Science, self-control and human freedom: a naturalistic approach

Gilberto Corbellini and Elisabetta Sirgiovanni

A recurring assumption among political philosophers is that freedom as the ancients conceived it was different from the kind of freedom experienced in the modern world. On 13 February 1819, in his famous lecture on *The Liberty of the Ancients Compared with that of the Moderns* held at the Athénée Royal in Paris, Benjamin-Henri Constant de Rebecque gave one of the most brilliant formulations of liberal thought. Constant affirmed that modern men's liberty is 'individual liberty', whereas that of the ancients was the freedom to collectively exercise sovereignty. He wrote that the ancients were 'machines, whose gears and cog-wheels were regulated by the law'. The moderns, after Hobbes, Locke, Spinoza and Hume, used the law to circumscribe the space of expression of autonomy, which was intended a priori as indefinite and – this is the crucial difference from the ancients – no longer located in the public forum but in the so-called 'inner' or individual conscience. So, the function of law had changed, as it no longer prescribed what a citizen *must* do but what he or she *may* do. In one phrase, popular in English law: everything that is not forbidden is allowed. In this sense, the law becomes the premise, in Constant's words, for the 'pacific enjoyment of private independence'.

Constant was presenting the classical liberal theory of freedom, in which freedom is understood as the right to be subject solely to the law, and therefore not to be arrested, imprisoned, sentenced to death or mistreated by the arbitrary will of one or more individuals. Moreover, liberal freedom implies the right to express one's opinion, to choose one's work and to perform it, to make use and abuse of one's own private property, to associate with those one prefers and to exercise an influence on the administration of government. Of course, traces of such modern ideas of liberty can be found in antiquity, but wherever slavery was legal, freedom was thought of in opposition to slavery, and since the subordination of the individual to the state and the laws had to be total, the idea of 'negative liberty' found little room to advance. Even for Aristotle, the philosopher who comes closest to a modern way of thinking, what distinguished the slave from

the free man in the *Politics* was not that the former was limited in his actions or subject to coercion, while the latter enjoyed personal autonomy, but the fact that everything a slave did was done to serve someone else's interest.

One question to which neither Constant nor others have provided satisfactory answers remains, however. What really happened to catalyse the cultural processes from which the moderns' ideas of liberty were shaped? In this chapter, we would like to provide a naturalistic answer to this question.

Being a naturalist about human behaviour means believing that human behaviour, including moral and social behaviour, results from the functioning of the human brain, a complex, multilevel, anatomical organ evolutionarily and developmentally determined by genetic and epigenetic factors, and that understanding our social brains is a crucial step towards explaining social facts (Corbellini and Sirgiovanni 2013). Throughout the history of philosophy, naturalists have been most concerned about the existence and sources of freedom, since while they need to face the problem of reconciling freedom with determinism just as spiritualists do (for whom it is not nature that determines human behaviour, but God or some other spiritual force), naturalists cannot escape the problem by appealing to an immaterial soul or mind. We will not deal with these metaphysical questions here, but we will examine the evolutionary and historical processes that allowed human beings to achieve those skills that determined the relevant cognitive and moral improvements that we today define as 'freedom', those that made liberal and democratic achievements possible. We believe that the introduction of modern science, especially experimental method, had a crucial role in the process (Corbellini 2011).

Naturalistic hypotheses about science and human freedom

Curiously enough, historical accounts of human liberty give very marginal consideration to the role played by science in the birth of modernity, particularly in the construction of the epistemological and psychological conditions for the development of the kind of behaviour we today consider compatible with the civic and democratic coexistence of individuals. If it is unquestioned that civic and democratic behaviour was inspired by the introduction of a new idea of freedom, that is, autonomy or self-determination, including both positive and negative components of liberty (respectively, liberty as the capacity to self-govern and liberty as the absence of external interferences or constraints), there is far less agreement about the role that modern science had in this cultural process. Important exceptions to this tradition are books by Niall Ferguson, especially *Civilization: The West and the Rest* (2011), and the volume *The Science of Liberty: Democracy, Reason and the Laws of Nature* (2010) by the science writer Timothy

