CHAPTER 7

In the smoker's head: neuroscience and smoking prevention

Gemma Calvert[1], **Karine Gallopel-Morvan**[2], **Sarah Sauneron**[3] and **Olivier Oullier**[4]

"Tobacco is the leading cause of avoidable mortality in France (60,000 deaths per year) and the leading cause of cancer. One smoker in two will die of the consequences of smoking[5]*",* repeats the Ministry of Health and Sports, which has made the fight against smoking one of its priorities.

An article published on the 25th of February 2010 in the scientific magazine *Nature* calls for no slackening of efforts in the fight against smoking in the face of statistics that can appear encouraging[6]. In fact, the occurrence of some tobacco related illnesses has tended to fall for the first time for years in some industrialised countries[7]. There still remain 1.2 billion smokers in the world[8], for whom 6.3 trillion cigarettes were produced in 2010. This colossal figure represents a mean annual consumption of over 900 cigarettes for each man, woman and child on the planet.

According to the *Report on the Global Tobacco Epidemic* published in 2009 by the World Health Organisation (WHO)[9], **tobacco kills over 5 million people every year.** If current trends are maintained, this figure will reach 8 million by 2030. WHO estimates that a billion people will succumb to the direct or indirect consequences of smoking before the end of the century if nothing changes.

---

[1] Professor of Neuroimaging and Chair of Applied Neuroimaging at the University of Warwick (Great Britain); founder of Neurosense Limited.

[2] Lecturer, researcher and accredited research director, Rennes Management Institute (University of Rennes 1), member of the Economics and Management Research Centre of the University of Rennes-1 (UMR CNRS 6211)

[3] Project Manager, Department of Social Affairs, Centre for Strategic Analysis.

[4] Scientific adviser, Department of Social Affairs, Centre for Strategic Analysis and Associate Professor of Neuroscience, Cognitive Psychology Laboratory (UMR 6146), University of Provence (France).

[5] Statistic from the Ministry of Health and Sports dating from 2007 ;.

[6] Samet J. M. and Wipfli H. L. (2010), 'Globe still in grip of addiction', *Nature*, vol. 25, p. 1020-2021 ;

[7] See Robinson S. and Bugler C. (2008), *General Lifestyle Survey: Smoking and drinking among adults*, UK Office for National Statistics, Crown, 74 p. To view this survey (in English):. Also see Wald N. and Nicolaides-Bouman A. (1991), *UK Smoking Statistics* (2nd edition), Oxford University Press, Oxford.

[8] Or about 40 % of men and 10 % of women. See Shafey O., Eriksen M., Ross H. and Mackay J. (2009), *The Tobacco Atlas* (3rd edition), American Cancer Association ; www.tobaccoatlas.org/. The latest figures published in March 2010 by the French Observatory for Drugs and Drug Addicts reveal that in France cigarette sales increased by 2.6 % in 2009. Pharmacists sales of stop smoking treatments fell by 21.5 % in the same year.

[9] World Health Organisation (2009), 'WHO Report on the Global Tobacco Epidemic, 2009: Implementing smoke -free environments- Executive summary', 5 pages.

Faced with the repeated failures of the various strategies introduced, public authorities must explore new options to improve the policies to prevent this plague. This chapter address the potential inputs from neuroscience, for a better understanding and prevention of smoking behaviour. Recourse to neuroscience for this purpose is not new because it has notably allowed a better understanding of the cerebral mechanisms of addiction to nicotine[1]. Also, many mechanisms prescribed to help smoking cessation act on the so-called cerebral 'reward' system.

Going beyond nicotine-associated addictive behaviour, the novelty of the approach introduced here resides in **the use of neuroscience to refine and prepare smoking prevention strategies.** The example of so-called 'shock' (often inane) campaigns, which are spreading on cigarette packets and in the media, highlights the necessity to mobilise all available scientific resources to optimise effective communications and avoid potential perverse effects. Among these inputs, the currently little used but very substantial resource offered by consumer neuroscience appears promising for future years.

1. Faced with the complexity of the problem, a diversity of solutions

1.1. Making people aware of the harmfulness of tobacco is not sufficient

If the need for information for better prevention of smoking suffers from little discussion, the strategy of simply informing people that tobacco is harmful is nevertheless vastly insufficient.

Anybody, once they have been informed of the danger that a habit can present for their health, should either not start, or alternatively stop as quickly as possible. Such reasoning, which is nevertheless so much contradicted in daily life, has been that of marketing specialists, who like some economists, have too often prepared models and strategies around the idea of a rational economic agent. This agent, the famous '*homo œconomicus*', will take decisions using all the information available to him and, having compared all the alternatives, will select the optimal outcome (economically and medically in the case that interests us).

Now, in reality, **the knowledge of the occurrence of a danger and the consequences that it could cause has never prevented human beings from exposing themselves to it**, rather the opposite. If this was the case, all car users would wear their safety belt and everyone would have protected sexual relations. In the case of tobacco, examples of such behavioural biases are often enlightening. For example the proportion of doctors and health personnel who smoke is almost the same as in the general population[2]. Awareness, however precise, thus does not lead

[1] Consequently the present chapter will not specifically consider cerebral correlations of cigarette addiction. The interested reader could refer to the numerous scientific works published on this subject. See, for example, volume 8(11) of the scientific periodical *Nature Neuroscience* published in November 2005, www.nature.com/neuro/journal/v8/n11/index.html.

[2] The 'Tabac & Liberté' (~Tobacco & Liberty) doctor's network estimates from Health Barometer data that in 2000 general practitioners reflected the general population in smoking. However, it remarked that in 2005 new doctors were less likely to smoke than previous generations, notably due to a feminisation of the profession.

to a brake on risky behaviour. Having access to statistics on the dangers of smoking, *via* information and prevention, is thus not the single solution to all its evils, far from it. Complementary strategies must therefore be envisaged, with not only different communication media, *via* fear or surprise, but also more restrictive measures.

1.2. Countries are implementing numerous preventive strategies[1]

Faced with the human catastrophe and the economic burden of smoking[2], governments, NGOs and other associations involved are working unflaggingly, often in concert, with the aim of finding new ways of fighting the damaging effects of tobacco. For this, WHO prepared a 'Framework Convention on Tobacco Control', which was adopted in 2003 and now has 168 signatory countries (including France) covering 86 % of the world population[3]. As stated in the WHO 2009 Report, this initiative denotes a *'worldwide political will to make the fight against tobacco more global and effective'*.

Among the preventive measures, taken in isolation or coordinated between countries, we cite **the increase in the price of cigarette packets, prohibiting smoking in workplaces[4] or in public places, regulation of advertising or sponsorship, the use of generic packets, or the prohibition of exposing cigarette packets to customer view at** sales points. The measure that will be of more particular interest to us here is the **placing of visual prevention messages (instead of the current text format)** on cigarette packets, to illustrate the dramatic consequences of tobacco addiction better. One of the outcomes sought by all strategic approaches is to make smoking socially unacceptable.

To make its action more effective, WHO has developed the MPOWER practical support programme, that allows it to follow the development of the epidemic and the worldwide efforts to fight it [5] with greater accuracy. One of the priorities of MPOWER is to prevent and inform about the dangers linked to the consumption of tobacco, for both smokers and non-smokers (passive smoking or *'second-hand smoking'*)[6].

