Risk Communication

This section discusses issues related to risk communication across a range of publicly perceived high-risk industries (such as pharmaceuticals, nuclear, oil, etc.). It reports critically and provides analysis on risk communication as an outcome of risk research within these industries. Contributions are intended to include methods working towards the advancement of risk perception research and describe any lessons learned for successfully communicating to the public about risk.

Cognitive Neuroscience, Decision Making and the Law

*Barbara Bottalico**

I. Introduction

Cognitive neuroscience was born when the theories and methods of cognitive psychology and neuropsychology were combined after a long period of parallel development. Over the last few decades, neuroscientific studies have begun to meet the challenge of understanding cognitive functions, thereby identifying the causal chain of neural events that underlies cognition. The development of powerful brain imaging technologies is now likely to present a range of opportunities in many spheres of public life, such as the criminal and civil justice system, and the business world. The integration of neuroscience into psychological research, and the spread of academic societies, publications and scholarships that focus on this area, have allowed the birth of new disciplines combining cognitive neuroscience with other areas of study, such as *neurolaw*, *neuroeconomics*, *consumer neuroscience* and *neurophilosophy*.

The international legal debate has focused particularly on possible uses of such neuro-techniques for forensic purposes and as a tool to investigate human decision-making. Initially, the greatest enthusiasm has been displayed in the United States, where internationally discussed case law has developed, and wide-ranging initiatives, such as the *Law and Neuroscience Project* funded by the Mc Arthur Foundation, have been launched. Interest in the legal implications of neuroscience has also developed in the European context, where various projects such as the *European Association of Neuroscience and the Law* (EANL) have recently been launched[1].

The classic case of Phineas P. Gage has long been an emblem of neuroscience, since it revealed that behavior is not simply the direct product of our personality and will: the biology of our brains also plays a crucial role. Phineas P. Gage was a US railway worker. While compressing gunpowder with a tapering iron in 1848, he was victimized by an explosion. A rod more than a meter long pierced his cranium and exited on the other side. Gage miraculously survived the injury. Yet the trauma utterly changed his behavior: although he was responsible and good-tempered, he became unpredictable, driven by immediate passions. Gage had lost large parts of his ventromedial prefrontal cortex. Today, thanks to brain imaging techniques, scientists are able to see the brain and analyze its functioning within the clinical context. Clinicians and scientists use these technologies[2] not only to map sensory, motor, and cognitive functions, but also to study the neural correlations of a range of physical and mental conditions, behaviors, characteristics, and preferences[3]. Due to its recent move outside clinical and research contexts, fMRI raises a number of ethical, legal, and social issues. As a result, the widespread belief in the possibility of predicting a behavior or finding a correlation between brain and actions has cleared the way to a wider debate about the possible impact of neuroscience on the law.

II. Neuroscience and behavioral economics

The recent allure of neuro-related disciplines stems from an increasing interest in the mechanisms that allow our brain to make choices. Advances in brain imaging techniques have permitted researchers to

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1 EANL is led by the University of Pavia (Italy). It involves neuroscientists, legal scholars, and ethicists from the UK, Italy, Belgium, Germany, France, The Netherlands, Spain, and has partnerships with the US, Canada and Australia.

2 The Functional Magnetic Resonance Imaging (fMRI) is currently the most used brain imaging technology: it uses the technology of regular magnetic resonance imaging to detect changes in hemodynamic properties of the brain occurring when the subject is engaged in very specific mental tasks.

3 S. Tovino, "Functional Neuroimaging Information: A Case for NeuroExceptionalism?", 47(415) *FLA. ST. U. L. REV.* (2007), pp. 423–41.

better understand how individuals process different stimuli and reach decisions, with the great advantage of being able to interpret cognitive processes in the brain as they are taking place.