Ferris. As they interestingly argue, the rise of the modern idea of liberty, along with the evolution of the psychological capabilities that permit much more advanced possibilities for planning and control, has been a consequence of the advent of experimental science and thus of the spread of critical thinking applied in a systematic way. The pioneers of political liberty were well equipped with the scientific knowledge of their time – a quite obvious claim. The idea that modern science was at the origin of the democratic revolution rests on the fact that a sizeable proportion of scientific minds were directly involved in the revolutions that led to the establishment of fundamental human rights and therefore to the birth of modern democracies, immediately before the Enlightenment and during the scientific revolution. More compelling is the reason why science made this contribution, which is, according to Ferris, that science *required* liberty and so produced social benefits by creating a sort of symbiotic relationship between liberty and science, in which the freer nations were better able to move forward with scientific endeavour, which in turn rewarded populations with knowledge, well-being and power.

Among the particular characteristics of scientific endeavour, Ferris notes that science is anti-authoritarian, self-correcting, requires the production of specific intellectual resources, is powerful in the action of transforming nature and is a social activity. These are characteristics long observed by scientists, philosophers and sociologists during the period in which science was a model of knowledge. In addition, according to thinkers who are politically very different from one another – such as John Dewey, Michael Polanyi, Joseph Needham and Karl Popper – science and democracy share epistemological and ethical–political aspects. In particular, science and democracy both require tolerance, scepticism, rejection of authority, respect for facts, freedom of communication and free access to results.

More specifically, the discovery of the advantages of the hypothetical–deductive and experimental method, starting from the ancient traditions of logical and naturalistic thought, entailed the exercise and improvement of abstract and metacognitive reasoning capacities. This determined a more decisive detachment of naturalistic research from common sense at the dawn of the modern age. Theories that scientifically explain natural phenomena are almost always counter-intuitive. We might mention a very long list: heliocentrism, the Galilean–Newtonian theory of motion, the statistical–mechanical theory of heat, the Darwinian theory of evolution, the Mendelian theory of inheritance, the second law of thermodynamics, the restricted and general theory of relativity, quantum mechanics, the mathematical theory of communication (information theory), neurobiological theories of memory and learning, cognitive and evolutionary theories of psychology, along with many others. Abstract thought had been used by Greek philosophers and naturalists and had spread for centuries, also being cross-fertilised by other oriental traditions, but only when it met with a set of

material conditions such as the ecological diversity of the economic productive systems of the late Middle Ages could it stimulate the contagious development of counter-intuitive explanations through brain training for ‘unnatural’ thought.

Starting to think like a scientist was a new and powerful resource for real-life problems in the modern world. By using analysis, abstraction, hypothetical reasoning and experimental control, a series of evolutionary predispositions, which were not set spontaneously, were triggered. What were the neural structures involved?

From science to freedom through self-control

By looking at neurocognitive research about scientific learning, we may infer which brain structures were crucially trained and enhanced by science so as to determine the birth of the concept of liberty in the modern age. As we know, science learning activates frontal and prefrontal brain areas to a great extent, areas that are responsible for cognitive processes, affective regulation and social choices and contribute both to the capacity for control over the environment (e.g. the ability to find or produce food, to reproduce more and with a better chance of survival for the offspring, to treat illnesses and reduce suffering) and self-control (the effortful capacity to regulate one’s automatic thoughts, feelings and behaviour in favour of long-term interests or goals).