The WHO report shows that only 10 % of the world's population is currently covered by one of the MPOWER measures (*Figure n°12*). Only 2 % live in countries that have adopted legislation forbidding smoking in public places that is well respected; and

---

[1] The major part of the statistics and analyses presented in this section come from the R*eport on the Global Tobacco Epidemic* published in 2009 by the WHO (see *supra* for the link).

[2] According to the WHO, health expenditure and productivity losses due to smoking are now reaching record amounts (193 billion dollars per year in the United States).

[3] After its adoption by the 56th WHO assembly in 2003, the *Framework Convention on Tobacco Control*, FCTC, was opened for signature. The Framework Convention came into force on 27 February 2005, 90 days after the fortieth State had adhered, ratified, accepted or approved.
To read the Convention: http://whqlibdoc.who.int/publications/2003/9242591017.pdf. To consult the list of 168 signatories: www.who.int/fctc/signatories_parties/en/index.html.

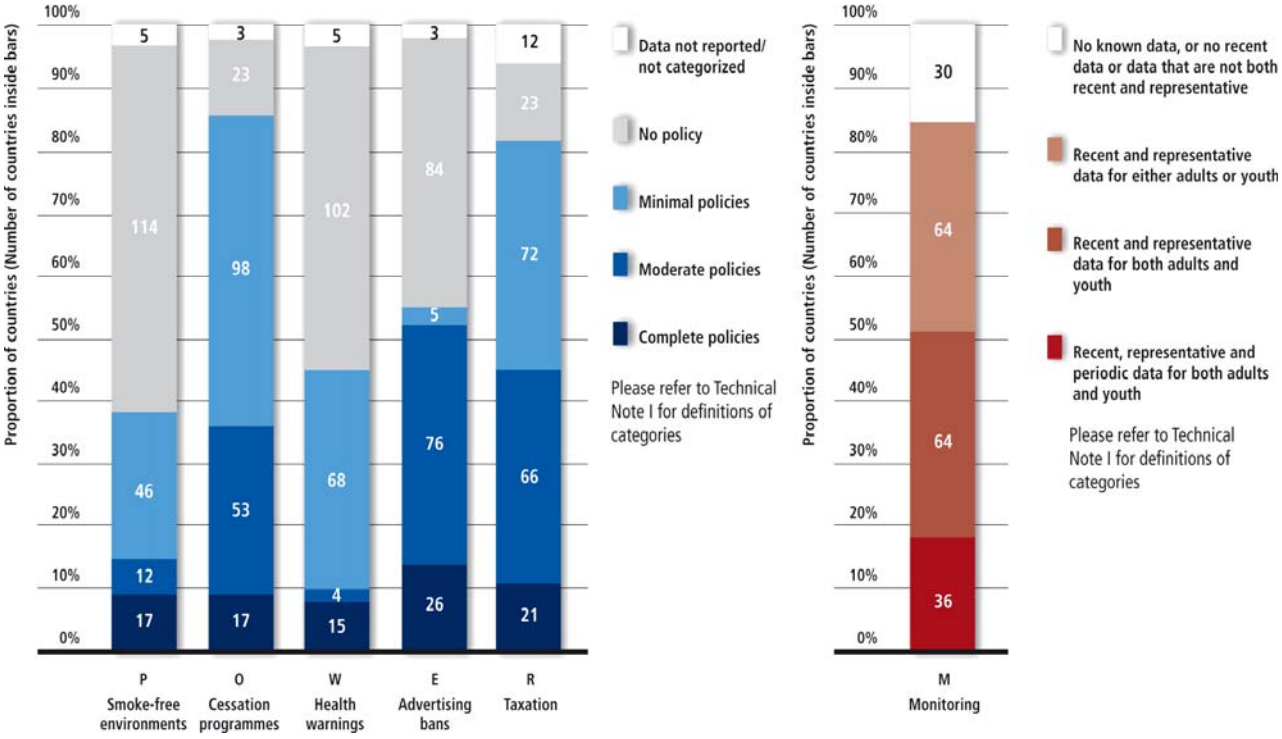
[4] Introduced for the first time by Ireland in Europe in 2004, the prohibition on smoking in work places was then adopted by numerous countries and often extended to all public places.

[5] MPOWER: Monitor Protect Offer Warn Enforce Raise. This programme is based around the following actions: monitoring tobacco consumption and prevention policies; protecting the population against tobacco smoke; offering help to those who want to renounce tobacco; warning about the dangers of smoking; ensuring the prohibition of tobacco advertising, promotion and sponsorship is respected, increasing taxes on tobacco.

[6] A third route for contamination is now being considered, *'Third-hand smoking',* which brings out the potential harmfulness of housing or offices that have been occupied by smokers for a long time.

5 % live in countries that tax the price of cigarettes by 75 % and over, as recommended by MPOWER.

Figure n° 12: **The state of selected tobacco control policies in the world**



Source: World Health Organisation © - 2008

2. On the usefulness of developing actions on the social environment

2.1. Suppressing all forms of advertising and sponsorship

The Evin Law (1991) prohibits any kind of tobacco advertising (TV, magazines, radio, posters, sponsorship, PR, Internet, etc.). It has not had the intended effect of changing the positive image of this product, as huge marketing efforts are being made by the tobacco industry to combat it and continue communicating the product via advertising tools reminding people of the brand universe. Proof of the existence of such illegal communication can be found in the internal documentation of cigarette manufacturers, but also by observing their activities out in the field (*Box n°7*)[1].

[1] Dubois G. (2003), "*Le rideau de fumée, les méthodes secrètes de l'industrie du tabac*", Seuil. Gallopel-Morvan K. (2009), "*Comment changer l'image du tabac en France?",* in *Rapport sur le tabagisme,* report coordinated by M. Tubiana, *Académie Nationale de Médecine*, May, p.5 and17-20

Box n°7
A powerful tobacco industry

One of the most redoubtable obstacles to the prevention of smoking remains the tobacco industry. Certain international brands continue to contest the scientific proof of the harm of passive smoking to non-smokers, and use their immense financial resources to influence the political process, by lobbying, indeed contesting certain anti-tobacco legislation.

An article published in 2008[1], and based on British American Tobacco internal documents (BAT, the second largest multinational in tobacco-derived product production), describes the attempts by this company to minimise public awareness of the harmful effects of passive smoking in the Chinese market. Besides promoting the benefits of 'resocialisation by tobacco', this multinational goes as far as offering training courses to industry, public and media employees aimed to convince them that the effects of passive smoking are negligible compared to that of air pollution.

In France, the National Anti-Tobacco Committee (a recognised public association) has implemented observation of illegal advertising practices within the tobacco industry. Amongst the infractions recorded (some of which attracted fines) were: cigarette packets targeting adolescents, a strong tobacco brand presence on the Internet, unauthorised advertising at over 30% of cigarette sales outlets visited by the association in 2007and the presence of tobacco brands in major competitions broadcast on TV stations in 2006 (27.6% of which are illegal), etc.

We present below the results of a study using functional Magnetic Resonance Imaging (fMRI) to estimate the cerebral activity of smokers when they are exposed to different types of cigarette brand advertising and cigarette packets (with or without a preventive message on them)[1].

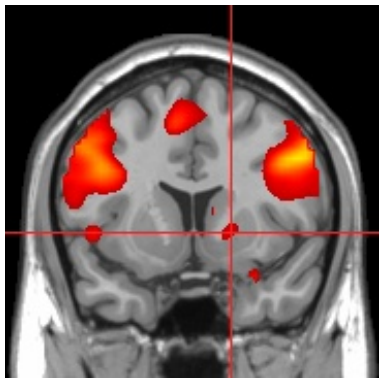
Previous neuroimaging studies undertaken by Neurosense Limited showed that when exposed to smoking related stimuli, the cerebral activity of smokers increases significantly, notably in the prefrontal cortex, the anterior cingular cortex, the ventral striatum and the accumbens nucleus – a part of the brain that is rich in dopamine, a pleasure neurotransmitter that participates, among others, in the desire to smoke and more generally in cerebral addiction mechanisms (*Figure n°13*).