Neuroscience findings have raised questions about the usefulness of some of the most common constructs that economists commonly use, such as risk aversion, time preference, and altruism. The approaches of disciplines like classical economics and behavioral economics are now seen in a new light. The former tended to assume an individual's decision making behavior is mainly rational. However, behavioral economics, attempting to take a more empirical view on human behavior, has instead identified scope for human irrationality, which may be described as consistent systematic reasoning mistakes with important consequences[4]. As recently noted by Camerer and colleagues[5], neuroscientific findings have pointed out some of the main inadequacies of the pure behavioral approach: first, the brain implements automatic processes of which we are not aware, faster than conscious deliberations. Secondly, our behavior is strongly influenced by affective systems; when these are damaged or perturbed, for example because of brain injuries or stress, the logical-deliberative system cannot properly regulate behavior. Behavior requires interaction between cognitive and affective systems, but because we are more aware of controlled processes than automatic ones, many behaviors are falsely interpreted as being the product of cognitive deliberation only[6].

III. Law and neuroeconomics

Having considered empirical findings from neuroscience and behavioral decision making, we may ask how neuroeconomics[7] informs law? First, it may provide a better understanding of the perceived benefits of the behavior, as well as the limitations currently imposed by legal rules. Legal doctrine has found various possible interactions between neuroeconomics research and the legal arena. Chorvat and colleagues, for instance, refer to contract theory, property law and business association[8]. In relation to contract theory, it would indeed be helpful to "create an ability to make promises that will be enforced, thereby reducing the scope of opportunistic behavior, as well as to explain the notion of consideration"[9], that is the value given by both parties to a contract that induces them to enter into the agreement to exchange mutual performances. Neuroeconomics evidence about heterogeneity in peoples' perception and analysis might also be helpful in the analysis of different methods of interpreting contracts. As to property, neuroeconomics might give insights into how the perception of property affects behavior, as well as into intellectual property (IP). The problem for an IP regime would be to convince people that taking IP is a matter of right and wrong, not merely a possible cause for punishment. The project "Property, Intellectual Property and the Brain"[10] launched by the Gruter Institute has tried to understand better the "evolved psychology" of the IP, and to find a way to make law-respecting emotionally compelling in a field where technology is making law-breaking easy[11]. Taking the brain's capacity for creating, understanding and internalizing tangible property and intellectual property as a starting point of the investigation, the Initiative considers the insights of cognitive neuroscience into the role of emotion in behavior and decision-making as very significant.

More generally, advances in behavioral and experimental economics combined with neuroscience, are also rejuvenating old questions about the relationship between the individual, the law and the concept of justice. Part of legal doctrine maintains that current advances in neuroeconomics are suggesting the physical mechanism by which behaviors are inherited: they may be indeed generated not by a determinate triggering of a particular stimulus/response pathways, but rather by the "indeterminate triggering of a particular behavior from probabilistic distribution of

4 T. Chorvat *et al.*, "Law and Neuroeconomics", available on the Internet at <http://ssrn.com/abstract=501063> (last accessed on 8 July 2011).

5 Camerer *et al.*, "Neuroeconomics: how neuroscience can inform economics", 43(1) *Journal of Economic Literature* (2005), pp. 9–64.

6 *Ibid.*

7 The term "neuroeconomics" was used for the first time in 2006 by Kevin McCabe for a course on neurology and economics; the first major books discussing this discipline was written in 2003 by Paul Glimcher, *Decisions, Uncertainty, and the Brain: The Science of Neuroeconomics*, MIT 2003.

8 T. Chorvat *et. al.*, "Law and Neuroeconomics", *supra* note 4.

9 *Ibid.*

10 The concept of the Research Initiative " Property, Intellectual Property and the Brain" is available on the Internet at <http://www.gruterinstitute.org/Intellectual_Property_files/IP%20abstract%20MGC%207-11-06.pdf> (last accessed on 8 July 2011)

11 O. Goodenough, "Can Cognitive Neuroscience Make Psychology a Foundational Discipline for the Study of Law?", in Belinda Brooks-Gordon and Michael Freeman (eds), *Law and Psychology* (Oxford University Press, 2006), Current Legal Issues Vol. 9.

