to access emotions

**Neuroimaging techniques** have been employed not only to study the cerebral mechanisms taking part in visual, olfactive and gustatory perception, *etc.*, but also to try to **better understand the way in which consumers think, what influences them** and, more generally, how their brain responds to the environmental signals to which they are exposed[5]. One of the major contributions of behavioural sciences as regards public health prevention is to make it possible to take into account the cognitive and emotional biases that intervene in decision making. Indeed, **far from *homo œconomicus*, the "cold-calculator" whose choices are always optimal, *homo***

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(2008), "Endogenous steroids and financial risk taking on a London trading floor", *Proceedings of the National Academy of Science of the United States of America*, 105, p. 6167-6172.

[1] Oxytocin is a nanopeptide formed in the hypothalamus and transported, and then stored, by the posthypophysis, which releases it into the blood stream. In particular produced by expectant mothers, it is often called the "love hormone".

[2] Kosfeld M., Heinrichs M., Zak P. J., Fischbacher U. and Fehr E. (2005), "Oxytocin increases trust in humans", *Nature*, 435, p. 673-676.

[3] Zak P. J., Stanton A. A. and Ahmadi S. (2007), "Oxytocin increases generosity in humans", *PLoS One*, 2, e1128.

[4] Camus M., Halelamien N., Plassmann H., Shimojo S., O'Doherty J., Camerer, C. *et al.* (2009), "Repetitive transcranial magnetic stimulation over the right dorsolateral prefrontal cortex decreases valuations during food choices", *European Journal of Neuroscience,* 30, p. 1980-1988.

[5] It is advisable however to clearly distinguish what one expects (both on an academic and industrial level) from the use of these techniques and from the information that they really provide. There is generally a great difference between the two.

***consumerus*** **is the result of histories, emotions, desires, and constant interactions with his or her environment**.

Behaviours are the fruit of processes that take place below the threshold of conscious detection. If this were not the case, the brain would be overwhelmed by the amount of information received simultaneously from each sense. Rather than deal with this massive flow of data consciously, "attention focusing" makes it possible to "sort" and to concentrate on the environmental events that are the most important in regard to the task being accomplished or goals set. This treatment of sensory information from various sources (visual, auditive, tactile, gustatory, olfactive, proprioceptive or even semantic) which one does not notice, is no less essential. In fact, to ask people why they act in such a manner, or to try to predict their reactions, is a simplistic approach that often gives rise to unreliable or even erroneous data. **An individual does not have access to all the parameters and influences that determine his or her decisions** [1].

However, for years public institutions have called upon traditional marketing techniques[2] based on verbalisation and some forms of introspection (surveys, discussion groups, interviews), whereas specialists in the communication, such as Gerald Zaltman, agree in denouncing the limitations of these or even their obsolescence: "*The world has changed, but our methods for understanding consumers have not. We keep relying on familiar but ineffective research techniques and consequently misread consumers' actions and thoughts. The products we create based on those techniques simply aren't connecting with consumers"* [3].

As shown by Nisbett and Wilson in a seminal paper, when a person is asked, he or she will always tend to say more than what he or she actually does or know [4]. To explain this phenomenon, it has been proposed that all the information given regarding the determinants of his or her decisions is nothing but post-hoc **justifications and rationalizations** and is thus in fact distorted [5]. There is also a bias that consists in **wanting to present oneself in a favourable light to interlocutors: it is thus a case of "social desirability".**

Lastly, the formulation of the questions and the coding of the answers can influence the conclusions. Asking *"Does this image frighten you? If so at what point?*" or *"At what point does this image frighten you?*" is thus not equivalent, the second question making a negative answer more difficult.

All these arguments invite one to reconsider the traditional communications tools. From this point of view, **consumer neuroscience can help today to better understand the consumer by offering data that is sometimes less subjective than verbalisation and that allows a new form of quantification.**

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[1] And also, there always remains the possibility of lying, which many people do when answering surveys, in particular when they are accompanied and their true behaviour or reason is not in agreement with the dominant thought (social norm).
[2] These techniques generally result from experimental and social psychology.
[3] Zaltman G. (2003), *How Customers Think: Essential Insights into the Mind of the Market*, Harvard Business Press, Cambridge..
[4] Nisbett R. and Wilson T. (1977), "Telling more than we can know: Verbal reports on mental processes", *Psychological Review,* 84*,* p. 231-259.
[5] Bertrand M. and Mullainathan S. (2001), «Do people mean what they say? Implications for subjective survey data", *American Economic Review*, 91(2), p. 67-72.