For this new study, smokers aged between 18 and 50 years old had to refrain from smoking for four hours before the experiment. Their brain activity was then estimated using fMRI while they looked at cigarette packets with and without warning messages. They were also shown promotional objects distributed by cigarette manufacturers – lighters, clothing – as well as advertising posters or even vehicles in the colours of these brands, as seen in the context of sponsored sporting events (rallies, Formula 1)[2].

[1] Muggli M. E., Lee K., Gan Q., Ebbert J. O. and Hurt R. D. (2008), 'Efforts to reprioritise the agenda' in China: British American Tobacco's efforts to influence public policy on second-hand smoke in China', *Public Library of Science Medicine*, vol. 5(12): e251 ;

[2] During this experiment, the subjects must: (1) Look at a packet of cigarettes without preventive message; (2) look at a packet of cigarettes with warning; (3) look at photos of sporting events sponsored by brand of cigarettes; (4) look at cigarette advertising; (5) look at advertising products (lighters, tee-shirts, etc.) in the colours of a brand of cigarettes; (6) look at images having nothing to do with the world of tobacco ('control condition').

Figure n° 13: **Activation of the accumbens nucleus (in the cross hair) of smokers viewing stimuli linked to cigarettes or tobacco brands (packets, advertising, sponsorship, derived objects)**



Source: Neurosense Limited©, www.neurosense.co.uk

After an exposure of several minutes to packets or cigarette brand advertising, all the volunteers unsurprisingly reported a strong desire to smoke.

All the tobacco-related visual stimuli used in the experience lead to a significant change in activity in the accumbens nucleus. In addition, **the activity in this nucleus was highest for the sponsorship images.** So, it appears that the strategy of applying brand-related colours on objects at public leisure events, without the brand being explicitly mentioned and which has been employed by several tobacco manufacturers, works because it triggers an association in smoker's brains equivalent to or even greater than that of a potential nicotine reward.

Such results demonstrate **the relevance of measures forbidding tobacco advertising** such as the Evin Law in France[1]. In addition they invite questions on the **means of regulating all indirect forms of advertising and the nature of the mechanisms that can be put in place to control illegal communications by the tobacco industry.**

2.2. Forbidding the display of packets at point-of-sale (POS)

The above experiments demonstrate that simply viewing a branded cigarette packet can lead to a desire to smoke. Going into a tobacconists for any purchase whatsoever, will thus expose people to temptation.

In 2000, the county of Montgomery in Maryland in the United States voted for a law obliging stores selling cigarettes to hide the packets behind the counter so that they were not in view of children[2]. Inspired by this example, at the end of 2008, the British government adopted an unprecedented law to **force shopkeepers not to exhibit cigarettes.** After increasing the minimum legal age to buy cigarettes from 16 to 18 years old, these new restrictions were decided upon following a wide consultation on measures aiming to reduce the number of children tempted by cigarettes and to help those who are already dependent to stop. They were notably able to base it on a study done in California, which showed that the risks of smoking for a child between

[1] www.legifrance.gouv.fr/affichTexte.do?cidTexte=LEGITEXT000006077071&dateTexte=20100304.
[2] http://no-smoking.org/sept00/09-20-00-1.html.

11 and 14 years old increased by 50 % if packets of cigarettes were exhibited in a shop near their home[1]. New restrictions on cigarette vending machines should come into force to complete this measure.

2.3. Optimising media communication campaigns: moderation *versus* over-stimulation

Mass awareness campaigns have experienced a progressive evolution of the message transmitted and the manner of transmitting it[2]. **Appealing to reason, fear, surprise, responsibility, embarrassment or disgust**, are strategies that all present advantages and limitations. Scientific experiments can contribute to evaluating their impact.

Some one hundred psychological and social marketing studies have been carried out on the subject of negative emotion and persuasion. The majority of these studies show a positive relationship between negative emotions felt, the ability of a message to attract attention, retention and the associated intentions of individuals to change their behaviour.[3] Researchers explain this positive impact of negative emotions on persuasion by the motivation they trigger. Thus, when individuals are exposed to a shock advert, they feel an unpleasant emotion that they will try to rid themselves of to rebalance their psychological state. One way of doing this is to adopt the behaviour promoted by the message. Even if we see a positive impact of negative emotions on persuasion in a majority of cases, there are still limits on their use. In fact, we sometimes observe the opposite reactions to what was expected. Here, rather than adopting the behaviour promoted by the sender of the advertising message, individuals develop a defence or rejection strategy of repressing the advert content, doubting its credibility and underestimating the risks shown – avoidance and denial. In the worst cases, a shock campaign creates a boomerang effect: the incriminated behaviour is reinforced instead of being reduced or stopped.

This kind of situation occurs when the target audience does not feel able to adopt the recommended behaviour (they see themselves as weak). If so, it is advisable to provide information and advice along with the negative message in order to help individuals to adopt the desired behaviour more easily (telephone support number, information on how to stop smoking etc.). This is what the researchers Rogers (1983) and Witte (1998)[4] recommend in the motivation model for self-protection and the extended parallel processes model recording the rules for developing an effective shock prevention message, i.e. one that motivates individuals to change their behaviour in the desired way. Rogers and Witte also advise putting the emphasis of

---

[1] Smith R. (2008), 'Cigarettes to be sold 'under the counter", *The Telegraph*, edition of 8 December.
[2] See Chapter 5.
[3] For a summary of these studies, see, Gallopel-Morvan K. (2006), "*L'utilisation de la peur dans un contexte de marketing social : état de l'art, limites et voies de recherche*", *Recherches et Applications en Marketing,* vol. 21 (4), p. 41-60 or Gallopel-Morvan K. (2008), "*Comment réaliser des communications publicitaires efficaces ?"* in *Le marketing et la communication des associations*, 2008, Dunod.
[4] Rogers R.W. (1983), « Cognitive and physiological processes in fear appeal and attitude change : a revisited theory of protection motivation », *Social Psychophysiology*, eds. J. Cacioppo et R. Petty, New York : Guilford Press, p. 153-176. Witte K. (1998), « Fear as motivator, fear as inhibitor : using the extended parallel process model to explain fear appeal successes and failures », in *Handbook of Communication and Emotion : Research, Theory, Applications and Contexts*, Academic Press, p. 423-450.

the effectiveness of the solution proposed on escaping danger (stop smoking to significantly reduce the risk of cancer). Another limitation of these studies on negative emotions is that they are based on statements made by individuals. To remove the inherent bias in these methods (social desirability, under- and over-estimation in answers given etc), it would be a good idea to observe directly what happens in the brains of people exposed to the shock message.

The most recent study to have used neuroscience to test the effectiveness of prevention messages as part of the fight against smoking was published in May 2009 by scientists at the University of Pennsylvania[1]. Daniel Langleben and his team used fMRI to estimate the cerebral activity of smokers exposed to different prevention messages. The study was financed by the National Institute on Drug Abuse[2] (NIDA) and by the National Cancer Institute[3] (NCI), two components of the National Institutes of Health[4] (NIH), which is the largest public health research institution in the United States.

