Honours Review

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Welcome!

A word from the editorial board

It has been over a year since we took off on this journey and here it is: we have finally reached the destination! You hold it in your hands or if reading the digital version, look at it on your screen. *Honours Review*, when still on the horizon, was just a blurry shape, but it revealed itself to us as we worked on it and now we are proud to officially present it.

The story began when the former Dean of the Honours College took the initiative to give students a chance to have their ideas, conceived in the course of the Honours program, published and shared with fellow students and a more general audience. The resulting idea was that of a scientific journal, which would foster further discussion of the scientific issues students dedicate themselves to and help initiate interdisciplinary collaboration.>>>

Current editorial board, from left to right: Alexander, Henri, Martijn, Sébastien, Kees and Homer. Veerle and Merit unfortunately not depicted.

>>>To set up the project, the dean sought the support of Dr. Kees de Vey Mestdagh, who then approached some of his best students to form the first editorial board. They did part of the foundational work, after which a new and larger team of Honours students continued to work on bringing this project to life. By 2013, the inspired collaboration of these motivated students, with the help of both the Honours College and its associated teachers, paid off in the establishment of *Honours Review* and publication of this first issue.

The goal of this initiative is to offer a stimulating platform for Honours students, where they can formulate, develop and communicate their ideas. *Honours Review* sees quality of content, interdisciplinary dynamics and intellectual independence as its three inseparable foundations. As a consequence, the publication does not shy away from academic language. However, during our discussions of what this magazine should and could be, we decided that to best reflect the spirit of our young student contributors, and the excitement and freshness of their ideas about science, *Honours Review* should be a journalistic-scientific publication. This essentially means we combine the best of both worlds: deep, high quality material sourced from students' academic work grounded in the scientific method, but written and formulated in an attractive and entertaining manner. We made this decision hoping to resonate and engage with our primarily intellectual audience.

The Honours College of the University of Groningen gives talented, motivated students the opportunity to challenge themselves by offering a program followed in addition to the regular degree. The program sees as one of its goals the fulfillment of the scientific ideal of a multidisciplinary education. Therefore *Honours Review* – representing the work of Honours College students – aims to cover all science, and to make its content comprehensible regardless of the background of the reader. Our publication also intends to, whenever possible, find and cross the borders of disciplines, to shed light and present novel interpretations of scientific and societal issues.

This issue includes seven articles selected to best reflect our mission and showcase the dynamics of students' work. From the power and responsibilities of the academia, through a layman's view of the complex physics theories and the philosophy behind their discovery, to answering the great question of what causes the good and the bad in the world.

Without further ado, we hope you enjoy reading the magazine as much as we did preparing it for you. Quoting Dexter, the cartoon childhood hero of many future scientists: "Let the science begin!"

We welcome any and all suggestions you may have that could help improve this initiative. If you are a student, submit your work* and apply for a position in the editorial board - this journal is created by students and for students!

*writing criteria are available at honoursreview.nl

Humpty Dumpty

The advantages of an interdisciplinary approach in academia

Jeremy Dillmann

A multitude of global issues, including overpopulation, war, a growing gap between rich and poor, as well as our increasing dependence on fossil fuels – and the environmental costs related to it – represent highly complex problems that we will face in the coming century. These involve child mortality in third world countries, ambiguity in international interventions, and the potential flooding of the Netherlands due to global warming. A common element shared by these issues is their complexity; they involve many factors interacting in synergistic ways. Lee Bollinger, president of Columbia University, wrote in the inauguration of the interdisciplinary 'Columbia Committee on Global Thought', that academia are "uniquely capable" and responsible for providing knowledge on modern global issues (1). In line with Bollinger, I argue that in order for us to gain an understanding of the aforementioned issues, holistic analyses are necessary.

Philosophy | Interdisciplinarity | Collaboration

>>> I also propose that Academia, with its inherent diverse disciplines, has a great potential to analyze large scale societal problems comprehensively and to unveil their underlying mechanisms. Perhaps the greatest strength of Academia is that Scientists from disciplines as varied as anthropology, sociology, physics, history, business, law, biology, psychology and engineering can commonly be found in every university. In spite of the great potential their collaboration might yield, individuals from these diverse backgrounds, though united by science and the proximity on campus, often fail to communicate with each other. Insufficient communication between scientific disciplines might lead to waste of resources, as perhaps exemplified by a medical paper (2), in which the author spent time and research funding on essentially reinventing a standard mathematical tool, - the Trapzoidal Rule. Apart from producing publications that 'reinvent the wheel', failure to consult or collaborate with other disciplines may leave many fruitful roads untraveled. These untraveled roads, or inefficiencies in researching major societal problems, might translate to prolonged death and suffering as we speak.

Academia are "uniquely capable" and responsible for providing knowledge on modern global issues.

In the following I would like to convince the reader that valuing and incorporating alternative disciplines not only allows Academia to realize its full potential, but also is our best chance at reducing human suffering on earth. Having established the value of crossing disciplinary guidelines, I will outline difficulties and perspectives of interdisciplinary work. Presently we are faced with the far-reaching, yet trivial sounding, "humpty dumpty problem". This alludes to an English tale of an egg-like character that falls of a wall. He falls into many pieces and no one knows how to reassemble him. Waddock and Spangler (3) use the problem of reassembling Humpty Dumpty as a metaphor for large scale problem solving in human society:

"(professionals)...are expected to somehow put their -and only their- pieces of Humpty Dumpty back together again. Further, they are to accomplish this task without really understanding what Humpty looked like in the first place, or what the other professions can do to make him whole again. Clearly, this model does not work. In addition to their traditional areas of expertise, professionals must be able to see society holistically, through lenses capable of integrating multiple perspectives simultaneously." (3, pag. 211.)

This very original description illustrates that we cannot succeed in solving major societal problems, without communication between the disciplines. In reality, problems are often dependent on many factors that are difficult to grasp for each discipline alone, and therefore requiring holistic appraisal. Although many sub-components might finally emerge, that can be best studied by a specific discipline, I argue that the global analysis of the problem and the setting of goals is made more effective by an interdisciplinary, holistic approach. A further analogy that illustrates the usefulness of interdisiciplinarity is the construction of buildings: If you would like to build a house and have a suited profession, for example that of an architect or electrician, the house you construct without assistance is bound to be imperfect. If you are an electrician you might be able to wire up your house with ease, but the foundation, insulation and roof are bound to be of mediocre quality. Coming from one field, it is unlikely that your expertise will extend to all necessary fields.

The numerous complex buildings, for example the Burj Khalifa in Dubai- currently the tallest building in the world - are clearly the product of an interdisciplinary team, with each member providing expert knowledge in his or her domain. It seems logical that an approach with a diverse interdisciplinary team is the most effective way to treat such complex problems

He has used his mathematical analytical approach to provide new insights into the workings of our social world.

as building the Burj Khalifa, advising government administrations, or improving infrastructure. It appeals to us that such assignments are complex and call for the collaboration of experts from different fields. I maintain that just as interdisciplinary teams are necessary to create complex, 830 meter tall buildings, they are necessary in Research, to deal with life-threatening societal problems.

The Potential of Interdisciplinary Teams

Let us consider overpopulation, which is a complex and highly relevant issue of increasing significance. Overpopulation involves the growth of human population to an extent that it surpasses our planets carrying capacity, requiring unsustainable energy consumption and a dramatic worsening of the individual quality of life (e.g. 4,5). Many factors on several different levels of analysis influence overpopulation. Imagine what a team of economists, psychologists, sociologists, anthropologists, computer scientists, and applied mathematicians would be capable of. Sociologists study changes in societies, contributing information on values, norms and mechanisms in different societies. They could provide information on the societal phenomena leading to extreme population increments. Anthropologists add through their expertise on the relevant cultures and the origin of different viewpoints. Psychologists provide information on the needs and processes within individuals revolving around issues such as compliance and individual decision making. Economists bring valuable insight on the financial structure of the country, relating economic factors to population growth. Applied mathematicians supply several assets. They are used to having an abundance of information and making abstractions. They possess powerful tools such as the capability to construct reductionist models of complex phenomena. Computer scientists could provide possibilities to use computing power to allow for a more convenient manner of working with the issue. Such a team has the potential to create a comprehensive view of the problem at hand, or alluding to Humpty Dumpty, they have the possibility to confer who is holding which part of the egg-shell (i.e. the problem) and how to reassemble it. Initially each discipline cultivates its own paradigms and might ascribe different meanings or importance to different facets of the issue. This is likely to lead to a more thorough assessment and discussion of the issue at hand. Even though this might not increase the ease with which discussions are led, I argue that a 'collision of paradigms' yields the potential to facilitate a more thorough and holistic analysis of the problem. Furthermore, being able to draw from the tools of several disciplines allows for the most effective strategies to be employed. Techniques such as observational and experimental, qualitative and quantitative designs, as well as relatively novel techniques such as computer simulation and modeling of complex systems might be combined into an efficient programmatic research program. However, even if cross discipline collaboration and discussion do not lead to joint programmatic research, two ends will nevertheless have been met:

1. Discussions allow for a holistic analysis of the problem, allowing individuals to integrate this additional holistic insight into their consequent research/correspondences.

2. Individuals might learn of hitherto unknown paradigms that could be adapted in useful ways.

Contemporary Examples of Interdisciplinary in Research

The value of using training in one discipline to provide insights in another field, has been recognized for centuries. The prominent psychologist William James (1842-1910), who brought psychology from Europe to the United States of America, is a genuine example. Later in life he went into the business sector, using his psychological knowledge to create effective advertisements. An additional example is the story of Duncan Watts' success. Watts was a physicist trained in mathematics and engineering but turned to sociology during his graduate training. He has used his mathematical analytical approach to provide new insights into the workings of our social world via small world network theory (6). What is more, Watts' conception of a network in which most nodes (e.g. representations of single, persons, diseases, organizations etc.) are located in separate clusters but nevertheless closely connected, via few nodes connecting the clusters, is now being used widely. Borsboom and colleagues (7) utilized small world network theory to illustrate organizational patterns of comorbidity (two pathologies co-occurring) in clinical psychology. What is more, Watts' concept of small world network appealed to neuroscientists who proposed that the human brain might be organized according to the principles Watts discovered (8). Paradigms developed in physics and biology to study complex systems and chaos, are increasingly being adapted to study human interaction and influence systems (e.g. 9). Complex systems theory, which originated in physics, provides a language with which to study self-organizing, nonlinearly interacting systems that are highly complex but not yet chaotic (10). The power of such an approach is exemplified by the work of the applied mathematician Steven Strognatz. He was interested in how self-synchronizing systems, such as fireflies lighting in synchrony, organize themselves (11). Having explained this mechanism in one model, the concepts can be applied to other topics, such as the pacemakers in the heart. A further, rather striking example of interdisciplinary work is provided by British Medical researchers who have recently adapted algorithms, originally developed in Astronomy, to improve automatic cancer screening methods (12). By incorporating methods from Astronomy, Medical scientists came to an insight that might save lives in the future, while also making very efficient use of resources by adapting existing techniques. To extract the essence from the above examples: Using interdisciplinary knowledge can be invaluable.