## 1.3. The neuroscience of marketing versus the marketing of neuroscience

**Many communication and marketing specialists**, aware of the potential advantages of resorting to **neuroscience, have developed a private interest in them** [1]. **An industrial sector emerged: that known as "neuromarketing** ". Despite the prudence generally observed by scientists in regard to the effectiveness of this method [2], some media and marketing experts seized the subject, attributing exaggerated capacities to the neuroscience in "decoding the intentions of the consumer" [3].

The companies that offer this kind of services all over the world (more than a hundred today) contribute to this phenomenon by "overselling" their expertise. Many of these companies do not even have recourse to neuroscience but are recycling their traditional marketing speeches decorating them with some concepts – often erroneous – of neuroscience.

Moreover, **the image of a brain gives the illusion of understanding of its functioning both for the specialist and for the layman**. The "neuro" affixed before "marketing" has thus become a modern version of "scientifically tested" that is put on products for them to sell better. This impact has been experimentally tested in two studies in experimental psychology during which more or less extravagant facts were presented, supported (or not) either by cerebral images [4], or by neuroscientific explanations [5]. In both cases, "playing the neuroscience card" proved to be a paying strategy because the subjects (including some having a background in cognitive neuroscience) were convinced when the image of the brain or the scientific explanation accompanied the remarks; a phenomenon qualified by some as *" explanatory neurophilia "*[6] thanks to the "aura of the brain ". Some professionals did not hesitate to "use this trick" and "market neuromarketing" in their turn![7]

It is thus appropriate to **differentiate between private sector neuromarketing and its promises and consumer neuroscience that are a rigorous and careful scientific academic field.** This point is not trivial. It may prove to be harmful for academic research if neuroscience are perceived by public opinion as just neuromarketing, one of its mediatic variations, often promoted without reserve by certain industrialists. The subject is sensitive and has been discussed on several occasions at the French Parliament within the framework of the preparation for the bioethical law revision[8].

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[1] Zaltman G. (2003), "How customers think: Essential insights into the mind of the market", *Harvard Business School Press.*

[2] Oullier O. (2003), "Le neuromarketing est-il l'avenir de la publicité ?" "Is neuromarketing the future of publicity?", *Le Monde*, edition of October 25th ; Valo M. (2009), "Les neurosciences au secours de la pub" "Neuroscience to the rescue of advertising", *Le Monde 2*, edition of March 28th.

[3] In particular see Lindstrom M. (2008), "Buyology: Truth and lies about why we buy*"*, *Broadway Business.*

[4] McCabe D. P. et Castel A. D. (2008), "Seeing is believing: The effect of brain images on judgments of scientific reasoning", *Cognition*, 107(1), p. 343-352.

[5] Weisberg D. S., Keil F. C., Goodstein J., Rawson, E. and Gray J. R. (2008), "The seductive allure of neuroscience explanations", *Journal of Cognitive Neuroscience*, 20(3), p. 470-477.

[6] Trout J. D. (2008), "Seduction without cause: Uncovering explanatory neurophilia", *Trends in Cognitive Science*, 12, p. 281-282.

[7] Oullier, O. (2008), "Neuroéconomie et neuroéthique", "Neuroeconomics and neuroethics", *in* A. Claeys and J.-S. Vialatte (editors), *La loi bioéthique de demain (Tomorrow's bioethics law),* volume 2 Paris, National Assembly, p. 196-202.

[8] Hearing of March 26th, 2008 by the Parliamentary Office of the scientific and technological choices: www.assemblee-nationale.fr/13/rap-off/i1325-tII.asp#P1263_431843 and hearing of

## 2. Reconsidering public health prevention in the light of "emorationality" [1]

### 2.1. Theoretical progress: towards an "emorational" model of decision making

Among the recent contributions of neuroscience to the understanding of economic behaviour, the results show that the **dichotomy traditionally established between emotion and rationality is not as distinct** at the neurobiological level as it can be found in philosophy, psychology or moral cognition.