possible behaviors"[12], and these insights might have implications both for ancient questions about mind-body interaction and for the foundation of the law. Moving from premises established by Oliver Wendell Holmes' jurisprudential model[13], based on a pioneering synthesis of law and biology, Morris Hoffman holds that studying the brain could be crucial to the understanding of individual variations to the general predisposition to follow three central behavioral rules: i) promises to reciprocate must be kept (contract law) ii) reciprocal exchanges must be relatively equal (tort and criminal law); iii) serious violations of the foregoing principles must be punished[14]. Starting from neuroscientific findings about the involvement of brain structures in decision-making, scientists are elaborating a new paradigm that may go a long way toward explaining how adaptive behaviors are expressed in individuals and then transmitted through generations. Combining models of study such as the "ultimatum game", with cognitive science studies might be very relevant to a reconsideration of previous schemes of decision-making in humans, and the result can be applied in the areas of both economics and law.

These studies, furthermore, have a clear relevance also in the field of risk communication – a central part of risk management – providing a disciplined way of communicating decision makers' needs to policy makers. A process that begins by analyzing risks from decision makers' perspectives, giving formal representation to the situations they face and the help they need, is fundamental. It helps to ensure that individuals are judged fairly, when evaluating their risk perceptions and decisions. Effective institutions should be able to communicate messages to members of society in a form they can understand, one which gives rise to optimal exchange solutions. This leads on to the importance of an analysis based not only on behavioral studies, but also on the findings of cognitive science.

IV. Neuroscience and risk management and analysis

Neuroscience seems able to provide interesting cues about the ways regulators approach general risk management. A system of regulatory requirements, economic incentives and disincentives, and communications is supposed to control the perceived risk from exposure to environmental dangers or unsafe products. Initially described as a domain of psychology, anthropology, and policy context, studies on individuals' responses to risk are today extended to the field of cognitive neuroscience[15]. Insights offered by neuroscientists and biologists are currently considered important. The center of gravity of the risk assessment theory is switching from the identification of human irrationality in terms of errors and deficits in judgment in how risks are perceived (as described in section ...), to a new bunch of questions. What neural systems are involved in mediating risk, or in deciding what to do when faced with a gamble? What happens in the brain when we buy something or when we see a commercial? Maintaining a conceptual distinction between "objective" and "subjective" measures of risk, without degrading the subjective aspect, is a great challenge, not only in terms of risk-perception research, but also within the general approach to neuro-related issues. The role of emotion and cognition in these issues is crucial. In recent years many doctrines have developed. Antonio Damasio's well-known Somatic Marker Hypothesis relies on the fact that emotion-related signals assist cognitive processes in implementing decisions. Because somatic markers are non-conscious, they might bias behavior[16]. Focusing especially on decision-making deficits after brain damage in personality (the above-cited Phineas Cage's case was a primary example), Damasio's theory aims to describe the neural events taking place during the process of choosing, and the role of emotions is described as a fundamental one[17]. From another perspective of analysis, the groundwork laid by the so-called Cultural Cognition Theory of Risk is particularly interesting. Dan Kahal and his colleagues at the Cultural Cognition Project have tried to find an explanation for public disagree-

12 M.B. Hoffman, "The neuroeconomics path of the law", 359 *Phil. Trans . R. Soc. Lond. B.* (2004), pp. 1667–1676.

13 O.W. Holmes jr., "The path of the law", 1897(10) *Harvard Law Review*, pp. 457–478.

14 M.B. Hoffman, "The neuroeconomics path of the law", *supra* note 12, p. 1671.

15 A.M. Finkel, "Perceiving Others' Perceptions of Risk. Still a Task for Sisyphus", 1125 *Ann. N.Y. Acad. Sci.* (2008), pp. 121–137.

16 M. Reimann, A. Bechara, "The somatic marker framework as a neurological theory of decision-making: Review, conceptual comparisons, and future neuroeconomics research", 31 *Journal of Economic Psychology* (2010), pp. 767–776.