Clinical and experimental neuroscience show that frontal areas, which are also the last to reach complete maturity at the end of adolescence (in the period therefore during which the acquisition of scientific thinking can take place), are implicated in abstract reasoning, calculation and information processing for planning one’s own behaviour. These capacities adaptively improve individuals’ goal-directed actions and behavioural performance. From primatology and anthropological research, we may suppose that over hundreds of thousands of years it was human beings’ constant need to meet practical challenges that represented the main selective pressure for the progressive evolution of these complex structures. Presumably beginning from the fabrication of lithic artefacts, which in the course of millennia went through increasingly developed symmetries and forms, higher and higher capacities of mental representation for conceiving implementable models of artefacts were selected. Other authors have extended this hypothesis to social needs. If we consider that the increase in primates’ brain size and capacity is not explicable solely by daily practical activities such as finding food or defence from predators, but is much more conceivable as an adaptive response to the increasingly complex social environments in which they evolved (Byrne and Whiten 1988; Dunbar 1998; Whiten 2000; Whiten and van Schaik 2007), it seems that the development of intelligence was a consequence of the extension of social groups and of the growth and development of new kinds of relationships among their members, apart

from parental or sexual bonding. New interpersonal skills were required, such as the necessity to create alliances and to negotiate, to scrutinise others or manoeuvre them, in order to give rise to increasingly complex and relatively stable hierarchical social structures. From the Neolithic period, our ancestors must have possessed roughly the same neural structures as us, which they used to free themselves from material and social conditioning and to manage social group hierarchies.

We can suppose that historical changes intervened in the expression and potentialities of such structures, whose most powerful enhancement came with the introduction of scientific method in the modern age, which we believe involves two types of intelligence, contrary to what is generally claimed. The first is a strictly academic intelligence, estimated by conventional psychometric measures of so-called crystallised (gC) and fluid (gF) general cognitive intelligence, according to the standard Cattell–Horn–Carroll (CHC) theory (McGrew 2005). gC describes the cognitive functioning detected by classic psychometric methods, such as for example IQ tests, and based on previously acquired knowledge available in long-term storage (e.g. semantic knowledge, episodic memory), while gF refers to more flexible reasoning capacities such as problem-solving ability, the ability to see relationships and analogies, to abstractly represent concepts and figures, or to combine letter or number series – all skills which are independent from prior experience and learned knowledge.

The second kind of scientific intelligence is a social intelligence, that is, the capability to navigate and negotiate with others, because scientific method is an intersubjective process that depends upon the careful inspection of results, as well as their approval and sharing by other members of the scientific community. Socially speaking, science is a liberal–democratic system in which scientists have freedom of thought and expression and share values and rules that allow rational comparison between divergent options in order to harmonise choices by different individuals, whose expectations rarely coincide. In this sense, science requires the employment of social capacities that depend on cognitive capacities such as mindreading (i.e. the capacity to attribute, explain and predict others' mental states) and emotional resonance, not only strictly academic capacities, so as to protect and restrict the concept of freedom in order to impede possible infringements but also to avoid negative outcomes as chaos.

Needless to say, scientific reasoning and practice modify the brain plastically and evidently increase cognitive skills. Neuroimaging findings show that, even if different neural networks distributed across the entire brain probably contribute to intelligence, aspects of both the so-called crystallised intelligence and fluid intelligence, especially working memory, attention, complex decision-making processes and high-level behaviour planning, are integrated in frontal areas, which are characterised by increased connectivity in the brain matter, thanks to which information processing is incredibly enriched. Nowadays there is great interest in fluid cognitive capacities, as

neuroscience has still to explain why these capacities show much more age-related decline in comparison with crystallised ability (Deary et al. 2010). Although it is true that research in psychology has found evidence that social intelligence is a relatively distinct domain from general cognitive intelligence, because the former involves much more emotional processes (Kihlstrom and Cantor 2000), there are also important overlapping systems, such as those devoted to problem-solving abilities, knowledge, memory, language or creativity, sustained by the activity of the prefrontal cortex, which is also presumed to function by connecting and integrating the activities of frontal systems for reasoning and limbic ones for emotions in a much more interactive brain architecture (Barbey et al. 2014). Nonetheless, as research into different disorders such as autism or psychopathy has shown (Greenspan and Love 1997; de Oliveira-Souza et al. 2016), social intelligence is not merely a matter of planning actions but also comprises capacities such as theory of mind and emotional resonance and affective response to others, and hence it also involves the activity of the temporal lobes and limbic areas. A feature of social competence is the masterly regulation between rational decision-making and emotional impulses. The notion of 'self-control' encompasses a broad range of diverse and complex behaviour of the sort that this regulation produces.