Persepectives on Interdisplinarity in Research

To make use of knowledge from different disciplines, researchers often need to invest considerable time and energy to learn about different paradigms and methods of analysis. This might entail training in Calculus or Algebra in which one is not necessarily trained. Hence, an optimistic estimation of the workload needed to implement interdisciplinary paradigms, would be about one year spent reading about and corresponding with the alternative field (depending on the field). Not many researchers could afford to do this. Most scholars are obliged to publish frequently in the highest ranking journals possible. To work with interdisciplinary paradigms scientists would be required to reduce research activity, so as to study new techniques that might or might not yield interesting results. It is obvious that these are not the kind of odds one would like to invest in. However, even if researchers were motivated to take on this endeavor, they might receive a defeating blow by academic journals that refuse to publish their work, claiming that the utilized techniques are not conventional and it is therefore not possible for readers to critically assess their meaning. Therefore, the outlook is often bleak; investing a lot of time and energy, having no guarantee of meaningful findings, and even if one were to attain meaningful findings, they would be difficult to publish. Does this mean that our dream of a happy interdisciplinary world goes up in smoke? Emphatically not! A recent paper reviewing the

I challenge the reader, and myself, to become open-minded.

development of interdisciplinary research between 1975 and 2005 concluded that interdisciplinary research in related disciplines increased by 50% (13). However, by using a more strict definition of interdisciplinary research, requiring collaboration of entirely distinct scientific fields and an increased integration of knowledge, the authors calculated a growth of 5 % in interdisciplinary publications. I believe that the percentage of interdisciplinary publications has grown since and will continue to grow in the future. This is in part due to the following elements which facilitate a continued and perhaps accelerated increment in interdisciplinary research:

1. Information is freely available and easily accessible via the Internet. For many analyses you do not need to be an expert in the field, but simply need a learning orientation and a working internet connection.

2. It is possible to collaborate with experts from other fields, decreasing the need for both to have extensive knowledge of the others field. These researchers could take an approach of using their strengths and managing their weaknesses.

3. As science and the world develop, we are left with increasingly complex problems that no single discipline can explain on its own. Increased complexity of problems could force us to work together. Moreover, increased awareness of the futility of intra-disciplinary approaches in solving major societal problems, as well as increased awareness of the potency of interdisciplinary approaches might change the criteria journals have for publication.

In conclusion, I grant, that interdisciplinary research might be more strenuous than work within disciplinary confinement. Nonetheless, I hope to have conveyed the fruitfulness of interdisciplinary approaches to the reader and to have provided reasons to consider the extra effort. Only time will tell, if we take our responsibility of resolving large scale societal problems seriously and increasingly dare to sit down with colleagues from different disciplines to discuss - together - who is holding which part of 'Humpty', what his holistic shape is, and how we should go about in reassembling him. I challenge the reader, and myself, to become open-minded towards other paradigms, to learn the languages of alternative disciplines, and to contribute to the growing appreciation of interdisciplinary research.

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Born to be Wild

Criminality and biomarkers

Bettina Franke

Evil visited this community today", said Connecticut Governor Dan Malloy after the school shooting on 14-12-2012 in Newtown, Connecticut. In the attack, 20 children and six adults were killed (1). In the face of such tragedy people feel insecure; they try to fathom what has happened and try to find an explanation. Whenever a spectacular crime is committed, investigators, the media and the public start speculating about the reasons for committing the crime. They will look into the perpetrator's social background to find motives that make people commit crimes. When a social background does not give easy answers, though, explanations focusing on people being evil by nature quickly come into mind. However, could we indeed find innate, biological characteristics of people that predict criminal behaviour? And if we do, what do we do with this knowledge?

Criminology | Biomarkers | Warrior gene

>>>The idea that there is something profoundly different between criminals and non-criminals is not new. In 1872, Cesare Lombroso tried to prove that criminals can be differentiated from the rest of the population by their physical features, like asymmetry in the face, or having large hands (2). This theory was rejected, but the search for a biological underpinning of criminal behaviour was not over. Since the beginning of the 2000s, there has been a steep increase in the interest in biomarkers from psychiatry. Biomarkers are biological characteristics that are hoped to be valid representations of other present or future characteristics (3). In medicine, a blood test can be an indication of HIV, and in psychiatry a brain scan can show particular anomalies, which are associated with depression. Biomarkers can also be specific genetic sequences, which can be detected in a genetic screening. It is hoped that these biomarkers can be used as tools in assessment and prevention of disorders.

Concerning criminality, researchers from Brown University claim that there is a "warrior gene", which predicts aggressive behaviour (4). They show that participants with the low-activity form of the monoamine oxidase A gene (MAOA-L) are slightly more aggressive than participants with the high-activity version of the gene. Another study using brain-imaging at the University of Chicago found that adolescents with aggressive Conduct Disorder showed atypical neural responses when watching videos of other people in pain (5). Research like this can make an important contribution to the explanation of criminality and thus the prevention of crim

Biomarkers and neurological explanations of behaviour are very popular. Why? It seems very comforting for people to have a quick and easy biological explanation for everything. It is not your kid's fault that he is impulsive, it is because of the ADHD. Something is wrong with the neurotransmitters. It is also more convenient to explain criminality from a biological-dispositional point of view. It separates criminals from the general population. Something is inherently wrong with these people, they are evil, they are not like us. People like this kind of explanation, because they do not have to think about the complex interaction of society, culture, upbringing and biology.

Something is inherently wrong with these people, they are evil, they are not like us. People like this kind of explanation.

Not only the public, but also many researchers embrace biomarkers because they believe that they are more objective than traditional measures, but this is not really true. We need to consider that human decisions precede blood tests, brain scans or genetic analysis, meaning that human beings decide on certain tests after listening to and observing a person. Equally, the results of these tests are interpreted by humans. Assuming that a brain scan would show depression, but the person does not exhibit any symptoms, could we say that the brain scan is the objective indicator? If someone has the "warrior gene", but never committed a violent crime, is the genetic analysis an objective indicator of his aggressive potential?

We should not be overenthusiastic about biomarkers. There are scientific as well as ethical limitations, which have to be discussed. Singh and Rose argue that biomarkers are not yet reliable predictors of psychological disorders and are not used in clinical practice. They hardly present evidence for the cause of a disorder, but remain only estimators for the probability that a condition will develop or that a child will become a delinquent (3). Similarly, no one in the field of genetic research would seriously claim that having a particular gene leads directly to a life of crime. The environment always has an influence. Indeed, in the aforementioned study from Brown University, the effect of the MAOA-L gene was only found in a condition of high provocation (4). Other researchers contend that a trigger, like childhood maltreatment, can influence whether people will actually have a violent crime record (6). Researchers in the field of behavioural genetics are sure that genes influence criminal behaviour, but can only show this on a group level.

Suppose people get to know that they have a "warrior gene", would they start behaving more aggressively because they can now justify it?

Even though their limitations are understood in scientific circles, the popularity of biomarkers is problematic. Studies have shown that adding neuroscientific information makes people unable to critically assess an argument. Apparently, even students taking neuroscience classes judged bad explanations as better if irrelevant neurological information was added. Simplification and overgeneralization of the facts is common in the popular media (7). Scientists understand that a phrase like "warrior gene" is being used to catch attention, not to say that a single gene can make someone aggressive. Also, when reading the article, one can find out that 'aggressive behaviour' was operationalized in a computer task as giving someone virtual hot sauce to eat. It is not clear whether we can transfer these findings to the real world. Many people do evil things in computer games, but are totally harmless citizens. Everyone in neuroscience or genetic research knows that the field is very much at the beginning of understanding how our genes influence our behaviour and what we can actually learn from brain scans, but does everyone watch shows like Dr. Phil? (8)

Therefore, scientists always need to be aware of the social and ethical consequences of their work. Scientific tools may not be ready to be used because they are not reliable enough yet, or because they were never invented to be used in practice. To illustrate the last point I refer to the case of Robert Dixon, which has been made public on a radio show called "The Psychopath Test (9)." Robert Dixon is trying to get parole for his life sentence, but is failing because the PCL-R places him in the high range of psychopathy. The PCL-R is a psychological test, which was invented by Robert Hare in 1980 to do basic science on psychopaths. It does not test any biological factors, like the biomarkers talked about before, but it uses certain personality features that make someone a psychopath. At that time, no one in criminal justice thought that this test was relevant to understanding crime. As Alix Spiegel tells in the show, "Criminals were made, not born". However, one of Hare's students, Stephen Hart, found out that the test was very good at assessing who would commit another crime. Today the test is routinely used in the US by parole boards and in other countries, like the Netherlands, for risk assessment (10).

It might not sound very problematic that a test, which was intended for basic research, is being used in criminal justice, but scientists - including Robert Hare - began to doubt that it did a good job outside the lab. Recent research found that it actually does a bad job at predicting future offenders with one of the lowest rates of predictive validity (11). Nevertheless, Robert Dixon will currently be judged mainly by his score on the PCL-R, and probably denied parole, even though his friends, family and psychologist think that Dixon has changed and matured. They do not think he is a psychopath. Dixon himself does not understand why he gets such a high score on the test. If we used biomarkers to predict criminality we could end up using a similar tool that shows promise in research, but has not been proven to be valid or reliable in practice. Using biomarkers in court or risk assessment would be premature.

When the effectiveness of a biological assessment tool seems to be overrated and overused in the public domain, researchers have to inform and try to use their influence to change this. According to the ethical guidelines of the American Psychological Association, psychologists need to "take reasonable steps to correct or minimize the misuse or misrepresentation (12)." The question is, what is reasonable? Obviously, researchers cannot control every post on pseudoscientific blogs, but individual behavioural geneticists have used scientific findings to influence forensic decision-making. In 2009, a judge in Italy ruled for a lighter sentence on the basis of a psychiatric report, which stated abnormalities in brain imaging scans and genes connected to aggressive behaviour. This sentence is very controversial in the scientific community and was followed by a special feature in the nature journal (13). This did not detain another Italian judge to rule on a similar sentence in 2011 (14).

It is quite obvious that there is a lack of communication, which has to be resolved. In their editorial for the feature on science in court, nature proposed "that the US Congress create a National Institute of Forensic Science, which would have strong ties both to academic science and to forensic practice (13)." This would be a good start, but clearly, this solution would not answer any problems in Europe. There is a need for a board of scientists and members of the juridical profession, which is able to propose guidelines based on valid and reliable scientific research findings, preferably to an international audience. Additionally, ethicists have to be involved to assess ethical questions, which could arise with this emphasis on biological origins of behaviour. What constitutes good evidence for using biological measures in court? For which issues could we use it? Is it morally wrong to put or keep someone in jail for something they cannot change like their biological characteristics? If biomarkers were used to assess aggression even before someone actually committed a crime, as a screening device, would this create unjustified stigmatisation? After all, even if biological links between a gene and aggression were proved, this would only show a predisposition. Some people who read an article about a disease can feel the symptoms of the disease two hours later. Suppose people get to know that they have a "warrior gene", would they start behaving more aggressively because they can now justify it? Then we would be talking about a self-fulfilling prophecy.