17 See also the work by Jennifer Lerner's Emotion and Decision Making Group at the Harvard Kennedy School, bibliography available on the Internet <http://content.ksg.harvard.edu/lernerlab/papers/> (last accessed on 5 July 2011).

ment on the significance of empirical evidence[18]. Cultural cognition is defined as the individuals' tendency to "fit the perception of risk and related factual beliefs to their shared moral evaluations of putatively dangerous activities"[19]. People indeed seem psychologically disposed to consider, as socially beneficial, behaviors they find virtuous. Applying this theory to the personal evaluation of scientific expert opinions, we might conclude that reaching a consensus among individuals is very difficult: people tend to overestimate the degree of scientific support that exists for positions they are culturally predisposed to accept; and vice versa. This is a possible explanation for the difficulty in obtaining laypeople's consensus on expert scientific opinions, which consequently gives the latter very limited policy-shaping power. In order to overcome this effect, enriched attention, on the part of communicators, to the cultural content of information, as well as the scientific, is desirable[20].

An interesting evolution of this theory might be an analysis of how the cultural cognition of science could explain the judicial perception of neuroscience, and its impact on the practical application of criteria for the admissibility of scientific evidence in civil and criminal trials. In the US legal system, for instance, the Daubert Standards and Frye Test require both a judicial evaluation of the reliability of scientific evidence, and the consensus of the relevant scientific community. The admission of scientific evidence is different between common-law and civil-law systems. Within the Common Law adversarial system, both parties at the trial appoint expert witnesses who are entitled to provide information and evidence on the basis of their scientific knowledge. They are also cross-examined by the attorneys, who try to explore weaknesses in the testimony and to influence the jury's view of the scientific issue at stake. In civil law systems, however, the court-appointed expert plays a crucial role. In Italy, for instance, when scientific or technical issues arise, the judge consults a list of noted professionals in the area, whose competence is presumed, and normally appoints an expert in order to clarify the issue at stake, before deciding on the reliability of the report. Parties' appointed experts play a consultative role; presenting their own findings to the judge. Moreover, they have the chance to criticize or support the court appointed expert's work, giving the court a wider view on the topic.

In both systems, judicial evaluation as to the admissibility of scientific evidence is a decisive moment. Current research suggests that science has a limited influence in formulating a basis for public policy debates, and trust in experts varies across laypeople, who generally evaluate information about risks and benefits with criteria different from those used by scientists[21]. Considering that judges are by definition laypeople with regard to science, how can they be biased on the interpretation of neuroscience when it is used for forensic purposes? Can a cultural cognition theory give us insights into their trust in a neuroscience-based explanation of individual actions? Judges are entitled to ultimately evaluate the reliability of a scientific theory or method by interpreting it themselves, taking into account the general consensus of the scientific community. Having insights into how this happens could thus be important for civil and criminal procedures. As the establishment of permanent criteria to evaluate the reliability of scientific evidence is not possible (science is a never-ending work in progress), more information about how the current evaluation system works would be crucial.

V. Neuroenhancement

Neuroscience studies of human decision-making are often conducted on the basis of a model individual personality. What if, however, that pattern was no longer reliable, and if new interventions on people's brain were able to change basic personality traits[22]? In the Phineas' Cage case, the individual's personality changed after a brain injury. However, such a change could happen also after pharmacological interventions.

Recent studies indicate impairments of those traits in patients treated with psychoactive drugs.

The most-used psychopharmacological agents in psychosomatic medicine are antidepressants, anxiolytic agents, hypnotics, antipsychotics, beta-blockers

18 Kahal *et al.*, "Cultural Cognition of Scientific Consensus", 14 *Journal of Risk Research* (2011), pp. 147–74.

19 *Ibid.*

20 *Ibid.*

21 B. Fischhoff, "Judgment and decision making", Wily Interdisciplinary Reviews: Cognitive Science (New York: Oxford University Press, 2010).