This result has been put forward by coupling neuroscientific experiments with game theory and in particular with that of the so-called "ultimatum game". This experiment, which is well known in experimental economics, consists in giving an individual A (the proposer) an amount of money and asking him to share it with another individual B (the receiver) who he does not know. The rule is the following: if B accepts the division, A and B each gain their respective share of the money as proposed by A; if, on the other hand, B refuses the offer, A and B will leave without anything.

Generally, if A offers less than 25% of the capital, B does not accept the division. This result goes against the "homo œconomicus" model. If the latter were true, B should accept any offer, however negligible, since it would always be better than receiving nothing. This experiment has been conducted hundreds of times throughout the world with the most varied social groups. The reported result has appeared consistently, even when the equivalent of several months of wages has been at stake [2].

Refusal by B would tend to show that his emotions took precedence over a purely rational and utilitarian computation of gain. This assumption seems to be confirmed by an experiment using functional MRI, which shows that the variations in the insula[3], which belongs to a part of the brain often referred to as "emotional", make it possible to know whether B will accept a non-equitable offer or not. However, if the functioning of another part of the brain (the right prefrontal dorsolateral cortex), which is involved in "reason", is inhibited by repetitive transcranial magnetic stimulation (rTMS), B accepts lower offers (normally refused due to emotion). And this despite that his judgment of the equity of the offer has not changed [4].

This counter-intuitive result, that is, that of the dysfunction of a brain known as "rational", which economically speaking involves a more rational behaviour, indicates that **the opposition between emotion and rationality "does not hold" on the**

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September 22nd, 2009 by the parliamentary mission for the preparation of the bioethical law revisions: www.assemblee-nationale.fr/13/rap-info/i2235-t2.asp#P8198_3647635.

[1] In neuroscience, to our knowledge the term "emorationality'" was first coined in Oullier O. (2010), «The useful brain: Why neuroeconomics might change our views on rationality and a couple of other things", *in* E. Michel-Kerjan and P. Slovic (eds), *The Irrational Economist: Making decisions in a dangerous world*, New York: Public Affairs, p. 88-96.

[2] Camerer C. F. (2003), *Behavioral Game Theory: Experiments in strategic interaction*, Princeton, Princeton University Press.

[3] Sanfey A. G., Rilling J. K., Aronson J. A., Nystrom L. E. and Cohen J. D. (2003), "The neural basis of economic decision-making in the Ultimatum Game", *Science*, 300(5626), p. 1755-1758.

[4] Knoch D., Pascual-Leone A., Meyer K., Treyer V. and Fehr E. (2006), "Diminishing reciprocal fairness by disrupting the right prefrontal cortex", *Science*, 314(5800), p. 829-832.

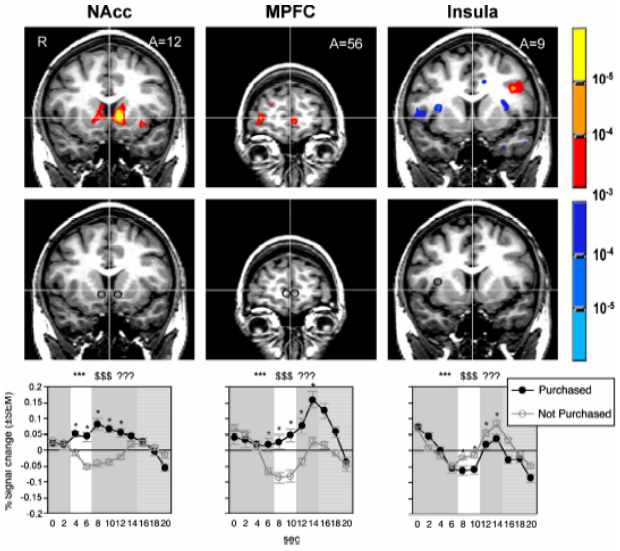
**neurobiological level** [1]. The parts of the brain involved are connected by dense and complex networks and function in a largely interdependent way. **The brain would function in a hybrid way, that is to say, with a sort of "emorationality"**[2]. In other words, reason and emotions need each other in order to exist and function.