Criminals commit crimes and cause a lot of pain and distress with their behaviour. It is absolutely necessary to research anti-social and aggressive behaviour. At the hands of psychologists are several conventional tools, and biomarker research can potentially make an important contribution. There is some evidence that biomarkers can be connected to criminal behaviour, but there are also many open questions as well as scientific and ethical reservations. At the moment we must admit that we still do not know if some people are just born to be wild. Using biological markers in court is simply premature with the current evidence. Research must go on and ideally be discussed and evaluated in an ethics committee including people from many specialities like sociology, psychology, neuroscience, law and forensics.

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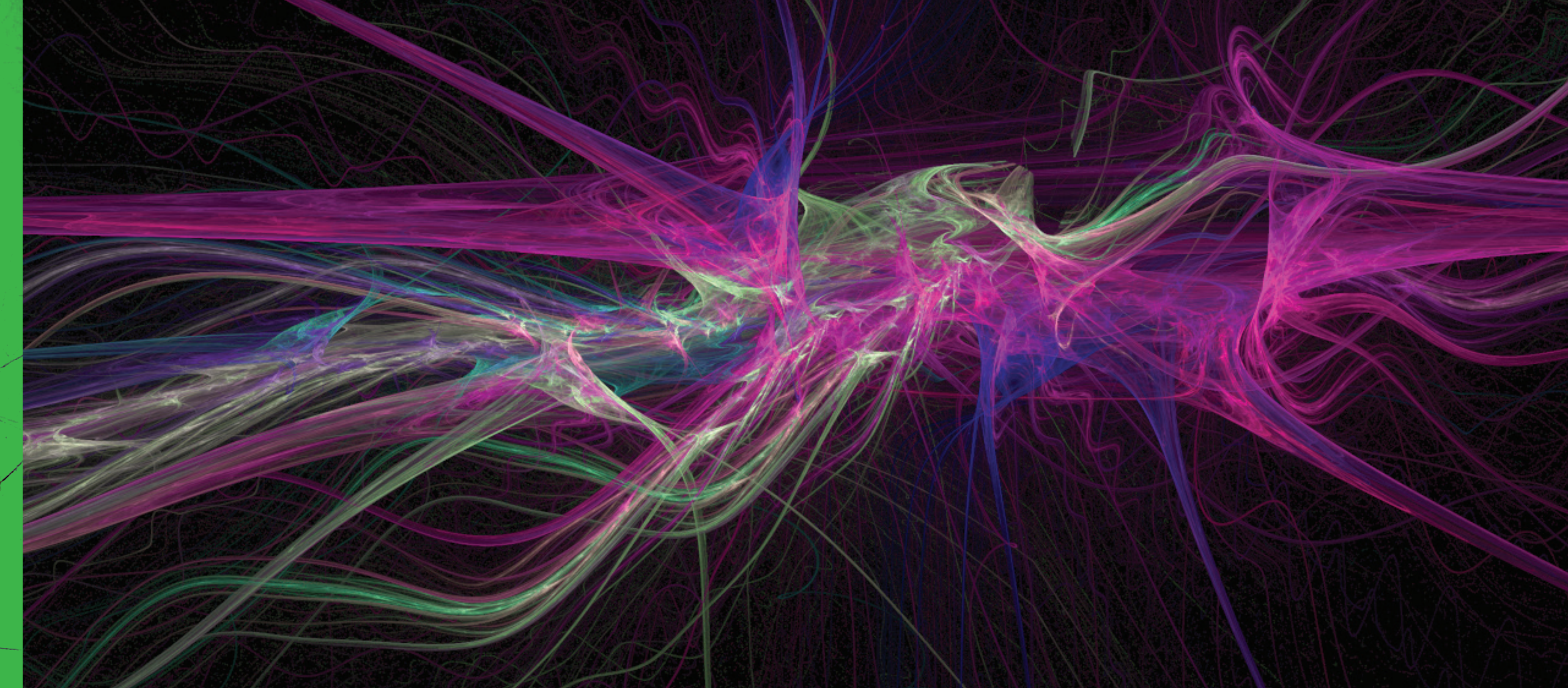
On Physical Romanticism

A layperson's attempt to describe why Superstring Theory is a contender for a theory of everything

Tobias Meierdierks

In 1905 Albert Einstein handed in a paper on the photoelectric-effect that would start off a whole new era in physics. By proposing a particle-wave duality as a characteristic of light-particles – Photons – he paved the way for modern quantum field theory (1). Interestingly enough, he himself did not fully agree with many aspects of the quantum revolution that he had partially initiated, since he rejected the probabilistic character of quantum mechanics, as proposed by Niels Bohr. Nevertheless, quantum theory developed further and brought forth the "Standard Model of Particle Physics", which is up until today the closest (with regard to its acceptance in the scientific world) to what might be called a "Theory of Everything", therefore sometimes referred to as a "Theory of almost Everything" (2).

Physics | Superstring Theory | Romance



>>>The theory remains uncompleted as it seems to be impossible to unify it with another theory proposed by Einstein. In 1916 Einstein went on and proposed a theory of general relativity, which describes gravity as a geometric property of spacetime, a model that is used to describe the combination of the three space-dimensions we can observe with our own eyes and the fourth dimension: time. Einstein's theory thereby directly opposed the former assumption of gravity being an energetic property of a messenger particle called Graviton, as it was hypothesized by quantum mechanics in the 1930s (3). Up until today no conclusive theory has been proposed that proved able to unify these two, seemingly opposing characteristics of gravity. The pursuit of the Theory of Everything has not been given up yet, although many actually doubt the possibility of its existence. One theory - among others - has called much attention upon itself, having such famous supporters as Stephen Hawking and Leonard Susskind. It is the Superstring Theory and the following paper will describe how it attempts to reconcile quantum mechanics and general relativity in a manner that is fairly comprehensible for non-physicists.

Walking on Safe Grounds - The Standard Model of Particle Physics

The Standard Model of Particle Physics describes the interactions of the known subatomic particles (2). The model recognizes 12 elementary particles, which can be divided into 6 Quarks, which bind to each other in order to form matter like protons and neutrons, and 6 Leptons, which are solitary particles and therefore are components of matter themselves (the electron is a prime-example). Quarks and Leptons each exist with 3 (so far discovered) different amounts of mass, so called generations, and each generation of quarks and leptons again comes with 2 different charges (i.e. within the first generation the "up quark" has a positive 2/3 elementary charge, while the "down quark" has a negative 1/3 elementary charge). Together quarks and leptons form the essential constituents of atoms; however, on the subatomic level they are not alone. A certain group of particles, called gauge bosons, exists as well and is less strongly associated with the constitution of matter (protons, neutrons, electrons etc.) and more with the interaction between other particles, although the cut between particles constituting atomic structures and interactions between particles is not

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that clear. The basic idea is that these gauge bosons act as messengers between (for example) quarks and are able to transmit energy from one particle to another, thereby transmitting force between them. For this reason they are called force carriers. The four bosons included in the standard model are those associated with the transmittance of natural forces: Photons, which carry electromagnetic interactions; W and Z bosons, which carry the weak interactions and Gluons, which carry the strong interactions.

An example: Three quarks (2 ups and 1 down) constitute a proton; protons are very stable constructs. The reason for their stability is the strong force that attracts the quarks to each other and thereby prevents a breakup of the proton.

A model that does not require a force, which has already been proven, can hardly be called a "Theory of Everything".

However, the reason for the force is a gluon that constantly travels between the quarks in order to create a stable bond that can only be broken by an expenditure of massive amounts of energy. Similar processes cause electromagnetic interactions, as in the case of electricity, and weak interactions, such as radioactive decay, but these only make up for three of the four known natural forces. In its current state the standard model is unable to explain the fourth force: Gravity. In order to fit the force into the existing model it was hypothesized that gravity should have its own force carrier, called Graviton (3). However, the graviton has not been proven up until today and current quantum mechanical equations do not need to include gravity since the effects of the gravitational force at the particle level are in fact so small that they can be treated as non-existent from a mathematical point of view. This circumstance is very beneficial in order for the standard model to be of functional use, yet it also shows that the standard model is not suitable to explain the gravitational force. A model that does not require a force, which has already been proven, can hardly be called a "Theory of Everything".

The Great Division - Einstein's General Relativity

That gravity cannot be proven on the particle level does not mean that it hasn't been proven at all; in fact, gravity was the first natural force to be successfully established. It was Albert Einstein (4), who proposed that objects bend the spacetime-continuum around them proportionally to their mass.

Without any external influences any motion would have a specific direction and would not change unexpectedly; it would follow a straight line through space, so to speak. The basic idea of general relativity is that the mass of matter causes a curvature in exactly this space – a gravity field - and therefore the straight line of motion experiences curvature as it moves through the area of effect of any particle with mass. This theorem allows to assume that the effect of gravity is not necessarily a characteristic of interactions between two masses (like for example, the electromagnetic force is a characteristic of interactions between two electrically charged particles), but due to the effect every single mass has on the spacetime-continuum. This aspect of the theory of general relativity explains why even photons, which are massless, are affected by gravity as well. Not because their own mass attracts them towards other masses, but because the realm - they would normally cross in a straight line - has been bent and therefore deteriorates from the original pathway.

This way of interpreting gravity leads to the discrepancy between general relativity and quantum mechanics. While general relativity understands gravity as geometric characteristic of mass within spacetime, quantum mechanics demands it to behave like a particle - according to probabilistic properties (i.e. rather than being measured in a discrete position within spacetime, quantum mechanics would assign a probability distribution of possible positions to a particle). Therefore, mathematical assessments are simply incompatible. An application of gravitational fields to the particle level completely fails; conversely, applying the statistical methods of particle physics to a single point in a defined spacetime does not work out either. It appears as if gravity follows completely different rules, depending on the dimension of its interactions.

Minding the Gap - Compactification

In order to explain how Superstring Theory attempts to make sense of the discrepancy between general relativity and quantum mechanics, it is helpful to describe how quantum mechanics relates to spacetime. The quantum field theory describes the theoretical framework of quanta by assigning an own field – or physical realm – to each type of them, thereby saying that for example all electrons existed on the same grid, on which the same laws applied to all of them, but not to other non-electron-particles. The quantum field theory further describes how different fields interact with each other; however, it does not explain how different fields can coexist at the same time and within the same space.