The scientists presented several types of televised public service announcements (PSA) classified according to the sensations that they produced, i.e. the '*message sensation value*' or MSV. Television advertisements with a high MSV were rich in information that intensely stimulated several sensory channels: the production was rhythmic, with frequent cutaway shots and sound effects. Messages identified as having a low MSV were characterised by a steadier rhythm, a more linear discourse keeping to the facts, without wanting to dramatise and not excessively stimulating the different sensory channels. Finally, a 'control condition' consisted of viewing neutral video clips which conveyed messages with no connection to the fight against smoking.

The results show that the spots having a high MSV lead to higher occipital activity in the primary visual cortex than the others (*Figure n°14*, centre column). The authors explained that this activity reflects both the surprise and attention of the spectator, and that this sensory and information influx had a clearly discernible and distinctive reaction on the brain.

For spots with a lower MSV, significantly higher activity was observed in the frontal and temporal cortices in regions notably associated with memory encoding (*Figure n°14*, right hand column).

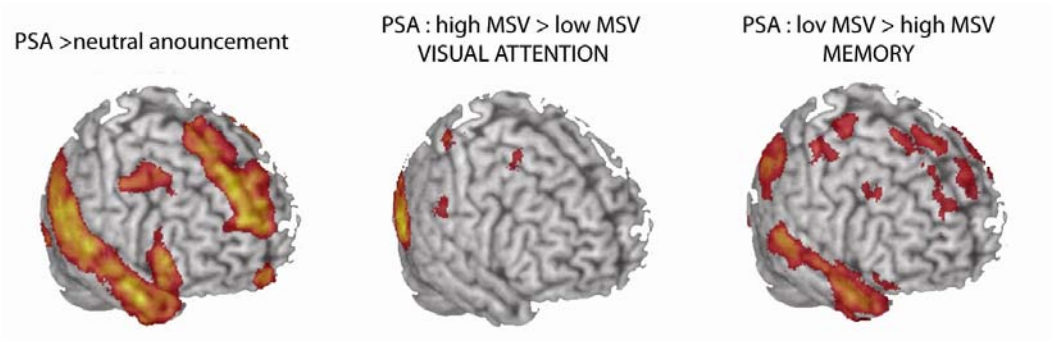
The conclusion that was drawn by the authors of this study was that while shocking the smoker might attract his attention, informing him 'without shocking him too much' could ensure he retains the message better. Subsequent retention tests confirmed this hypothesis: smokers retain messages set out in low MSV spots better.

This study shows that **recourse to the emotions triggered by prevention messages in large scale awareness campaigns must be stimulated to the correct dosage, so that the interest aroused is not temporary and solely due to surprise** (*Box n°8*).

[1] Langleben D. *et al*. (2009), 'Reduced prefrontal and temporal processing and recall of high 'sensation value' ads', *Neuroimage,* 46, p. 219-225;
[2] www.drugabuse.gov/.
[3] www.cancer.gov/.
[4] www.nih.gov/.

However, Daniel Langleben and his team recognise that they are unable to predict from these studies the long-term impact of these messages on smokers subsequent behaviour. Retaining information does not automatically imply that it will lead to a modification of habits or a desire to smoke. The team of researchers are currently continuing their work by collecting longitudinal data to analyse the behavioural consequences of viewing several types of prevention spots.

Figure n°14: Modulation of cerebral activity according to the intensity of the smoking prevention message



Source: Adapted from Langleben et al. *(2009), Neuroimage. Copyright Elsevier*©

Box n°8
Media tobacco, prevention flop

The study by Daniel Langleben illustrates the idea that poorly prepared shock communications can prove to be counter-productive.

One example was evident in France at the end of February 2010, in the commotion excited by the campaign run by the Droits des Non-Fumeurs association (DNF – Non Smokers Rights Association). To attract attention, DNF used a deliberately provocative and incongruous metaphor[1]: equating tobacco and cigarette manufacturers to paedophiles thus suggesting the innocent submission of smokers to tobacco[2]. This campaign ;provoked widespread anger, including from sources within the French government. The director of the Professional Advertising Regulation Agency (ARPP) therefore declared that the campaign *'manifestly contravened the rules of decency and dignity and the rules prohibiting submission and dependency'*[3]. The paradox is that this advertisement had only, so far, appeared in a very confidential way and was withdrawn by the DNF only three days after the start of the controversy. The same ARPP stated: *'There was no advertising campaign. The agency told us that it consisted of 15,000 cards distributed in night clubs and bars in the Île-de-France'*[4]. Instead it was the reiteration of the commotion in the media and the declarations of opponents that transformed a marginal initiative into a highly public world campaign, thus playing into the hands of the

[1] Cigarette in the mouth, kneeling in front of standing man, young people were forced to smoke, as though a paedophile was subjecting them to fellation. This visual image is accompanied by the message: 'Smoking means being a slave to tobacco'.
[2] Basso F. and Oullier O. (2010), 'Smokers are suckers: Should we use incongruent metaphors in public prevention?', *The American Journal of Public Health*, in press.
[3] *Le Monde* and AFP (2010), 'The Advertising Authority demands a stop to an anti-smoking campaign', *Le Monde*, edition of 24 February
[4] Girard L. (2010), 'Comment faire un tabac avec une campagne fantôme (~How to make a hit with a phantom campaign)', *Le Monde*, edition of 27 January

communication agency that had orchestrated the coup anticipating just this eventuality [1].

The final winner of such an enterprise is not the fight against smoking, but rather the agency, which, at minimal expense, obtained a worldwide echo in 48 hours. *Quid* for prevention? Certainly, DNF gained in notoriety. But no information on the nature of its action was forthcoming, nor any public advice on how to combat smoking. We can even question whether the communication reached its target audience. According to the President of the DNF, *'the campaign was developed after a survey among secondary school students', but the people shocked 'are the over 50s and we are not aiming at them'* [2].

3. The cigarette packet – another way of fighting against tobacco

The fight against tobacco is not limited to media campaigns, either televised or otherwise: it also applies to the cigarette packet itself, given the proximity of smokers to these health warnings, and the possibility of creating generic (or unbranded) cigarette packets. These tools are relevant to governments because they are free (unlike media campaigns) and they are seen around 7,000 times a year by regular smokers and the people around them.

3.1. The limitations of written health warnings

Since 2003, new EU rules require that at least 30% of the front surface of a packet of cigarettes must be devoted to one of the two written messages 'Smoking kills', or 'Smoking can seriously harm your health and that of your companions'. In addition, at least 40% of the rear surface must carry one of the 14 written health warnings made available to member countries, such as 'Lung cancer caused by smoking is fatal' or 'Smoking can cause a slow and painful death'. This is currently in place in France.

The experiment performed by Neurosense Limited (*supra*, section 2.1.) provides new information about the impact of such written messages. In fact, activity of smokers' nucleus accumbens – a part of the brain's reward circuit that takes part in the addiction process – was negatively correlated with their stated subjective reaction to these labels. The result highlights an important distinction between what people say and what's actually happening in their brain. .

Contrary to the government's intention, written warning messages failed to suppress brain activity in regions participating in the desire to smoke. In fact, it would have been very surprising for such a stimulus to instantaneously 'calm' the part of the brain playing a central role in the nicotine addiction process, a phenomenon that is fundamentally anchored at the neurophysiological level and generally results from an addiction going back months, even years.