In neurobiology, the capacity for self-control or self-regulation has been correlated to the functioning of the so-called reward system, a widely distributed network of brain structures (fronto-basal-ganglia circuit) (Aron et al. 2007), which includes the dynamic interaction between frontal and limbic areas that respectively underlie rational and emotional processes, and is regulated by the projection of neurotransmitters such as dopamine, norepinephrine and serotonin. Extended research (see Hassin et al. 2010) has shown that the development of these capacities depends on the combination of genetic dispositions and environmental triggers such as upbringing, education and relationships with peers. A long series of neurological and psychiatric pathologies (such as OCD, addiction, eating disorders or psychopathy, to mention some) have been studied as self-control deficits and associated with failures in cognitive and social domains, while psychological studies have highlighted that developing self-control competence is widely beneficial, since it contributes to personally and socially positive outcomes in life such as well-being, autonomy, and career and interpersonal success (Tangney et al. 2004).

Something that we want to point out here is that we have reason to believe that the introduction of modern science was crucial to the enhancement of the functioning of the prefrontal cortex, resulting not only in an increase in academic competence but also contributing to the enhancement of other abilities in the social domain, mainly the wise understanding and managing of the interpersonal situations and transactions required to achieve collectively desired goals, which is usually referred to as social

intelligence. These empowering effects on the capacity for self-control generated the bases for experiencing and conceptualising the modern idea of liberty.

Some might find the link we are making between the exercise of self-control and freedom bizarre, and the most common reason is that in ordinary thinking, self-control is wrongly identified with obedience to authority and social conformity, with examples coming from military or educational contexts where self-controlled soldiers and students are those who show total observance of and compliance with orders coming from higher authorities. However, the proper expression of the capacity to alter or override dominant response tendencies – self-control, as described in neuropsychological literature (Mischel 2014) – for example, deferring gratification and exercising impulse inhibition, such as resisting a delicious fattening cake or remaining calm in the face of one's aggressive boss – includes the agents' fundamental competence to understand and counteract the harmful effects of situations so as to regulate goal-directed actions, even interpersonally, and not to produce automatic responses, which submission and conformity reactions typically are. This means that, even if influenced by habit and automaticity, self-control capacity allows agents to adjust their behaviour according to their own values and chosen commitments, showing the best expression of wise self-government in social domains.

In this sense, we intend self-regulation to go along with willpower (Baumeister and Tierney 2011). Even if contemporary neuroscience has clarified that much of the will is expressed outside the agents' awareness (Roskies 2012), this is not really something that concerns us here, since unconscious willpower is sufficient to self-determination, autonomy and critical thinking, the kind of capacities we believe that science education is able to enhance.

Science education and self-control enhancement for social improvement

The best lesson we can learn from neurocognitive theories of control concerns the effects of basic cognitive mechanisms of self-regulation on intrapersonal and societal-level goals and motivations. As we argued in the previous section, cognitive and social intelligence are relatively distinct but interacting capacities, and both are required for better academic achievements. What it is crucial to understand, however, is that neural mechanisms connecting rational decision-making and affect so as to exercise self-control and self-regulation are those which are enhanced by science education. First, the learning of a way of thinking that is unnatural, in the sense that it is not developed spontaneously or necessarily, makes it possible to practise 'unnatural', complex, social behaviours, such as those that lead to economic exchanges (free market) or to democracy, where decisions are made by

cultivating rational discussion rather than relying on emotional impulses, and where the personification of authority as an absolute guarantee of rules of social control is no longer needed. Each individual becomes capable of self-regulation, making reference to a law applied in an impartial way (the rule of law) within the context of a political system that can now become representative. Second, in order to coach students to succeed in research, complex scientific training shapes their neurocognitive processes in a way that makes them aware of the benefits of self-control and self-regulation, such as more solid and long-term rewards and gratification in their work and lives.