An interesting solution for this problem originates from the discovery of a contemporary of Einstein, namely Theodor Kaluza (5). Seeing how Einstein had created a grid for gravity in three-dimensional space, he attempted to do the same for the only other natural force that was known by that time – the electromagnetic force. He failed to apply it to the same grid that described gravity, which is essentially the same problem modern quantum physicists are facing as well. However, he found that he could mathematically relate electromagnetism to the basic principles of general relativity if he added a fourth dimension. Within this fourth space-dimension electromagnetism could be described without contradicting principles of general relativity. A general idea was born and refined over the years, the idea of a multidimensional universe with more than just the three space-dimensions (which are commonly adjoined to the fourth: time) that are observable for us humans. This raises an important question: Where are those dimensions?

Oskar Klein (6) was the first to propose that next to the well-known three space dimensions, more dimensions exist in curls that are posited on the axis of the already known dimensions. A particle, following the straight underlying line of the observable dimension, could follow the loop without actually changing its direction; thereby it would behave according to the directions of one tiny dimension and according to those of the bigger dimension at the same time. Thus, through the compactification of the fourth space-dimension, that is, assigning it a given length and periodic character, Klein showed that theoretically, the existence of more dimensions is possible, without disturbing the already existing model of space.

Connecting the Strands - Superstring Theory

In an attempt to find one common constituent of all matter, theorists took a drastic step. For mathematical reasons it had been assumed that particles behave as 0-dimensional objects, that is, as mass without volume. This is, of course, an idealized abstraction, but the behavior of particles can indeed be described within quantum mechanics as if they would not take up any space themselves; they

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apparently had an infinitely small size – therefore being called a point mass (7). Now, this created the problem of particles to be unrelated to any kind of space-dimension since they simply lacked the characteristic dimensionality itself. With particles lacking the characteristic of dimensionality it would obviously be quite hard to fit them into spacetime-based concepts (such as general relativity). In order to make a unification of quantum mechanics and general relativity possible it therefore had to be theorized that particles in fact had dimensional characteristics. And that is exactly what string theorists have done.

They proposed that quarks, leptons and all the other particles are formed by an even smaller constituent that would be responsible for the existence of all matter. They were of course talking about strings. Strings are (so far and only according to String Theory) considered to be the smallest structure existing and they are described to be 1-dimensional, oscillating filaments of energy, hence the term "string". The different patterns in which these strings vibrate would produce vibration-specific matter such as quarks, leptons and so forth and give them their unique characteristics. Interestingly, mathematical descriptions of how these strings would behave do not work in the common 3-dimensional space; in fact,

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Superstring Theory requires ten space dimensions plus the dimension of time (8). Coming back to Kaluza and Klein, compactification of these ten dimensions would create a highly complex dimensional structure of many dimensions curled on each other (9). The Calabi-Yau manifold is an attempt to depict the six dimensions that would be curled again on the observable 3 dimensional grid. This now leaves room for exciting possibilities in order to explain gravity and other phenomena. It allows for the assumption that the effects of gravity might be bound to different dimensions as the ones we can observe. Maybe the hypothesized Graviton actually exists, but it does not behave according to the 3-dimensional room we know and instead "disappears" into other dimensions. This offers a solution for the great fissure that splits theories of gravity fields and particle physics. If gravity, and maybe even all natural forces, behave according to certain dimensions or maybe the interactions between them, then it is no longer impossible for both positions to coexist. The laws of particle physics might be exactly true regarding particles that behave according to the dimensions we can readily observe, but they simply do not suffice to predict behavior of particles that are bound to those extra dimensions. It would then be of very little surprise that we fail to describe gravity with the help of a model that does not apply to the dimension according to which gravity occurs. The gravity field might be perfectly applicable on the other hand; just not to our well known spacetime, but to those compactified extra-dimensions that coexist next to and around it. This is the beauty of superstring theory. It does not attempt to deny any one of the established, but seemingly contradicting theories; instead it offers a common ground on which both can be retained.

The Greater Picture - A Theory of Everything

The assumption of strings, which vibrate in accordance to all eleven dimensions and thereby create matter, offers us yet another opportunity. If we were able to understand and predict how these eleven dimensions interact with strings, we would hold the key to understanding existence itself, as strings are supposedly the source of all matter. In this sense the Superstring Theory could really be a Theory of Everything one day. However, contemporary leading researchers are at variance on the issue of whether or not Superstring Theory is in fact true. Although very elegant and in itself quite conclusive, it is still a highly speculative theory, based on many unproven, at best just very logical assumptions (i.e. the assumption of subatomic particles to be 1-dimensional and the assumption of a multidimensional reality). It virtually has not been able to predict any phenomenon of our observable reality yet, that could not be predicted by other existing theories as well, and so far all attempts to verify its validity have failed (e.g. it failed to predict the occurrence of black holes, which are supposedly linked to gravitational effects). Whether or not Superstring Theory is correct, is a major question temporary and future research is concerned with. Departments of renowned institutions such as the MIT or CERN are currently attempting to gather evidence for (and of course against) the theory, but as for now it is important to remind oneself that Superstring Theory is currently not much more than an incredibly inventive and clever idea.

This may sound a little discouraging at first; but in my opinion, it is of great value to simply recognize how far Superstring Theory has broadened the understanding of possibilities this universe has to offer. Superstring Theory, at the moment, is less a description of what exists, but more a theorem of what is possible. Driven by our desire to form a Theory of Everything we have quite literally stepped beyond our imaginations. The theory allows us to seriously consider the existence of different dimensions, the existence of a multiverse (10), the existence of a smallest common building block of all matter and many other ideas that were believed to be plain crazy not too long ago became quite possible again. Furthermore, it created the opportunity to consider some form of existence beyond the currently observable and thereby it ultimately retrieved the option to imagine solutions that lie outside the box of already established theories. The vast amount of deductions that were made from the plain possibility of Superstring Theory being true speaks for itself; it is a theory that offers a home for physical dreamers, it is the epitome of physical romanticism. And it does not even end here; Superstring Theory is only one of several contenders for the Theory of Everything. There are many more unbelievable, yet to some degree plausible ideas of what might be possible, and each one of them might hold part of the physical truth we are seeking. I for myself am very positive that our pursuit of perfection (because this is what the Theory of Everything represents, it would be the perfection of knowledge) will pay off in one way or another, even if we might never achieve our ultimate goal. Einstein (11), in his ingenious simplistic manner, had put it this way: "The most beautiful thing we can experience is the mysterious. It is the source of all true art and science." I am pretty sure he would have enjoyed the hassles surrounding String Theory.

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Il Vittoriano

A struggle for national identity

Mark Boer, Ingrid Deijkers, Roel Donker, Veronique Jorna & Quincy Lobach

The center of Rome, the capital of beautiful archeology, houses one of the most despised monuments in the entire world (1). Il Vittoriano, the Italian name for the gigantic white monument in the center of Rome, built to commemorate Victor Emanuelle II, the first king of Italy, has been ridiculed by locals and art historians alike. The 'wedding cake' or the 'typewriter', as it has been nicknamed, is viewed by many critics as too pompous, too big and artistically inconsistent. In view of this criticism, it is surprising to discover that the Vittoriano was only built after an international architectural contest, in which not a single design was deemed acceptable after the first round of the competition. Apparently only the Vittoriano was able to fulfill the goals set by the organizing committee. It is therefore important to investigate the meaning behind the monument and the artistic choices that were made. Why was Il Vittoriano the answer for the organizing committee?

Art history | Monument | Nationalism

>>> In the following, we will discuss the Vittoriano in its political, social and artistic context. We will start off with a historical overview of the Risorgimento, the period in the 19th century leading to the unification of Italy. After this we will take a look at the decision making process for the Vittoriano. We will conclude with a closer reading of the monument and some of its elements. Italy as we know it is only a recent addition to the European continent. In the Middle Ages the geographical entity that we now call 'Italy' was littered by numerous city states, which even frequently fought amongst themselves. A sense of Italian unity was only introduced after Napoleon conquered the peninsula in 1805, as he enforced the French Code Civil in all city states and made Tuscan the official language (2). The new idea of a unified Italy was thwarted, however, when Austria demanded restitution of its former possessions in northern Italy after Napoleon was defeated. When Victor Emanuelle II rose to the throne in 1849, he immediately made a crucial decision. His father had given the people of Piedmont, in northwest Italy, a constitution the year before, thus making Piedmont the only constitutional monarchy in the entire peninsula. Even though he was not in favor of the constitution and was pressured by Austria to change it, he kept it in place (3). He might have had no choice, considering the weak position he was left in after a war against Austria, but it might also have served the political goal of gaining allies with some revolutionary parts of the Italian people in view of a later conflict with Austria. Whatever the reason, this decision made Vittorio Emanuelle II very popular with the masses. In 1859, Piedmont was looking for conflict with Austria once again. The new prime minister, Cavour, who turned out to be a political mastermind, made a pact with France, where they agreed that France would acknowledge a northern Italian state under Piedmontese rule in exchange for the province of Nice and Savoy, along with promises of influence in the rest of Italy. In 1859 the provoked Austrians finally attacked. The war itself was short: only lasting about two months, in which the Austrians were crushed. But this led to unforeseen events. The other city states in northern Italy held plebiscites, in which the people voted for direct rule by the popular Victor Emanuelle II. Moreover, in clear violation of the wishes of Cavour and Victor Emanuelle II, the old warlord Giuseppe Garibaldi conquered the Kingdom of the Two Sicilies on his own accord and started to march on the Papal States, the last Italian city state left. Fearing conflict with the French, the army of Victor Emanuelle II raced down to Rome to stop him. In November 1860 Garibaldi handed over the rule over the Kingdom of the Two Sicilies to Victor Emanuel II. Italy was formed, even though the final part, Rome, was captured only in 1870 after the defending French forces had retreated. The fall of Rome, however, was not the end of all problems. For one there was still the problem of the Church, which was clearly opposed to the unification of Italy. On the other hand there was still a powerful regional sentiment. In essence there was a feeling of unity, but not a particular strong one. Common grounds had to be created; they had to 'make Italians' (fare gli Italiani). The making of Italians was achieved on the one hand by cultural means, such as paintings, poetry and music, and on the other hand by history. In this way not only the Roman Empire but also historic personae like Dante were added to an Italian memory. The lack of a clear national memory, however, and with that the legitimacy of the Italian state, was one of the biggest problems facing the newly united Italy of 1870 and onwards.

The center of Rome houses one of the most despised monuments in the entire world.