More astonishing, **smokers who said that they were more affected by the prevention messages on cigarette packets** – and thus, in theory, the most likely to

[1] And in mentioning this affair we are playing the communication agency's game…
[2] *Le Monde* and AFP (2010), 'Sexe, outrage et cigarette (~Sex, outrage and cigarette)', *Le Monde*, edition of 23 February

take them into consideration – **showed greater activity of these nicotine addiction brain areas when the labels were present!**

In a similar vein, a study carried out by Crespo and his team (2007)[1] revealed the low level of effectiveness of a health warning message on an advert for a tobacco brand. Using the eye-tracking method, researchers were able to report that, in spite of its novelty value for the material tested (an advert), the written warning "smoking kills" does not make people remember the anti-smoking message any better or improve the cognitive processing of it.

In summary, the various research shows:
- the limited impact of such written health warnings;
- the low impact of certain types of health message (e.g. messages mentioning death such as "smoking kills"). This result is not that surprising. In fact, all you need to do is remember the success of the Death Cigarettes®, (*Figure n°15*) on the market in Great Britain, a brand that had a skull and crossbones as its logo[2] ;
- the limitations of studies on the impact of public health prevention that are solely based on questionnaires. In brief: the smoker says one thing and his brain says another. Thanks to neuroscience, we can see that some written health warnings **induce rather than suppress craving**, at a "cerebral" level at least.

This research, combined with that collated from studies on drug and alcohol addiction and health warnings in general, therefore tends to suggest that health warnings put on cigarette packets don't always have the intended effect, especially on smokers themselves. **However, this does not lead to the conclusion that governments should stop using warning messages, but rather use the growing body of neuroscientific and psychological information to refine their format and content**, whilst including restrictions on the environment as mentioned above. The research also shows that it is important to combine several methods when testing anti-smoking messages on individuals.

Figure n°15: The *Death Cigarettes*®
sold in Great Britain between 1995 and 1999

[1] Crespo A., Cabestrero R., Grzib G. and Quiros P. (2007), "Visual attention to health warnings in tobacco advertisements: en eye-tracking research between smokers and non-smokers", *Studia Psychologica*, 49, 39-51.
[2] Similarly, we should also mention the appearance of "funny" cards that mock the health warning messages. The pack of cards has become very popular, with smokers slipping them between the cellophane and the packet.

3.2. The WHO recommends graphic rather than written health warnings

Article 11[1] of the WHO Framework Convention on Tobacco Control and the Third Conference of Parties in November 2008 have emphasised the need to use graphic health warnings rather than written ones on cigarettes packets. In January 2009, the Minister of Health, Roselyne Bachelot, expressed a wish to introduce a preventive strategy in France, and this was integrated in cancer plan 2.

This measure was taken in 2001 in Canada, a pioneer country in the fight against tobacco, with images that occupied 50% of the front and rear faces of the packets. In 2010, around thirty countries put graphic health warnings in place (*Table n° 1*).

Numerous studies have shown the superiority of graphic warnings over written ones in the context of the fight against tobacco addiction. Graphic warnings are more visible, easier to understand (especially for illiterate people) and increase awareness of the dangers of tobacco.[2] Also, they are more effective in informing people on the unknown drawbacks of tobacco addiction (impotence, for example)[3].

---

[1] www.fctc.org/dmdocuments/French%20Factsheet%202.pdf.

[2] Trasher J.F., Hammond D., Fong G.T., Arillo-Santillan E. (2007), "Smokers' reactions to cigarette package warnings with graphic imagery and with only text: a comparison between Mexico and Canada", *Salud Publica Mex,* 49, suppl 2, p. 233-240.

[2] Trasher J.F., Hammond D., Fong G.T., Arillo-Santillan E. (2007), "Smokers' reactions to cigarette package warnings with graphic imagery and with only text: a comparison between Mexico and Canada", *Salud Publica Mex,* 49, suppl 2, p. 233-240.

White V., Webster B., Wakefield M. (2008), "Do graphic health warning labels have an impact on adolescents' smoking-related beliefs and behaviours?", *Addiction*, 103, p. 1562-1571.

[2] Hammond D., Fong G.T., McNeill A., Borland R., Cummings K.M. (2006), "Effectiveness of cigarette warning labels in informing smokers about the risks of smoking: findings from the International Tobacco Control (ITC) Four Country Survey", *Tobacco Control,* 15 (3), p. 19-25.

[2] Hammond D., Fong G.T., McDonald P.W., Cameron R., Brown S.K. (2003), "Impact of the graphic Canadian warning labels on adult smoking behaviour", *Tobacco Control,* 12, p. 391-395.

Hammond D. et al. (2004), *Op. Cit.*

Koval J.J., Aubut J.A., Pederson L.L., O'Hegarty M., Chan S.S. (2005), "The potential effectiveness of warning labels on cigarette packages: the perception of young adult Canadians", *Canadian Journal of Public Health*, 96 (5): 353-356.

[2] *WHO (2009), "Montrer la vérité. Les mises en garde illustrées sauvent des vies",* et Cunningham R. (2010), "Cigarette Package Warning Size and Use of Pictures: International Summary", Canadian Cancer Society, February 23 2010 et www.tobaccolabels.ca

Li J. et Grigg M. (2009), "New Zealand: new graphic warnings encourage registrations with the quitline", *Tobacco Control*, 18 (1), 72.

Borland R, Wilson N., Fong GT, Hammond D, Cummings KM, Yong HH, Hosking W, Hastings G, Trasher J and McNeill A (2009), "Impact of graphic and text warnings on Cigarette packs : findings from four countries over five years", *Tobacco Control*, 18, 358-364.

Miller C.L., Hill D.G., Quester P.G. and Hiller J.E (2009), "Impact of the Australian quitline of new graphic cigarette pack warnings including the quitline number", *Tobacco Control*, 18, 235-237.

Gallopel-Morvan K., Gabriel P., Le Gall-Ely M., Rieunier S. et Urien B. (2009), "*L'impact des paquets de cigarettes génériques et des avertissements sanitaires visuels sur des Français – résultats des études qualitatives et quantitative*", report for the *Institut National du Cancer*, December.

Graphic health warnings also generate negative emotional reactions (fear, disgust, anxiety etc), which have a positive effect on the intention to stop or not to start smoking.
Finally, warnings in the form of photos seem to be more effective than written messages in encouraging smokers to stop or reduce tobacco consumption, helping former smokers to stay off the habit and increasing the number of phone calls to the "tobacco information service."[1]

Also, the total lack of "glamour" of some graphic health warnings helps in the fight against making cigarette packets aesthetically attractive, which is the usual draw to young people and which the tobacco industry uses as a communication channel (*Figure n° 16*).

Figure n°16: Examples of graphic and written warnings proposed by the EU

http://ec.europa.eu/health/ph_determinants/life_style/Tobacco/pictorial_warnings_en.htm

One of the recurring reservations on the effectiveness of some graphic health messages is **that, consciously or not, they cause counter-productive defensive reactions**[2] of the denial type ("I know it exists, but it won't happen to me"). And, after a number of years, people habituate to the images and they become less effective[3].