## 2.2. Practical progress for public health prevention?

Consumer neuroscience makes it possible to obtain **new data with high application potential, in particular with respect to prevention** (see Parts 2 and 3 of the present book). Brain sciences have progressed a lot in their understanding of decision mechanisms over these past fifteen years. Thus, a hurdle was recently overcome thanks to the work of a research team from Stanford University[3]. In an experiment, subjects, placed in a context close to that of online shopping, could purchase (or not) products displayed on a screen. Researchers succeeded in "predicting" subsequent purchase decisions[4], thanks to fMRI and to co-variations of brain activity observed in a particular cerebral network (*Figure n°3*).

Figure n°3

**Simultaneous changes in the activity of three areas of the brain make it possible to predict the purchase decision**




*Source : Knutson et al. (2007) Neuron - Cell Press©*

[1] It is necessary to specify in this paragraph the qualities of a "rational" brain, " emotions" and/or "reason" are simplifications and inaccurate reductions from a scientific point of view of which the only goal is to not confuse (too much) the reader who is not familiar with neuroscience.

[2] The term "emorationality'" in the neuroscience was first coined in Oullier O. (2010), «The useful brain: Why neuroeconomics might change our views on rationality and a couple of other things", *in* E. Michel-Kerjan and P. Slovic (eds), *The Irrational Economist: Making decisions in a dangerous world*, New York: Public Affairs, p. 88-96.

[3] Knutson B., Rick S., Wirnmer G. E., Prelec D. and Loewenstein G. (2007), "Neural predictors of purchases", *Neuron*, 53, p. 147-156.

[4] Let it be noted that at the same time, Omnicom, a world leader in communication, turned to neuroscience. Source: Girard L. (2007), "Les publicitaires s'intéressent à notre cerveau" ("Advertising executives are interested in our brain"), *Le Monde*, March 28th edition.

**Box n°5**
**Towards mind reading?**

Data that make it possible "to predict" whether a person will buy or consume, is brought closer to recent work on what the general public knows by the name of **"mind reading"** or **"thought decoding"**[1].

Recent German and American work has paved the way, following many repetitions, to neurologically decode partially whether a person is looking at an image of a dog or that of a house. To arrive at this result, many repetitions of the same images are shown to a person to then try to extract a recurring cerebral activity pattern from the MRI data, which would be specific to each. Then, the experimenter and/or an algorithm tries to determine, with a double blind system, the reappearance of the one of these patterns: when it is the case, it will deduce the nature of the image presented.

The most recent progress in this field was made by American researchers who, after having flashed a thousand different images on two subjects in a brain imaging scanner, afterwards showed them visually different images representing the same type of objects. The algorithm that allowed for analyzing the patterns of brain activity succeeded in recognizing whether the person is seeing a dog, a balloon or another image with a high rate of recognition[2].

**This result was not possible a few years ago. However promising, it remains quite limited** as the experiments relate only to the decoding of a state of sensory perception, far from the matter of memories, intentions and intimacy[3].

This result constitutes notable progress and opens the way for new research (*Box n° 5*). For example, in relation to work on the trademarks, this could make it possible to better understand the circumstances that lead certain people to refuse to buy generic medicines. An experimental track is currently exploring.

As another example, recent studies showed how environmental factors may bias sensory perception during food intake. Thus, Samuel McClure and his team from Baylor College of Medicine in Houston showed that preference for two sodas of relatively equivalent chemical composition but of different makes, was not translated just into a sensory perception on the cerebral level[4]. Simply by seeing the make of the drink that is the leader on the worldwide market, researchers noted a higher activation of the hippocampus, an area of the brain related to memorizing and emotional biases.

Another experiment undertaken by Hilke Plassmann of the INSEAD consisted in making people placed in an MRI scanner taste the same wine though the price shown

[1] Haynes J.-D. and Rees G. (2006), "Deconding mental states from brain activity in humans", *Nature Reviews Neuroscience*, 7, p. 523-534
[2] Nay K. NR. and Gallant J.L. (2009), "I can see what you see", *Natural Neuroscience*, 12, p. 245-246.
[3] It is possible to determine for example how a flavour will "trigger" the reward cycle but not the origin of the taste for the same.
[4] McClure S. M., Li J., Tomlin D., Cypert K. S., Montague L. M. and Montague P. R. (2004), "Neural correlates of behavioral preference for culturally familiar drinks", *Neuron*, 44, p. 379-387.

on it varied [1]. Thus, as had already been observed before in various contexts, consumers declared that they preferred the expensive wine. More astonishing, this declared preference was positively correlated to the activity of the orbitofrontal cortex, which is part of the secondary gustatory brain, among other functions.