The decision making process

After the death of Victor Emanuelle II, the first king of Italy, the Italian parliament decided that a monument had to be built (4). It was quickly decided that a worldwide public tender was to be held. A committee was installed to judge the applications. This already led to problems, as regional differences made it difficult to agree on the judges. After a long time of discussion and disagreement, the first tender finally took place. An astounding number of 315 designs were sent in for the first round of the competition. Of those, 293 were eligible to be judged. There was also a great variety in designs, including inter alia triumph arches, temples, pantheons and statues. There were two problems the judges faced. First of all, the monument had to be somewhat innovative. For example, the designs of pantheons were dismissed as Rome already had a Pantheon. The main problem, however, was once again connected to regional differences. All across Italy the designs were reviewed in journals, but this was not always done objectively. When a Roman design for example got a bad review in Milan, the Roman press made sure to criticize a Milanese design. Local papers also accused the other old city states of prejudice. In this atmosphere the Committee had the daunting task of picking a design without seeming biased to a single region. In the end, the committee could not choose a single design to actually build. No design could fully fulfill the desire to depict Victor Emanuelle II not only as the military hero, but also as the unifier of Italy. The regional differences made it hard to decide which virtues, which symbols, and which historical events could be used as symbols of unification. The committee had to compromise. They decided for example that Antiquity should play a role, but not a dominant one. All the city states also had to be represented in some way. The second tender was held with more restrictions following the discussion in the committee. Out of 98 designs, the committee finally decided on the design made by Giuseppe Sacconi. But even after the building was commenced, the discussions did not end. The statue, the decorations, and the Altar of the Homeland were still heavily debated, as it was in these elements that the symbols referring to the unification could be found. Even as late as in the 20th century, when the building was almost completed, the Fascist movement decided to alter the virtues that would be depicted on the Altar of the Homeland. This, however, goes outside the scope of this paper.

A closer reading of the Vittoriano

The monument features elements of many different styles and eras. Antiquity has clearly influenced the Vittoriano. The architectural background was inspired by the classical altar of Pergamum. The white marble that the building is made of further enhances the link with Classical times. Finally, also the location of the monument, on the Capitol, in front of the Forum Romanum, and close to the Coliseum, shows a link with Antiquity. The staircases and the sculptural and ornamental compositions on the other hand are elements inspired by the Renaissance and later times. Il Vittoriano showcases a series of symbolic representations. The external sculptural and ornamental compositions show 6 virtues of Italy. One example is 'Action', by Francesco Jerace of 1912 (5). It depicts a group of fighters waving the tricolor, on which the words 'Italy and Victor' can be read, while the lion of Venice shakes off the chains of tyranny. The other virtues are 'Thought', 'Sacrifice', 'Law', 'Cohesion' and 'Strength'. There is also a series of figures depicting the city states of Italy. On the Altar of the Homeland we can find reliefs depicting 'Work' and 'Love of the Homeland', alongside the Roman goddess of the state, Roma. It is interesting to note that there are no Christian symbols used in the Vittoriano. The explanation for this should be found in the adversity of the Church against a unified Italy. The size of the monument is a further indication of this battle for power with the Church, as it completely covers an old church that is situated directly behind the Vittoriano and rivals the famous St. Peter's Cathedral in height. On a final note, we think that the clearest proof of the struggle of the committee to find a unifying principle might be found in Sacconi's original design for the Altar of the Homeland. Originally Sacconi wanted a procession at the side of the goddess Roma. On

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the right of Dea Roma there were supposed to be people that were coming to fight for the unification of Italy. Garibaldi would have been there, but not just figures from the military. Also Dante, Vergil, Michelangelo and other great cultural men would have been present (6). In this concept, the spirit of the time with the 'making of Italians' would have been ever present. However, after his death a decade later and much more discussion and disagreement, Sacconi's idea was eventually changed to the depiction of 'Work' and 'Love of the Homeland' (7).

Conclusion

In this paper we have tried to show that the Vittoriano is much more than an artistic faux pas made by the designers. We have argued that the unplanned and rather spontaneous unification of Italy gave rise to an important new problem: the lack of an Italian identity. How to 'make' Italians was the biggest question of the time. And this is also the problem that the organizing committee faced. There was still a lot of rivalry between the old city states, making the decision

The Vittoriano is much more than an artistic faux pas made by the designers.

process very hard indeed. In the end, the organizing committee saw no other choice but to compromise and to use a lot of different elements and styles. This solution, however, exactly showcases what we believe to be the core problem of the Risorgimento. There was not only no shared cultural memory, but each and every city state had their own, sometimes slightly different, memory. Dante is first and foremost a Florentine, not an Italian, so if he is made into an Italian, then the resulting connection is much stronger between Florence and Italy than between the other city states and Italy. Therefore there is a need for a lot of different elements to make everyone equally believe in the unity. But this need for a multitude of elements in itself shows that there was no solution to the problem faced by the organizing committee. How can there be unity if it only exists through an abundance of specific regional memories? And for this the Vittoriano can also provide testimony. Elements of the monument might be very nice, but if you look at it in its entirety, the critics are right. It is just artistically inconsistent: it lacks unity. Therefore the Vittoriano is an excellent child of its time. Meanwhile, the struggle for national identity proved to be a hard one, one that is even still present today.

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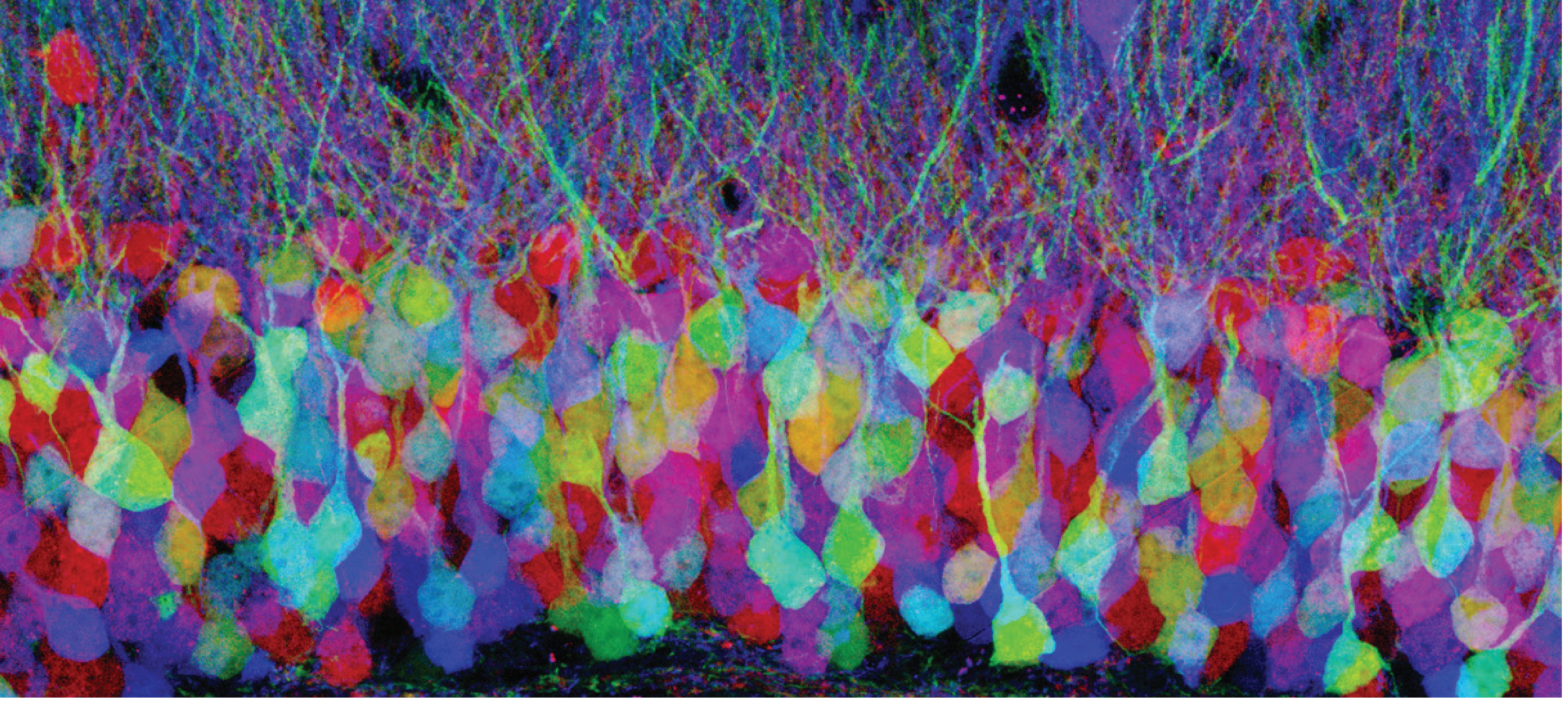
Neurolawgic

Responsibilities of neuroscience in the neuro-law debate

Clemens Ebeling

With the rapid advancement of brain imaging techniques in recent years, reductionist accounts of human behavior have claimed much popularity. The field of criminology and forensic psychology holds a special stance in this development as neuro-scientific accounts of misbehavior accumulate. Findings of brain imaging research therefore hold a strong grip on practical aspects that are deeply rooted in our understanding of today's society. There are two central aspects of areas where brain imaging techniques create pressing implications for their practical application. These are the communication of neuro-scientific findings to the public, and the consultation thereof in the judicial system. Interpretation, central to results of any research project, claims a central role in this regard, as it is an ethical aspect that directly maps onto the practical implications it bears upon the neuro-law debate.

Neuroscience | Interpretation | Ethics



>>>Just as any other respectable scientific discipline, the communication among researchers in the field of neuroscience takes place through the publication of journals, the organization of conferences, and the like. This channel of discourse, however, is almost exclusive to those participating in the field. The science behind it, in all its facets, then, takes place mainly unseen by the public eye. The most prevalent border between academic neurosciences and the folk's understanding of neuroscience therefore is what reaches the laymen through the media, such as popular science press or television. Often, these accounts reach a highly skimmed density in order to be easily digestible for the every-day user. Clearly, it would be unreasonable to expect the communication of scientific findings to be of the same quality in press designed for mass consumption, as compared to, for instance, a scientific journal. After all, there must be a reason why the public keeps to their own literature: research is undertaken for the sake of finding evidence. Mentioning the make-up of the participants or the environmental factors of the laboratory are surely necessary to ensure adherence to scientific standards. Yet, they are hardly of primary interest to those who wish to merely inform themselves about findings and the conclusions they suggest. Therefore, scientists are advised to communicate their results tentatively; it is all a matter of interpretation.

Consider the heading of an article on the webpage of Softpedia: "Scientists decode the brain of Pedophiles" (1). The use of 'decode' here appears highly suggestive. It promotes the idea of a clear demarcation between the brains of pedophiles from those of the ordinary people, i.e. the idea of 'actually having decoded' their brains. On closer inspection, however, the reader is reminded of the limitations of the neuro-scientific findings discussed in the article. Dr. John Krystal is quoted: "It is currently unknown whether this pattern of brain activation is a risk factor for the development of pedophilia or a consequence of their pedophilic sexual experiences". Reminding the reader of what is considered the 'reverse inference problem' among scientists, Krystal shows that conclusions do not thrust themselves at those who analyse the data. Again, the key to responsible research is fair interpretation. This may not be news to the sophisticated reader of scientific magazines. However, the importance of interpretation hints at issues of broader implications. As the neuro-law debate illustrates, in this line of research the implications are often of practical nature.

Such examples may easily project a 'my-brain-made-me-do-it' attitude.