[2] Stewart D. W. and Martin I. M. (1994), "Intended and unintended consequences of warning messages: A review synthesis of empirical research", *Journal of Public Policy & Marketing*, vol. 13(1), p. 1-19. Hammond D., Fong G.T., McDonald P.W., Brown K.S., Cameron R. (2004), "Graphic Canadian cigarette warning labels and adverse outcomes: evidence from Canadian smokers", *American Journal of Public Health*; 94 (8): 1442-1445

[3] Gallopel-Morvan K., Gabriel P., Le Gall-Ely M., Rieunier S. et Urien B. (to appear), "The use of visual warnings in social marketing: the case of tobacco", *Journal of Business Research.*

Table n°1: Countries where graphic health warnings appear on cigarette packets[1]

States	Year when illustrated warnings started to be used	Format of graphic warnings (pack front and back)
Canada	2001	50% and 50%
Brazil	2002	100% front or back
Singapore	2004	50% and 50%
Thailand	2005	50% and 50%
Venezuela	2005	100% front or back
Jordan	2005	33% one side only
Australia	2006	30% and 90%
Uruguay	2006	80% front and back
Panama	2006	50% and 50%
Belgium	2006	63% back
Chile	2006	50% and 50%
China (Hong Kong special administrative region)	2007	50% and 50%
New Zealand	2008	30% and 90%
Rumania	2008	53% back
United Kingdom	2008	53% back
Egypt	2008	50% and 50%
Brunei Dar es-Salaam	2008	50% and 50%
Cook Islands	2008	30% and 90%
Malaysia	2009	40% and 90%
Iran (Islamic Republic of)	2009	50% and 50%
Peru	2009	50% back
Taiwan	2009	35% and 35%
Djibouti	2009	50% and 50%
Mauritius	2009	60% and 70%
India	2009	40% front
Paraguay	2010	60% and 60%
Pakistan	2010	40% and 40%
Switzerland	2010	48% and 63%
Columbia	2010	30% and 30%
Turkey	2010	65% front
Mexico	2010	30% and 100%

This limitation seems to be confirmed by a Canadian study using fMRI to test the effectiveness of shock images. During an experiment financed by the Canadian Tobacco Control Initiative[1] (CTCRI), researchers at the University of Montreal analysed the cerebral reactions of smoking and non smoking women aged from 18 to 35[2], when exposed to shock images on cigarette packets.

When someone looks at shock images placed on cigarette packets, **the reaction of disgust is such that a significant increase in right hemisphere prefrontal cortex activity is observed**, this being a part of the brain that has been shown to take part in economic or moral decisions. Researchers have also observed a reaction in the amygdala, a structure that takes part in fear mechanisms. Moreover, **comparison of smokers and non-smokers reactions to these images shows that the former seem to have duller reactions.** This is consistent with the argument that non-smokers are by definition, less often exposed to shock images on packets than smokers who see them daily are are therefore likely to have habituated to their message. Data from neuroscience thus seems to corroborate and validate research carried out in other fields.

Finally, **the effect depends on the nature of the images**: those of a pregnant woman smoking, an ashtray filled with butts or an image of a man choking did not cause similar reactions in the brain. On the contrary, images portraying cigarette-stained yellow teeth, blackened lungs and other damaged organs caused a greater feeling of aversion, and most of all in non-smoking women.

The study by Canadian scientists tends to indicate not that shock health warnings are ineffective, as has sometimes been wrongly assumed, but rather that:

- messages provoking negative emotions must be used with care to avoid rejection. In accordance with the model of the motivation towards self-protection described before, the frightened person needs to be reassured and supported. Thus, if France decides to put shock health warnings on cigarette packets, it is important to put the phone number and web site details of the Tobacco Info Service on the pack, make the practical guide entitled “I’m going to stop smoking” available to the smoker and, if possible, insert leaflets detailing the various means of support for stopping smoking in cigarette packets. This has been implemented in Canada.

- graphic warnings need to be changed on a regular basis. In spite of recommendations by the WHO (article 11 of the Framework Agreement), countries rarely change health messages these days. Australia and New Zealand have two portfolios of images that are alternated each year. Switzerland, which put images on cigarette packets from January 2101, has developed three groups of images for rotation every 24 months.[3].

- not all graphic warnings are effective. It depends on the subject of the message and the target audience (men, women, smokers, non-smokers). So, messages

[1] http://ctcri.ca/en/.
[2] The population most likely to be a lifelong smoker in this country.
[3] Fong G. T., Hammond D. et Hitchman S. C. (2009), "The impact of pictures on the effectiveness of tobacco warnings"*, Bulletin of the World Health Organization*, 87, p. 640-643 ; www.scielosp.org/pdf/bwho/v87n8/v87n8a26.pdf.

that emphasize a marked change in visual appearance (yellowed teeth etc.) or show a child suffering passive smoking seem to be the most effective[1].

These different avenues can be explored through the neuroscience.

For example, it would be useful to carry out a brain imaging experiment in which smokers are repeatedly exposed to shock images to determine not only which have the weakest impact on the brain but also to calculate the frequency at which they need to be changed (evaluation of habituation in the brain). It would also be interesting to compare the different areas of the brain activated by each shock message shown (death, disease, passive smoking etc) and depending on individual characteristics (gender, smoker status). Finally, it is possible to evaluate the efficacy by which different messages designed to make smoking socially undesirable impact on the brain reward areas involved in processing social approval or social exclusion.

3.3. Putting health warnings on generic cigarette packets

Health warnings could have their effect increased if they were placed on neutral or 'generic' packets[2].On such packages, logos and other attractive designs would be prohibited. **The common, uniform packets would be distinguished only by the brand name written in small dark characters, without typography differing from one brand to another.**
So far, no other country has adopted the generic cigarette packet presumably because the challenges of implementing such packaging are numerous, as shown by the twenty or so reports from studies and research carried out on the subject [3] in Australia, Canada, New Zealand, the USA and France[4]:
- the generic packet makes redundant the packet as communication material and reduces the positive brand image: generic packets in weak colours appear dull, unattractive, uninteresting, ugly and boring,
- it increases the effectiveness of health warnings: it improves visibility, retention and credibility,
- it influences consumer perception: cigarettes in a generic packet are seen as being more dangerous, and consumers are prepared to pay less to buy them,
- in the end, the generic packet has a power to dissuade that will probably limit purchase by young people.

All of these results have come from declarative responses. It would be useful to follow this up with neuroscientific studies to circumvent the potential confounds associated with individual verbalisation. In fact, by looking at what happens at a neurophysiological level when desire, need, addiction and fear are simulated, this

---

[1] For a summary of these studies, see Hastings G., Gallopel-Morvan K. and Rey J.M. (2008), "The plain truth about tobacco packaging", *Tobacco Control*, 17, p.361-362.
[2] Freeman B., Chapman S. and Rimmer R. (2008), 'The case for the plain packaging of tobacco products', *Addiction*, 103, p. 580-590.
[3] Gallopel-Morvan K., Gabriel P., LeGall-Ely M., Rieunier S. and Urien B. (2009), "*L'impact des paquets de cigarettes génériques et des avertissements sanitaires visuels sur des Français – résultats des études qualitatives et quantitative*", report for the *Institut National du Cancer*, December.
[4] Gallopel-Morvan K., Gabriel P., LeGall-Ely M., Rieunier S. et Urien B. (2009), « L'impact des paquets de cigarettes génériques et des avertissements sanitaires visuels sur des Français – résultats des études qualitatives et quantitatives », report for the Institut National du Cancer, December.

would enable us to observe the precise combined impact of generic cigarette packets and health warnings.

4. Stopping smoking despite stimulation from the world of smoking

We borrow this witty remark from Mark Twain: *'Giving up smoking is the easiest thing in the world. I know because I've done it thousands of times.'.* Stopping is harder because external stimulation, whether by advertising, the sight of a packet of cigarettes or an ash tray are capable of provoking the desire and need to smoke at any time in the smoker and in the person who has decide to stop smoking.