There is an empirical indicator of this social change, the so-called Flynn effect (from the name of the academic James Flynn), which has detected a surprising increase in IQ of about three points every decade in Western developed countries, starting from the twentieth century (Flynn 2009). Authors such as Stephen Pinker (2011) have brilliantly correlated this to sociological research showing a decrease in violent criminal behaviour, and to the development of liberal democracies in those countries. According to Michael Shermer (2015), a great part of this phenomenon is attributable to the spread of science education in the general population, especially to abstract, categorical and hypothetical reasoning along with self- and other-mindreading, which determined the development of kinds of intelligence and behaviour modelled on the functioning of scientific processes.

Science goes beyond the mere formulation of hypotheses by adopting a criterion for the empirical testing of the control statements, which may be false. In this way, even though this may be unpleasant, scientists realise that they can always be wrong. Scientific training over time teaches us how to avoid the types of mental shortcuts or biases that systematically lead to wrong inferences and conclusions, stimulating critical and sceptical thinking unrestricted by external conditioning and governed by one's own scrutiny, or, better, an implicit model of both honest and autonomous behaviour which resembles the kind conceptualised by modern liberty. The intrinsic social nature of science, whose actors must respond to the rigorous examination of a skilled community but possess the tools and skills to prove an alternative and revolutionary theory to be true – a form of social expertise that strategically enables scientists to achieve goals associated with the mission of science – is the kind of ground that allows responsible behaviour to flourish in societies.

Some might object that episodes of misconduct and malpractice among scientists seem to show that the scientific community is not always the best example of ethical behaviour, and it is obviously true that much work in this sense must be done. Nevertheless, it should be clear that committing acts such as data falsification, fabrication or plagiarism, as well as workplace bullying, is a clear violation of science rules, and scientists who are shown to do this risk being marginalised and punished. Hence this is not the kind of behaviour that science promotes. Rather, identifying scientific

work with these bad episodes has caused very negative outcomes in the past, from the stigmatisation of scientists and mistrust on the part of the general population to wrong political choices that have favoured the growth of ascientific and magical thought. There are many possible solutions to scientific misconduct, which mostly concern the need for governmental reforms to improve the working conditions of scholars in contemporary academia around the world, since unethical behaviour is prevalently the result of career pressure and reputation seeking, since academics both old and young face an insufficiency of financial resources to conduct their research, an objective impediment to the expression of their scientific freedom that has consigned academia to one of its worst periods. Unfortunately, a more detailed examination of these circumstances goes beyond the purpose of this chapter. Nevertheless, these considerations align again with empirical research into self-control and autonomy, which shows that proper expressions of self-regulation and freedom, although emerging properly in competitive contexts, are possible only in non-stressful and resource-consuming environments, where hard effort is rewarded accordingly (Baumeister et al. 1998; Gino et al. 2011; Pyone and Isen 2011).

Occasionally a certain naivety might also be present among scientists, resulting from the fact that many of them fulfil their duties and interpret their professional roles as mere ‘puzzle-solvers’ in the famous Thomas Kuhn (1970) sense, meaning that they conduct their research mechanically within accepted standards, as if solving crosswords or playing chess or completing jigsaws, and are very rarely dedicated to revolutionary or extraordinary investigations, being also often unaware of the epistemological dynamics of the scientific research they are involved in. This is properly the educational task that pertains to empirically informed human and social sciences, which are specifically called to sustain and complete scientific education so to train future generations to be aware of and disclose epistemological biases, and be engaged in the effort of correcting them profitably for their own best interests and for the interests of others.

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