Consider the following example. When a teenager walks into school with a firearm and opens fire at fellow students and teachers at what appears to be at random, politicians and the public alike are quick at pointing fingers at the causes of these derailments; be it video games, drugs, you name it. In most cases, these accounts only bear upon one single aspect of the offender's make-up. Often, two different senses of causality are used interchangeably here. Usually, when we speak of causality we are talking about those aspects of someone's surroundings and inner workings that directly made them decide in the way they did. In another sense, however, literally everything in an offender's life that has taken place beforehand plays a part in the causal chain that led to the events to which they did. This leaves room to hold almost anything of the offender's history responsible for having led to their actions. Often, multi-determinacy of people's actions is discarded and, so it seems, the single most convenient cause is 'picked' and exploited to no end.

Recently, findings of neuro-scientific brain research appear to provide a popular account of people's determinants. Cases of mitigated sentences in court due to offenders' biology have created much room for discussion in recent years. Two prominent examples of neurological and genetic findings effectively influencing court-room decisions have taken place in Italy in 2007 and 2009 (2). Abdelmalek Bayout pleaded guilty to having stabbed and killed another man. His lawyer, however, was able to reduce the 12-year sentence by four years on the basis of genetic findings suggesting Bayout to be prone to erratic and violent behavior. Similarly, Stafania Albertani's defense was even able to reduce a life-imprisonment sentence to 20 years. She admitted to having murdered her own sister and the undertaking of plans to murder her parents as well. Again, brain abnormalities related to emotional functioning were considered mitigating circumstances, regardless of the crime itself or the originally proposed sentence. Dutch courts even go so far as to refrain from classic sentencing in some cases of mental illness. Such examples may easily project a 'my-brain-made-me-do-it' attitude onto the laymen's perception of research findings.

However, such conclusions could not be further from the truth. In the article quoted above, it is stated that "Pedophilia seems to be caused by a combination of genetic and environmental factors" (2). It is surprising that pedophilia only seems to be caused by an interaction between biological make-up and environmental factors. In fact, it would be illogical if this was not the case. After all, were there no 'outside' for the individual to operate within, actions in themselves are rendered unthinkable.

The discussion about the implications of neuro-scientific research has therefore departed from hardline reductionist accounts of the kind alluded to above. While the layperson ignores the interaction between our brains and their environment, neurological research is actually footed on a probabilistic ground. This means that certain brain properties do not either make us do or be something in a binary fashion, but that they contribute to our actions and our being in a fashion of degree. We are more likely to act in certain ways or refrain from certain actions. Certain brain properties are therefore understood as risk factors, much like certain behavior in health research. Smoking is a risk factor, increasing our chances to contract certain illnesses, while regular exercise is a beneficial factor, decreasing our chances to contract certain illnesses. Brain properties, then, can be either conducive to criminal behavior or mitigate it. Conclusively, clear-cut answers are not provided by brain research to this date. As Davi Johnson notes: "…functional brain imaging has no diagnostic utility…it is not possible to image an individual brain and determine from the image whether that person is healthy or whether he or she has a particular disorder" (3).

Again, the key to understand the breadth of the practical implications lies within the interpretation of the data. Interpreting brain data in the described way bears its very own questions and responsibilities if we wish to translate them into appropriate policies. Obviously, a probabilistic model of human misbehavior is at odds with the public's desire for 'finger pointing' at their scapegoat of choice. As Nikolas Rose correctly observes, "while predictions are always probabilistic, decisions and actions are determinate, and tend to assume the worst outcome and act to mitigate or prevent it – this is the obligation of risk management" (4).

Thus, this discussion has tried to illuminate the connection between neuro-scientific data interpretation and its implications on the neuro-law debate. A conceptual understanding of what it actually is that neuroscience tells us about our brains, and in turn, about our behavior, was shown to directly map onto the practical application of judicial systems. Decisions about the criminal nature of people's deeds are, in essence, ethical decisions. More and more, neuro-scientific data is used as a means to evaluate offender's nature, and its conceptual framework therefore deserves diligent scrutiny.

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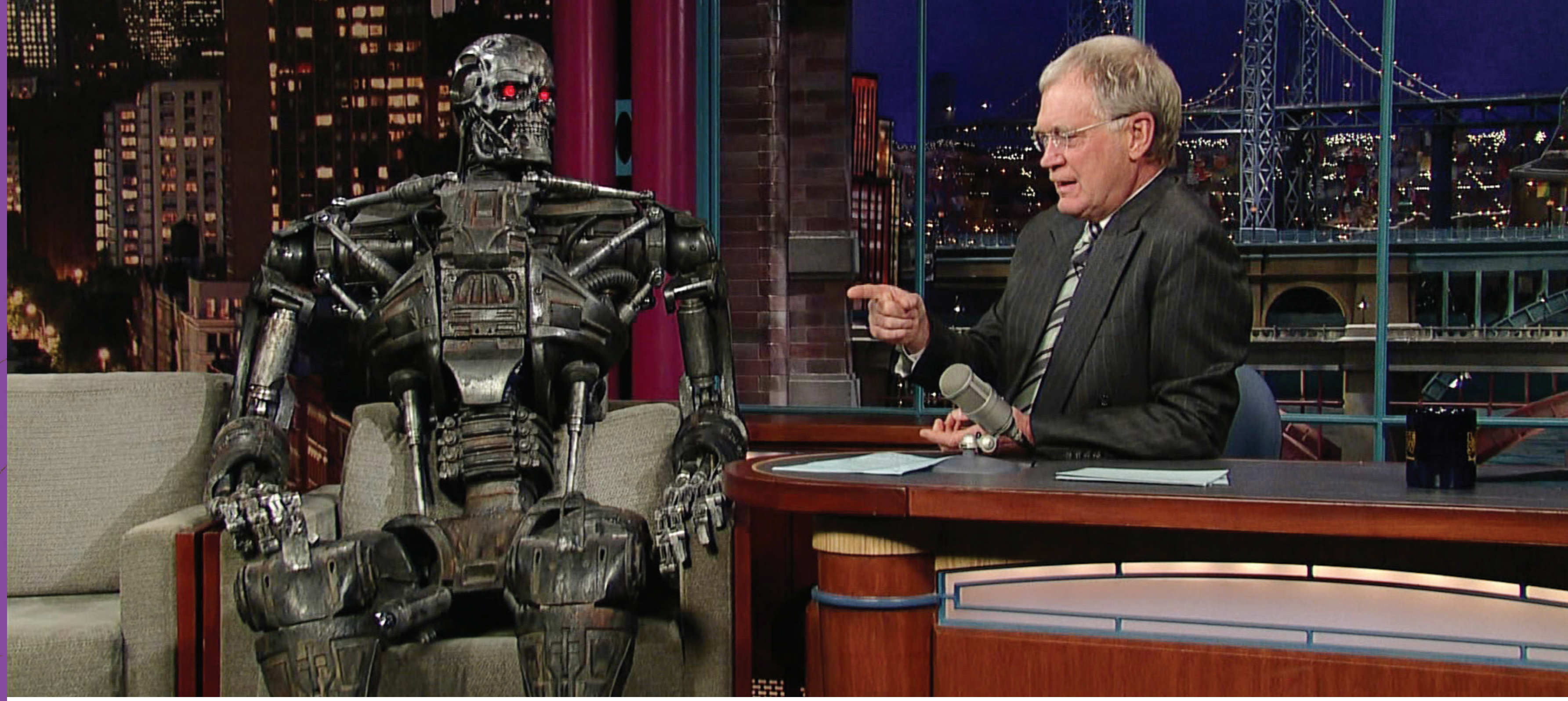
Welcome to the New World

Tobias Meierdierks

The madman jumped into their midst and pierced them with his eyes. 'Where is God?' he cried; 'I'll tell you! We have killed him - you and I! We are all his murderers. But how did we do this? How were we able to drink up the sea? Who gave us the sponge to wipe away the entire horizon? What were we doing when we unchained this earth from its sun? Where is it moving to now? Where are we moving to? Away from all suns? Are we not continually falling? And backwards, sidewards, forwards, in all directions? Is there still an up and a down? Aren't we straying as though through an infinite nothing? Isn't empty space breathing at us? Hasn't it got colder? Isn't night and more night coming again and again? Don't lanterns have to be lit in the morning? Do we still hear nothing of the noise of the grave-diggers who are burying God? Do we still smell nothing of the divine decomposition? - Gods, too, decompose! God is dead! God remains dead! And we have killed him!"

- F. Nietzsche, 'The Gay Science', 1882 -

Philosophy | Neurochips | Ethics



>>> It is a wondrous world we are living in and this thought, or maybe feeling, has stayed with mankind since the very first painting on a wall, the first tale of natural beauty, the first human who paused and simply gazed at the world around him. People wonder. And we discover. The feeling of admiration for the perfection we are surrounded by might be one of the greatest drives in the evolution of mankind, because it is this admiration that makes us wonder how nature can be so profound, so elegant and efficient, so... godlike. Hence we went on trying to discover god's secrets and tools. And with every discovery of the mechanisms that underlie natural phenomena, mankind's perception of the world was altered and people of any time anticipated this change with a mixture of fear and wonder, a feeling of strangeness caused by the diversion of knowledge from believe. We explored every corner of the world, relocated our position in the universe from its center to the less prestigious outskirts and finally started to dissect ourselves to the very core. Bit by bit we made the historical concept of

We teach ourselves to perform the miracles that past generations believed to be reserved for god and god alone.

god the creator obsolete and 140 years ago Friedrich Nietzsche exclaimed that we had finally done it: We killed god for good! Whether or not you believe in a higher existence, truth is with every year passing by; we teach ourselves to perform the miracles that past generations believed to be reserved for god and god alone. With the higher authority gone, it is now for us to carry the huge responsibility that comes with our knowledge. And as we keep on conquering we have to ask ourselves: Where do we WANT to go from here?

This question is particularly pressing with regard to a new advancement of human ingenuity: Neurochips - a technology that virtually crosses the line between human and machine and thereby becomes a primary stakeholder in the future course of human evolution. In order to deal with the topic appropriately, it is essential to become aware of the often underestimated state of current research on this remarkable technology.

A New Technology

In the year of 1998, S. Vassanelli and P. Fromherz (1) reported successful transmission of charge between silicon chips and neurons of a rat's brain. The researchers achieved this masterpiece of human inventive power through the utilization of a special cell adhesion protein, which allows the formation of a synapse-like cleft between the silicon and neuron. Due to this stable cleft, transduction of charge between organic cell and chip membranes was made possible or in more general terms: Neurons successfully communicated with electrical units – a way was found to connect brains and computers. In 2005 V. Kiessling and S. Vassanelli (2), who were part of the European "NACHIP" project, were able to create an interface between mammalian neurons and silicon chips, which allowed the researchers to record electrical activity of a single neuron through the chip's transistors. Furthermore, and probably even more important, the capacitors of these (often called) neurochips were also able to stimulate the neurons. The communication is therefore bidirectional, although many technical difficulties, such as unerring allocation of the chips and efficient calibration of chip-networks, have to be overcome before it becomes a reliable technology.