4.1. Can stopping be encouraged?

Anything that prompts the recall of cigarettes can excite the brain centres involved in nicotine addiction and so trigger the quest for and the use of cigarettes. Recent data suggests that these external stimuli have variable effects depending on their relationship with the ritualistic aspects associated with smoking: stimuli associated with the final phase of smoking a cigarette (a crushed stub, for example) will have different effects from those associated with the start of the ritual (sight of the packet of cigarettes or the lighter).

In an experiment published on 20 January 2010, researchers from the universities of Giessen and Würzburg in Germany used fMRI to compare the cerebral activity of non-smokers, deprived smokers (at least twelve hours without smoking) and smokers surfeited with nicotine when they were exposed to images associated with differences phases of the smoking ritual as well as images unrelated to smoking[1]. Before entering the fMRI scanner, subjects had to evaluate to what extent the different stimuli prompted a desire to smoke on a scale from 1 to 9 (*Figure n°17A*).

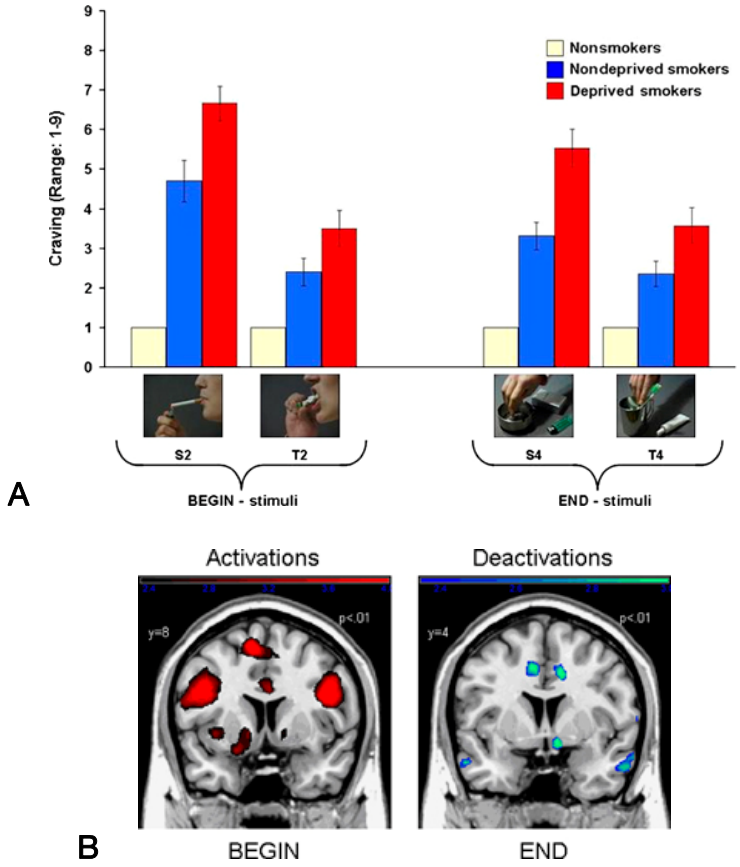
As expected, the subjective responses confirmed that tobacco-related images lead to higher desire scores in smokers than non-smokers, and had a greater effect than unrelated images. Importantly, the neuroscientific results revealed that **the cerebral activity of deprived smokers does not differ significantly from that of 'satisfied smokers' in response to images associated with the start of the smoking ritual, but are distinctly different when viewing end of ritual images**[2]. The difference is mainly located in the orbitofrontal cortex and the dorsolateral prefrontal cortex (*Figure n°17B*).

[1] Stippekohl B. *et al.* (2010), 'Neural responses to BEGIN -and END- stimuli of the smoking ritual in non-smokers, non-deprived smokers, and deprived smokers', *Neuropsychopharmacology*, in press.

[2] In 'smokers' who were not in a deprived state, the stimuli evoking the start of the ritual activated the cerebral network usually observed in 'addicts', meaning the ventral striatum, the orbitofrontal cortex and the anterior cingular cortex. In the same subjects, the end of smoking ritual stimuli lead to a different cerebral activity, notably a 'deactivation' of activity in the ventral striatum and the anterior cingular cortex.

Figure n°17: Comparison of effects of seeing images of the start and end of the cigarette ritual

(A) Behavioural responses to images of the start and end of the ritual compared with images unrelated to smoking. (B) Cerebral activity estimated by fMRI in smokers when they are exposed to start (left) and end of ritual (right) images.



Source: Adapted from Stippelkohl et al. (2010), Neuropsychopharmacology - Nature Publishing Group ©

The authors explain that smokers, when viewing end of ritual images, have less anticipation of a nicotine reward and so less desire for a cigarette. These results are interesting in the context of preparing messages for smokers' attention. For example, a brochure to accompany the process of giving up cigarettes would be that much more effective if it **did not show images evoking the start of the smoking ritual but only the end.**

4.2. Can relapse be predicted?

Could cerebral imaging techniques help support people trying to give up smoking? Data published in 2009 suggest that the brain activity generally associated with seeing images related to the world of tobacco can be significantly higher in people who have quit smoking. This could partly explain the propensity to relapse[1].

[1] Janes A. C. *et al.* (2009), 'Brain fMRI reactivity to smoking-related images before and during extended smoking abstinence', *Experimental and Clinical Psychopharmacology*, 17(6), p. 365-373.

In a study due to be published shortly, a team of researchers at the prestigious Harvard Medical School, have begun to shed new light on the matter.. People who had announced their decision to stop smoking were invited to view images invoking the world of tobacco, while their brains were scanned using fMRI [1]. The results are hugely promising as the combination of behavioural and neuroscientific data allowed the researchers to predict with 79 % accuracy those would subsequently relapse.

The subjects who did not 'stick it out' were those in whom the smoking related images led to high activity in the brain regions involved in emotion, interoceptive sensibility, planning and motor execution. In addition, the smokers who relapsed showed a reduction in functional connectivity (the way in which certain brain areas exchange information) between the prefrontal dorsolateral cortex and the areas affected when viewing tobacco related images, which suggests a reduction in the cognitive control needed to continue to quit smoking. If these results are confirmed in large populations, they could eventually be used to support those wanting to quit smoking to be better adapted to suit the expected difficulties (*Box n°9*).

Box n°9
Stopping smoking - a 'deep' problem

To treat certain pathologies, neuro-surgeons use deep cerebral stimulation, which consists of inserting micro-electrodes in patients' brains to stimulate parts of the brain.

These practices are not routine and require rare expertise and for the pathology to have had a severe effect in order to arrive at this stage. Scientists at the University of Cologne have shown that patients - in whom deep cerebral stimulation of the nucleus accumbens has been practised because they were affected by Tourette's syndrome, obsessive-compulsive disorders or anxiety problems – also stopped smoking as a result of this stimulation[2]. However scientists recognise that these patients were less dependent and more motivated than the rest of the sample at the start.

These results confirm the important role of the nucleus accumbens in nicotine addiction. However, in no way do they constitute a prompt to stimulate the brains of smokers who want to stop: the invasive character of such methods preclude their use in otherwise healthy individuals and raise a number of ethical challenges.