22 McCrae and Costa identifies them as: extraversion, neuroticism, agreeableness, conscientiousness, and openness to experience; R.R. McCrae, P.T. Costa Jr., "Toward a new generation of personality theories: Theoretical contexts for the five-factor model", in J.S. Wiggins (ed.), *The five-factor model of personality: Theoretical perspectives* (New York: Guilford, 1996), pp. 51–87.

and mood stabilizers. In 2009, the scientific journal *Nature* published the results of an informal online poll asking college students whether they had ever attempted to sharpen "their focus, concentration, or memory" by taking stimulant drugs. About 20 % of respondents replied in the affirmative. Competitive anxieties felt in the workplace or in college life seems to be the trigger for this tendency. Legal scholars and bioethicists are studying how society should respond to the growing demand for cognitive enhancement, taking different positions on whether that response must start by rejecting the idea that enhancement is a "dirty word"[23]. Should we expect to have, in a not too distant future, students using their home-based DBS machines before going to take an exam, just as they do with drugs such as Ritalin? Is such "neuro-enhancement" ethical? Should its use by healthy people be regulated by the law? Michael Sandel, a member of the President's Council on Bioethics, has raised the concern that neuro-enhancement poses a threat to human dignity. Sandel believes that "One aspect of our humanity that might be threatened by enhancement is our capacity to act freely, for ourselves, by our own efforts, and to consider ourselves responsible – worthy of praise or blame – for the things we do and for the way we are"[24]. The reality is that *Deep brain stimulation* and psychoactive drugs such as Ritalin and Prozac are already used extensively. The assessment of risks and benefits around technical safety raises further complex questions, as well as concerns about who should receive this kind of treatments.

A primary distinction has to be made between ill patients and "healthy" people being treated with specific drugs. Diseases frequently affect individuals' personality themselves (e.g. making patients depressive or aggressive). In this sense, both intervention and abnegation could be ethically problematic. In order to respect the patients' principal right to autonomy and not impair their medical decision-making, physicians have the duty to evaluate the patients' ability to give informed consent carefully, and to counsel them responsibly[25]. As to healthy people taking psychoactive drugs, the situation is more complex. Interviewed by Time magazine, the director of the Center of Neuroscience and Society at the University of Pennsylvania Martha Farah warns about possible side effects of these treatments, and maintains that drugs like *Ritalin*, *Prozac,* or *modafinil* are already manipulating brain function in millions of people[26]. She believes that half of the people she might see around her in a coffee shop have probably taken some kind of antidepressant or psychoactive drug, though they don't need them. Consider that future drugs will be more efficacious with fewer side effects, this trend is probably going to increase and the consequences for people's personality traits will become more relevant. It could thus be significant for studies on individuals' decision-making. Consider the various emotion-based theories of decision-making, such as Damasio's Somatic Marker Hypotesis[27]. What is going to be the "gold standard" of studied individuals in a new era of neuroenhancement?

Two issues can be further discussed. On the one hand, studies combining cognitive neuroscience and decision making theories can help in understanding better the effects of the so-called "botox for the brain"[28] on behavior and individual choices. On the other hand, cognitive studies on pharmacological neuroenhancement will be very useful for developing a more informed risk communication process in relation to drug risk perception. Many students and researchers are not aware of possible health risks related to the psychoactive drugs they take when under stress and pressure. Scientifically sound risk communication will require an explicit analysis of the decisions facing people when they are stressed and can relatively easily access new psychotropic drugs, empirical assessment of an individual's belief, values and decision making processes could be conducted with both psychological and cognitive neuroscience methods. Finally, communications focused on the

23 H. Greely *et al.*, "Towards responsible use of cognitive-enhancing drugs by the healthy", 456 *Nature* (2008), pp. 702–705.

24 M. Sandel, "What's wrong with enhancement?", 2002, available on the Internet at <http://bioethics.georgetown.edu/pcbe/background/sandelpaper.html> (last accessed on 8 July 2011).

25 S. Müller and H. Walter, "Reviewing Autonomy: Implications of the Neurosciences and the Free Will Debate for the Principle of Respect for the Patient's Autonomy", 19 *Cambridge Quarterly of Healthcare Ethics* (2010), pp. 205–217.