The possible applications of neurochips are endless. Enhanced technological devices are only one of several prospects: It was suggested that gene-coding could be utilized in order to create incredibly advanced memory-storing. Only recently, Church, Gao and Kosuri (3) succeeded in coding a complete book into DNA storage, which may last for millennia even in non-ideal conditions and is multiple times more efficient with regard to coding density. Also the control of electric devices could be directly linked to neurological brain functions, as for example in neural prostheses or thought-controlled aircraft. However, the main application of neurochips is currently found in brain-research, specifically in high resolution monitoring. It is without doubt that they will be a key-technology for brain-mapping, testing of drugs and research on neurological dysfunctions involved in psychological disorders. Due to their extreme accuracy in influencing and monitoring single brain-cells at ion-channel level, neurochips are currently developed into neuron-specific brain implants (4). These brain implants may well be used to artificially activate brain areas in a supportive fashion, but also in order to alter brain functions all together.

As futuristic as it may sound, this technology is not a subject of science fiction anymore. In 2006 Dr. Fetz (5) for example implanted neurochips into separated areas of a primate's brain in order to transmit activity from one to the other. Thereby he created an artificial bridge that might be the key to restoring connections lost due to brain damage. A prominent example of restoration was performed by researchers of the Dobelle Institute, Saint Louis (6), who used an implant to transmit visual input from a camera directly into the visual cortex of a non-congenitally blind man in order to partially restore his sight.

Another area of application is the treatment of neurological disorders. It was hypothesized that neurochips could be used to locate the roots of dysfunction in the brain that are associated with a certain disorder and then to promote a normalization process of the responsible brain functions (7). This can be achieved via inhibition of malfunctioning processes and activation of preferable processes. This way neurological functioning can be altered and adjusted.

A New Challenge

As tempting as the possibilities are - or maybe because the temptation is so great - we need to proceed with care and tact in developing the new technology of neurochips. It goes without question that restoration of lost abilities and adjustment of neurological dysfunctions is a highly desirable goal and this is probably the reason why arguments about negative consequences of neurochips are still very rare. It is clear by now that they are the future of technological devices and neurological treatment; however, it is very important that our society does not forget certain downsides of this advancement.

We are steadily eradicating the diversity that is the very foundation of the evolutionary success of the human race.

Alteration of brain functions is not something to be taken lightly. In our constant strive to normalize all that does not exactly fit our standards, we are steadily eradicating the diversity that is the very foundation of the evolutionary success of the human race. By judging and eradicating deviations in behavior and thought on the basis of standards that we set up ourselves, we are running the risk of simultaneously exterminating hidden qualities. Take sickle-cell anemia for example, a genetic blood disorder that causes the sufferer many troubles and would be eradicated immediately in the western world if we would know a cure for it. Amazingly it is also the only known natural protection against malaria and for a long time it actually offered an evolutionary advantage to people from tropic climate zones. It should not be forgotten that neurochips only pose a solution to a problem, not necessarily a statement about the cause of this problem.

Next to treating negative aberrations the problem of enhancement arises. It would obviously not be a problem if we were able to enhance our brain functions with the help of machines. The human race has done this for thousands of years, in fact, the human utilization behavior is said to have offered one of the most influential evolutionary advantages in the course of our race. What has changed is the social environment in which we use these tools.

The demand for self-enhancement that is rooted in social obligations is higher than ever before in these times of social networking and worldwide media coverage, and it would be naïve to believe that all suppliers of neurotechnology would only act with best intentions in mind. Holding the key to influence human brains directly and with extremely high precision provides us with a power to manipulate on a scale beyond our estimation. Companies like "Neurowear" (8) which produce gadgets that respond to brain activity and the heavy usage of pharmacological enhancers in the broad society, display the great commercial benefits that are contained in the technology of neurochips. However, giving someone the permission to influence how our brain functions is an act that should preferably not be guided by desires that arise from social pressure. Which brings us back to the question posed at the very beginning of this article: Where do we WANT to go from here?

A New Era

The development of neurochips is not a crossroad at which we decide where to head; it is a one-way street and it heads very straight towards a future in which the border between brain and machine becomes very blurry. As this border blurs, we learn to externally control something that has been out of reach so far: Ourselves. Toying with our own brains means playing with what we are. This contains opportunities and dangers likewise, and both are equally present. Our generation needs to become more aware of what it does. We need to stop and reflect on what we are doing BEFORE we are doing it. We must become aware of the fact that what we demand is what we will be provided with; hence it is highly important to reflect on our wishes.

Toying with our own brains means playing with what we are.

From a commercial point of view, neurochips will be just the same as all other commercial trend-industries that were booming in recent years. No one forces the individual to subscribe to "Google" or "Facebook", to buy "Apple" products or to adhere to cheap and often unnecessary self-medicalization with the help of our local drug store. All these trends have strong and also very dangerous aspects with regard to privacy and dependence, but in essence they are not a problem that needs to be solved by supervisory instances. They are all products that are heavily demanded by the people. The same will be true for neurochips, because just like "Ritalin" among students, antidepressants and anxiolytics in the workplace and alcohol in social situations, neurochipping offers satisfaction for the constant human craving for simple adjustment of bodily functions to standards that are dictated by social convention. They will work very conveniently and anyone not making use of them will essentially miss out on the improvements they offer. People will fear, but also love them. And just as it was with all inventions that promised great potential to benefit and to harm (just think of metalworking, gun powder and nuclear energy), people will embrace this opportunity in the most optimistic way.

Keeping in mind that this process is very human in its core, we are called upon, not to simply demonize the trend, but instead to handle it in a responsible manner. Each individual for him- or herself is called upon to reflect on the positive and negative aspects of implanting chips into one's brain, to reflect upon what he or she wants to happen to her brain, and to reflect upon whether it is really to his or her benefit to solve her problems the easy and uninformative way. This requires great educational efforts on the benefits of feigned 'weaknesses' that goes hand in hand with a general appreciation of oneself – surely not an easy task and probably just as naïve as the one imagining that mankind will able to use neurochips only for the best, but the options left to us are very sparse, as there is no authority anymore that is universally respected. There will not be a single person that simply places neurochips in our brains to take over control, and it also is not our government that will simply prevent a maladaptive societal trend. There is in fact no one to tell us what we should do. Only we are left to decide, every single individual, because god is dead. We killed him a long time ago and now we have to face our challenges alone. This is the new world we created with our own hands. Welcome.

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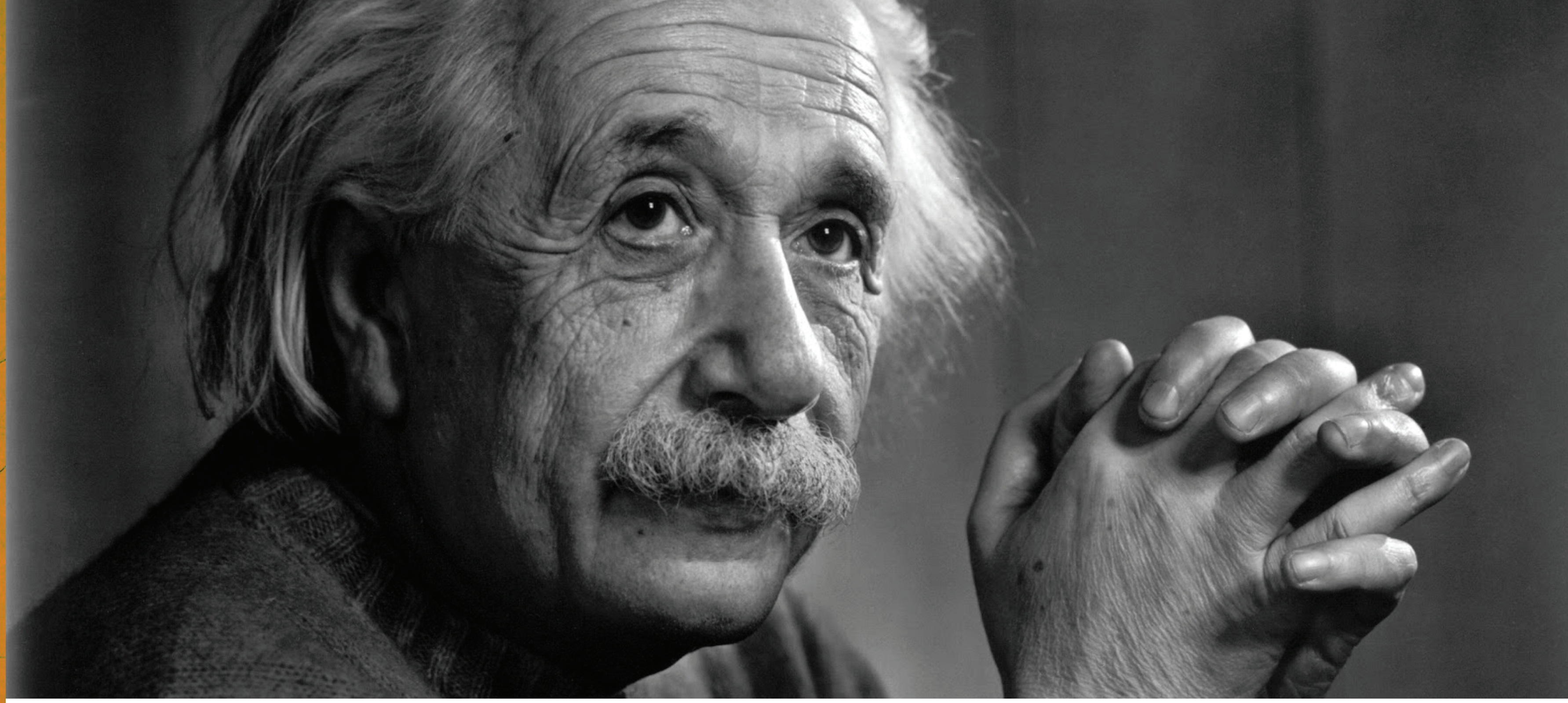
Einstein's Philosophers

How two philosophers shaped Albert Einstein's attitude to science

Hylke Jellema

Albert Einstein is possibly the most famous scientist of all time. Our image of a genius was largely shaped by that fuzzy-haired, smiling, sockless German eccentric who revolutionized our understanding of the world. However, while his status as a genius is undisputed, just a few people fully understand why it is that this man so thoroughly changed science and how he did it. To understand how Einstein's success came to be, and why he later resisted the similar success of quantum mechanics, knowledge of Einstein's philosophical background is essential. This paper paints a picture of how two philosophers influenced Einstein in his attitude towards physics and the world. Thus, it provides a case study of how philosophical convictions can drive or impede great scientific work.