* * *

Neuroscience research is now providing us with new insights into the mechanisms of nicotine addiction and the impact of conscious and unconscious messages aimed at both encouraging smoking and attempts to prevent it. This growing dataset must prove of great benefit to anti-smoking organisations, complementing insights derived from traditional methods that analyse explicit responses and behaviour. These new brain imaging tools are opening a window on the unconscious responses to sensory information from multiple sensory modalities (visual, tactile, auditory, olfactory, gustatory, proprioceptive and even semantic) that shape and influence our behaviour. While neuroscience alone may not yet be able to provide the definitive solution to

[1] Janes A.C. *et al.* (2010), 'Brain reactivity to smoking cues prior to smoking cessation predicts ability to maintain tobacco abstinence', *Biological Psychiatry*, in press.
[2] Kuhn J. *et al.* (2009), 'Observations on unaided smoking cessation after deep brain stimulation of the nucleus accumbens', *European Addiction Research*, vol. 15(4), p. 196-201.

smoking cessation, it is clear that it has a large part to play in helping improve, refine and position large-scale practical strategies and communications.

We believe it is therefore vital to mobilise this discipline when preparing to analyse the impact of various tobacco advertisements **on the general public (cigarette packets, sponsorship, merchandising, POS advertisements, etc.). Neuroscientific studies are also required in order to gain a much better understanding of the influence and likely impact of anti-smoking campaigns (graphic health warnings, media campaigns inciting fear, neutral packets etc).**

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

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

Improving public health prevention with behavioural, cognitive and neuroscience

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

Supervised by Olivier Oullier et Sarah Sauneron

CONTENTS

Introduction 9

Foreword by Vincent Chriqui, Director of the Centre for Strategic Analysis 11

Executive summary 13

Part 1
Rethinking public health prevention: beyond the rational decision maker model 19

Chapter 1 – "Diseases of society" and the search for the most efficient prevention strategies 23

1. The medical and economic burden of risk behaviours 23
1.1. Effects on mortality and morbidity 23
1.2. Economic and financial consequences 24

2. Given the pathologies resulting from risk behaviours, is an ounce of prevention always worth a pound of cure? 25
2.1. Prevention is not necessarily the most "economical" strategy 25
2.2. Prevention is not necessarily easy to implement 28

3. Limitations of traditional preventive approaches to public health 29
3.1. Effective economic tools that could penalize the most vulnerable ones 29
3.2. Informing people is not enough 30
3.3. Prospects of therapeutic education for chronic diseases 31

Chapter 2 – Changing behaviours at various levels in chronic disease prevention 33

1. Chronic diseases: a constantly increasing interdependent risk 33
1.1. A pandemic that affects the entire world 33
1.2. Colossal economic consequences 33

2. What can be done to act against the further spread of chronic diseases? 34
2.1. Small changes for major benefits? 34
2.2. How do we convince people of the health and economic benefits of better chronic disease management? 35

Chapter 3 – Improving public health prevention with a nudge 38

1. Behavioural economics 38
1.1. The unbearable rationality of being 38
1.2. From mathematics to psychology … 39
1.3. … and application for public policies 40

2. Libertarian paternalism 41
2.1. Libertarian paternalism 41
2.2. Influence and nudge 41
3. Some nudges for public health prevention 42
4. What is the future of behavioural sciences in public policy? 45

Chapter 4 – Consumer neuroscience, a new tool for prevention in public health 47
1. Inside the customer's head? 47
1.1. The appeal of neuroimaging should not hide its limitations 47
1.2. Going beyond verbalisation to access emotions 49
1.3. The neuroscience of marketing versus the marketing of neuroscience 51
2. Reconsidering public health prevention in the light of "emorationality" 52
2.1. Theoretical progress: towards an "emorational" model of decision making 52
2.2. Practical progress for public health prevention? 53
2.3. Towards social consumer neuroscience 55

Chapter 5 – Effectiveness of the prevention campaigns: evaluation by cognitive sciences 57
1. Good communication: a balance between attention, memory and emotion 57
1.1. Establishing a footbridge between cognitive science research and the world of communication 57
1.2. Attention and memory, a complex relationship 58
1.3. Good communication in prevention: the right proportion of emotion 59
2. Assessment of communication campaigns thanks to cognitive sciences
2.1. Importance of cognitive techniques in measuring attention and memory 60
2.2. Examples of health campaign assessment 60

Part 2
Fighting toxic substances with efficient packaging 65

Chapter 6 – The National Institute for Health Prevention and Education (INPES), a leading institution in the fight against smoking 69
1. Smoking prevention campaigns 69
2. The other vectors in the fight against smoking 71
3. Evaluation methods for INPES' anti-smoking campaigns 72

Chapter 7 – In the smoker's head: neuroscience and smoking prevention 74
1. Faced with the complexity of the problem, a diversity of solutions 75
1.1. Making people aware of the harmfulness of tobacco is not sufficient 75
1.2. Countries are implementing numerous preventive strategies 76

2. On the usefulness of developing actions on the social environment 77
2.1. Suppressing all forms of advertising and sponsorship 79
2.2. Forbidding the display of packets at point-of-sale (POS) 80
2.3. Optimising media communication campaigns: moderation versus over-stimulation 83
3. The cigarette packet – another way of fighting against tobacco 83
3.1. The limitations of written health warnings 83
3.2. The WHO recommends graphic rather than written health warnings 85
3.3. Putting health warnings on generic cigarette packets. 89
4. Stopping smoking despite stimulation from the world of smoking 90
4.1. Can stopping be encouraged? 90
4.2. Can relapse be predicted? 91

Chapter 8 – From marketing differentiation to household poisoning: are commercial practices on cleansing products a public health issue? 94

1. Marketing versus health 95
2. From appeal to poisoning 97
3. From poison control centre to experimentation 99
4. From the circumstances of an unintentional ingestion to a prevention solution 101

Part 3
Fighting obesity differently: early prevention and education strategies 105

Chapter 9 – Fighting obesity: a political priority 109

1. Parliamentary report: Turning the fight against obesity and overweight into a major national cause 109
1.1. Presentation 109
1.2. Making obesity a major national causee 109
2. The need to communicate and inform better 110
2.1. How can we improve nutritional information and training? 110
2.2. Taxation or health banners, do we have to choose? 111
3. Other major factors 113
3.1. Responding to the risk of stigmatisation 113
3.2. A move towards education in nutrition and cookery? 114

Chapter 10 – Rethinking information and education strategies for the fight against obesity 116

1. The complex aetiology of obesity 117
1.1. The major importance of the brain 118
1.2. Please, please me: obesity, reward and addiction 118
1.3. Other factors implicated in the onset of obesity 119
2. Improving public communication and information strategies 120
2.1. Previous campaigns have been somewhat half-hearted 120

2.2. Broadcasting sensitive health messages 122
2.3. Nutrition labelling: a necessity, but not panacea....125
3. Early intervention to support specific prevention campaigns for children 129
3.1. The necessity for early prevention strategies 129
3.2. The sensitivity of children to images: risk factors… 130
3.3. …and solutions 131

Chapter 11 – How can consumer neuroscience improve interventions to fight obesity? 134

1. Neural basis of food preferences at the time of food choice 134
1.1. The concept of value and value-based decision-making....134
1.2. Neural correlates of decision values....135
2. Changes in the neural basis of decision values lead to behavioral changes in food preferences....137
2.1. How inhibiting brain activity in the Dorsolateral Prefrontal Cortex changes food preferences?....137
2.2. Cognitive regulation of food preferences....137

Conclusion – Improving public health prevention with behavioural and brain sciences: Toward new interdisciplinary collaborations 139

APPENDICES

Author's biographies 145
Neuroanatomical illustrations 152
Bibliography 153
Acknowledgements 165

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