These two examples show to what extent the information contained in an advertisement or those given by the price of a food product may modify the appreciation of its taste. They are thus of unquestionable interest for public health prevention and the development of campaigns against obesity, in particular for promoting a balanced diet.

## 2.3. Towards social consumer neuroscience

Consumer neuroscience are being developed today mainly around the themes of decision making and the underlying cerebral processes. However, **the importance of the social context is also considered**.

This work opens the way for social cognitive neuroscience whose goal is to better understand how individuals interact, and how their body and brain dynamics evolve according to the exchanges between them [2].

Recent progress regarding the **mirror function of the brain**, that is to say, the fact that some of its areas are activated in similar ways whether one is experiencing an emotion, or whether one is observing somebody living this emotion, are of an high interest [3]. Indeed, **the question of confidence and mutual understanding lies at the centre of interpersonal relationships.** In prevention, such data could help to understand and favour patient-doctor interactions, salesman-consumer interactions or public authorities-population interactions.

More largely, research in social cognitive neuroscience covers **cerebral correlates of empathy, confidence, co-operation or altruism**. These topics have not yet been exploited, either on a private level or on a public policy level. However, to grasp the decision making mechanisms in a social context could bring new elements, for example the question of knowing how to favour organ donation, or even how to go about counselling or accompanying patients.

Lastly, work on moral cognition would be likely to **better define the cognitive constraints and functioning of the brain in view of social norms** [4].

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[1] Plassmann H., O'Doherty J., Shiv B. and Rangel A. (2008), "Marketing actions can modulate neural representations of experienced pleasantness", *Proceedings of the NationalAcademy of Sciences of the United States of America*, 105, p. 1050-1054.

[2] Oullier O. and Basso F. (2010), "Embodied economics: How bodily information shapes the social coordination dynamics of decision making", *Philosophical Transactions of the Royal Society, B: Biological Sciences*, 365, p. 291-301.

[3] Wicker B., Keysers C., Plailly J., Royet J. P., Gallese V. and Rizzolatti G. (2003), "Both of us disgusted in My insula: The common neural basis of seeing and feeling disgust", *Neuron*, 40, p. 655-664.

[4] Tassy S., Oullier O. and Wicker B. (2007), "Beyond the classical nature dual nature of moral behavior", *Science*, e-letter, 13 août ; Tassy S., Oullier O., Cermolacce M. and Wicker B. (2009), "Don't psychopathic patients use their DLPFC when making decisions in moral dilemmas?», *Molecular Psychiatry*, 14, p. 908-909.

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For years public institutions have called upon communication specialists who mostly use traditional marketing techniques based on verbalisation (surveys, discussion groups, interviews). The results of the interviews carried out are thus exposed to the biases of this methodology. Neuroscience can supplement this work today by making it possible to have, to a certain extent, better access to the emotional component of consumer behaviour. However, the work of neuroscience towards constituting a significant contribution must be carried out jointly with rigorous behavioural experiments, as the study of the isolated brain would be use. What also needs to be kept in mind is that one cannot read minds, all that is possible at the moment is "mindguessing" based on several tools that allow to estimate brain activity and to interpret it -but not to record it directly as claimed too often.

These possibilities offered by brain sciences must not make us forget the ethical stakes [1] involved in the prevention strategies. It is a question of evaluating well the risks of drifting from inciting prevention into intrusive and constraining measures, which would prove to be incompatible with democratic principles.

[1] Sauneron S. (2009), «Impacts des neurosciences: quels enjeux éthiques pour quelles régulations ?" ("Impact of neuroscience: what ethical stakes for which regulations?", *La Note de veille*, n° 128, Centre for Strategic Analysis, March 2009 ; www.strategie.gouv.fr/article.php3?id_article=948.

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PREMIER MINISTRE

Centre d'analyse stratégique

March 2010

# Improving public health prevention with behavioural, cognitive and neuroscience

Supervised by
Olivier Oullier and Sarah Sauneron

Rapports et documents

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Report handed to Nathalie Kosciusko-Morizet, Secretary of State for Strategic Planning and the Development of the Digital Economy

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Centre for Strategic Analysis
18, rue de Martignac – 75700 Paris cedex 07
www.strategie.gouv.fr