Philosophy | Einstein | Paradigm



>>>In 1905 Einstein had a puzzle before him. Without getting too much into the technical details, the puzzle was as follows: experiments had proven that no matter how fast we are moving and no matter in which direction we move relative to the source of light, light always seems to be approaching us with the same speed. Newtonian assumptions of the time claimed that light was a kind of wave which travelled through the undetectable medium of ether. This ether was assumed to be a kind of substance present all throughout the universe, that allows light waves to travel in much the same way as air allows sound waves to travel. Light was then supposed to move relative to this ether. So it had to have a constant speed only towards the ether, but not towards observers within the ether. However, the facts seemed to differ. A radically new approach was needed. Einstein developed this approach by criticising Newton's concept of time and space.

To understand how Einstein's success came to be, knowledge of Einstein's philosophical background is essential.

In his magnum opus Philosophae Naturalis Principia Mathematica Isaac Newton discussed his philosophy of time and space. In this he writes that time and space are real entities, and that time flows on eternally in the same pace, unlike material entities which are prone to acceleration and deceleration. He also writes that time is independent of any measurement of it (1). According to Newton, there is absolute time and absolute space in which everything happens. This philosophy of time was so accepted as dogma that Newton posited them as postulates. Few rose to challenge this dogma, until finally there came a young patent clerk named Albert Einstein.

Hume's Scepticism

It was the 18th century Scottish philosopher David Hume in which Einstein found his guiding inspiration for this radical attack on Newton (2). Einstein had read Hume's book An Enquiry Concerning Human Understanding, in which Hume attacks the concept of causation. Roughly, Hume claims that we often see two events that repeatedly go together, for example the contact of our toe with a table and the sensation of pain. From a repeated pairing of events, we infer that one causes the other. However, says Hume, this concept of causation is not needed to explain the events. All that is needed is the psychological mechanism of pairing two events as cause and effect. Causation has no existence of its own; it is simply in our heads (3). So, Hume took one of the most basic concepts we have and declared it unnecessary. We cannot observe whether causation truly exists, or whether there is simply the repeated conjunction of two events. So we may, according to Hume, eliminate the entire concept on the basis that there is nothing in our experience to suggest it.

Hume's philosophy is grounded in the idea that all knowledge comes from experience and that our beliefs are merely habits. Einstein was heavily influenced by this view. He too believed that we should discard any mysterious, unobservable concept which we do not need to explain a given phenomenon. Likewise, his method of eliminating unnecessary concepts was similar to Hume's, but instead of on causation, he focused on time and ether.

Two New Postulates

Einstein radically rejected those unseen, unnecessary, common-sense concepts which he saw as being the root of the problem. In his famous paper 'On the Electrodynamics of Moving Bodies' (4) Einstein first dismissed the concept of ether, the absolute space against which everything moves, which scientists had been unable to detect for decades. Rather, he postulated two concepts on which his approach rested. First, if two observers move at a constant speed to each other, they will experience the laws of nature as if at rest. This is the principle of relativity. Suppose I am in a rocket, moving away from earth, and you are in a similar rocket, next to me moving at a speed equivalent to mine. If I shoot a bullet at you, the bullet will act as if we are at rest and it will move in a straight line from my gun to your rocket (assuming we ignore the miniscule effects of friction and gravity). Obviously, for an observer on earth, the bullet's trajectory will seem curved because for that observer we have moved to a different location from the moment I shot until the moment it hit. But this is simply because we are moving relative to that observer.

Causation has no existence of its own; it is simply in our heads.

Einstein added a second postulate, namely that light travels at the same speed, regardless of the speed of the observer, as had been proven by experiments. Einstein's great insight was that this leads to a problem when we combine the two. In order to see this, think about the bullet again. From the perspective of the rockets the bullet travels in a straight path. But as viewed from the earth its path is curved. And if we shoot a beam of light between the rockets, it too would follow a curved path, just as the bullet would. However, both observers would have to observe the same speed of light, after all the speed of light is constant, irrespective of the observer. At the same time, we know from Euclid that a straight line is the shortest route between two paths. So how can something travel along a longer path in the same time with the same speed, as something which travels along a shorter path? This is seemingly impossible.

Relative Time

Einstein rightfully noted that the answer to this problem would have to lie with the concept of time. It meant that we needed to get rid of the common-sense notion of absolute time. Rather, the observer on earth would observe that time on board the rockets moved slower than time on earth. According to the observer on earth, everything on board the rocket would move slower. And if we accept this radical notion there is no longer absolute time. Time is not an entity. And the reason we do not need this notion of absolute time is that, as Einstein pointed out, we can only define time by referring to simultaneous events. We say, for example, that a train arrived at 7:00 pm because the arrival was simultaneous with the small hand on a watch pointing to the number seven. It is this way that we do things such as synchronize two clocks.

Einstein's willingness to part with cherished dogma had its limits.

But if the time seemingly moves at different paces for different observers then there is no simultaneity. A clock on earth would seemingly move slower for the observers on the rocket. So the events which seemed simultaneous when in relative rest would no longer seem simultaneous when in relative movement. And if we define time this way, rather than in the absolute way Newton did, then there is no absolute distance either. After all we may define distance as a function of the speed of an object, multiplied by the time it travelled, and if time is not constant, than neither is distance. So, in Einstein's theory, we no longer need absolute space and absolute time, as long as we let go of all our common-sense notions of absolute space and absolute time. Einstein's predictions have since been proven experimentally. The reason Einstein could bring this revolution was because of his philosophical commitment. In a letter to his friend Maurice Solovine, Einstein claimed that we must discard concepts "which have no link with actual experience" such as "absolute speed" and "absolute simultaneity" (5). He saw that the reason we think of absolute space or absolute time is that we hardly encounter the circumstances in which the problematic nature of these concepts is noticeable, because this happens only at very high speeds. So, much in the same way as Hume discarded causation as a force of habit, Einstein could discard the notions of absolute space and time. While others, such as Henri Poincaré were close to making the same links as Einstein, they were attached too strongly to the postulates of Newtonian physics (2). This was Einstein's strength which made him prevail over the dogmatism inherent in physics. But as we shall see, Einstein's willingness to part with cherished dogma had its limits. For this we have to skip ahead twenty years.

The Copenhagen Challenge

In the 1920's, revolutionary new discoveries were being made in the field of quantum mechanics; the physics of very small particles. Einstein himself had helped to find this field by discovering that light can be viewed as consisting of small packets of energy, so called quanta. People such as Bohr, Born and Heisenberg were upturning the world with their new theories based on these findings.

The way in which these scientists understood quantum mechanics was later named the Copenhagen Interpretation, after the city in which much of the important work was done. It is difficult to pinpoint exactly what the Copenhagen Interpretation is, because the scientists didn't think of themselves as a unified school. However, it can roughly be described as a philosophical attitude towards scientific theory. Since its very beginnings, science has essentially been understood to provide a description of objective reality. It was assumed that our theories describe the way in which the world actually is. Within early quantum mechanics this idea was dropped. Rather, the idea was that we can only make statements about things such as predictions, probabilities or measurements, but not about objective reality. Within this interpretation, particles are understood as having a certain probability of being at a certain location until we measure where the particle actually is. However, until we measure it, we cannot say that a particle is at a particular place at all (6).

So, there is no single underlying reality, independent from our measurements. As Niels Bohr put it: "It is wrong to think that the task of physics is to find out how nature is. Physics concerns what we can say about nature" (7). This interpretation of course uproots the very idea central to Newtonian physics; that there is a deterministic order in the universe. The classic image from Newtonian physics is that of the billiards table, with the behaviour of the billiard balls being explained by strictly deterministic natural laws. Quantum mechanics replaces this with a world that is strictly governed by probability.

The quantum scientists referred only to the data, rather than to concepts such as natural laws in order to explain everything, and they discarded the very idea of an objective reality as unnecessary for the scientific pursuit, as merely a thing we conveniently attach to scientific theories. This echoes the way in which Einstein treated the concepts of absolute time and space. But while the Copenhagen interpretation shows many philosophical similarities to Einstein's convictions, Einstein became one of its biggest opponents. On physics-conferences he would continuously think up increasingly complex thought experiments, which he hoped would prove quantum mechanics wrong. And despite the success of quantum mechanics, he rejected it until the very end of his life. (2). Why was it that someone who had championed Hume's philosophy of discarding unneeded ideas not founded in experience would reject a philosophy which had this very idea at its core?

Spinoza's God

A true follower of Hume would have no trouble with accepting the concepts of quantum mechanics. But while Einstein had rejected certain concepts of classical Newtonian physics, he always had a firm commitment to the idea that the goal of science was to provide a picture of the way the world truly is. His guiding quest was to discover the true order of the world (2). Because of this he was attached to the idea of a strictly deterministic universe. This had everything to do with his philosophy.

In Spinoza's God, Einstein saw something beautiful; a universe governed by a set of simple laws, which he very much wanted to understand.

While Einstein was a fan of Hume's philosophy, there was a philosopher he possibly admired even more. This was the Dutch philosopher Baruch Spinoza. Spinoza was a religious philosopher, whose notion of God was very different from the traditional vision. In Spinoza's philosophy God is not a personal, person-like entity, distinct from the universe. Rather, God is identical with the universe and everything in the universe is merely an aspect of God. According to Spinoza this also means that the universe is governed by perfectly deterministic laws because everything follows from the necessary essence of God. (8) Einstein thoroughly believed in this vision and he could not accept that laws would explain most of what happens in the universe, except for a few details. On several occasions he expressed his commitment to Spinoza's philosophy and to the idea of determinism in general. As Einstein famously wrote to Bohr: "(...) an inner voice tells me that this is not yet the real thing. The theory says a lot, but it does not really bring us any closer to the secrets of the Old One. I, at any rate, am convinced that He does not play dice" (9).

In Spinoza's God, Einstein saw something beautiful; a universe governed by a set of simple laws, which he very much wanted to understand. When asked whether he was religious, Einstein replied: "Try and penetrate with our limited means the secrets of nature and you will find that, behind all the discernible laws and connections, there remains something subtle, intangible and inexplicable. Veneration for this force beyond anything that we can comprehend is my religion." (10) Even though Einstein later admitted that the quantum theory had a strong empirical case, his dedication to the beauty of Spinoza's philosophy over the hard-nosed empiricism of David Hume led him to reject the philosophical implications of a world without a deterministic order. So, Hume's methodology of rejecting any concept which is not grounded in direct experience was tossed away by Einstein in favour of his ontological conviction that the world was made up of simple, deterministic laws.

Conclusion

We have seen how the philosophy of Hume gave Einstein the key to his most important findings. At the same time we have also seen how his commitment to the philosophy of Spinoza kept him from fully accepting new theories. Through understanding this we can now appreciate how Einstein's philosophical attitude was crucial to his scientific discoveries, while at the same time limiting his willingness to go with the change in attitude was needed to accept the findings of quantum mechanics. Einstein's philosophical limitations were very similar to that of his predecessors who were attached to the Newtonian world view and its underlying philosophy of time and space. Einstein cut through these philosophical prejudices of his predecessors. However, his own philosophical convictions made him into a scientific dogmatist himself when the notions he took as most fundamental were challenged. Thus, the case of Einstein helps us understand how individual philosophical attitudes may shape or defeat our understanding of the world.

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