26 F. Russo, "The Brain: How to Change a Personality", Time, Jan 18, 2007.

27 Other relevant theories are Risk-as-Feeling Concept: Loewenstein *et. al.*, "Risk as Feelings", 127(2) *Psychological Bullettin* (2001), pp. 267–286; Anticipatory Effect theory: C.N. Kuhnen, B. Knutson, "The Neural basis of Financial Risk Taking", 47 *Neuron* (2005), pp. 763–770; Net Emotional Response Strength: F. Hansen, S.R. Christensen, *Emotion, Advertising and Consumer Choice* (Copenhagen Business School Press, 2007).

28 R. De Jongh *et al.*, "Botox for the brain: enhancement of cognition, mood and pro-social behavior and blunting of unwanted memories", 32 *Neuroscience and Biobehavioral Reviews* (2008), pp. 760–776.

facts critical to these choices will have to be developed and empirically evaluated[29].

VI. Conclusion

Cognitive neuroscience attempts to understand how the brain enables the mind to function, as well as answering questions such as "What enables humans to make choices that lead to long-term gains?", and "Do we have a rational mind?" Decision making skills depend on the processes of action selection, choosing between one of several possible responses, reinforcement learning, and modifying the probability of selecting a choice on the basis of experienced consequences. Behavioral and cognitive neuroscience identify the neural systems involved in adaptive behavior, namely the ability to flexibly modify the relative reinforcement values of alternative choices.

What about the role of law in this context? Many scholars have maintained that neuroscience at its current stage of development cannot modify the law. Methods for comparing individual and population responses to stimuli are lacking, and there are fundamental differences between a clinical setting and the lab. There is, however, no denying that brain imaging is a powerful tool for cognitive neuroscience, whether used for medical or legal purposes. This raises the question whether the law should consider the emergence of these new technologies as a new challenge for regulators. It probably should. Discussion about the right regulatory environment raises a variety of well-known generic issues within the interface of law and science, but new policy implications might emerge with regard to neuroscience. Promoting lively international collaboration between legal scholars and neuroscientists is therefore crucial.

29 The general tripartite risk communication scheme, here adapted on drugs issues, has been delineated by Baruch Fischhoff, "Risk perception and communication", in R. Detels, R. Beaglehole, M.A. Lansang, and M. Gulliford (eds), *Oxford Textbook of Public Health*, Fifth Edition (Oxford: Oxford University Press), Reprinted in N.K. Chater (ed.), *Judgment and Decision Making* (London: Sage, 2009), pp. 940–952.

Trade, Investment and Risk

This section highlights the interface between international trade and investment law and municipal and international risk regulation. It is meant to cover cases and other legal developments in WTO law (SPS, TBT and TRIPS Agreements and the general exceptions in both GATT 1994 and GATS), bilateral investment treaty arbitration and other free trade agreements such as NAFTA. Pertinent developments in international standardization bodies recognized by the SPS and TBT Agreement are also covered. Risk regulation refers broadly to regulation of health, environmental, financial or security risks.
Of recurrent interest in this area are questions of whether precautionary policies can be justified, the extent to which policy can and should influence risk regulation and the standard of review with which international judicial and quasi-judicial bodies assess scientific evidence.

United States: Certain Measures Affecting Imports of Poultry from China – Just Another SPS Case?

*Lukasz Gruszczynski**

The SPS Agreement may apply to budgetary measures if they are motivated by SPS concerns. Equivalence-based measures are subject to regular disciplines of the SPS Agreement, including but not limited to Article 4. This means that WTO Members when engaging in the recognition process need to observe other SPS provisions such as requirement of scientific risk assessment (Articles 5.1–5.3) or quasi-consistency obligation of Article 5.5. An SPS measure which has been found inconsistent with certain provisions of the SPS Agreement (e.g. Articles 2 and 5), cannot be later justified under the general exception of Article XX(b) of the GATT 1994 (author's headnote).

I. Introduction

The *US – Poultry*[1] case was the first sanitary/phytosanitary (SPS) dispute decided by the WTO panel

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1 Panel Report, *United States – Certain Measures Affecting Imports of Poultry from China*, WT/DS392/R, adopted on 29 September 2010.