**[New Target in Brain for Treating Depression — The BMP Pathway](http://brainblogger.com/2016/10/08/new-target-in-brain-for-treating-depression-the-bmp-pathway/)**

neurology

In a new study on mice, scientists at Northwestern Medicine have discovered a pathway in the brain that may be a promising new drug target for people with non-responsive depression.

Sarah Brooker, the first author and an M.D./Ph.D student at Northwestern University Feinberg School of Medicine explains:

Identifying new pathways that can be targeted for drug design is an important step forward in improving the treatment of depressive disorders

Brooker conducted the study in the lab of senior study author Dr. Jack Kessler, a professor of neurology at Feinberg and a Northwestern Medicine neurologist.

The aim of their research is to gain a better understanding of how current antidepressants work in the brain, with the ultimate goal of finding new drug targets that are more effective for people who do not respond to current medications.

During the study, scientists discovered for the first time that antidepressant drugs such as Prozac and tricyclics target a pathway in the hippocampus called the BMP signaling pathway. A signaling pathway is a group of molecules in a cell that work together to control one or more cell functions.

Like a cascade, after the first molecule in a pathway receives a signal, it activates another molecule and so forth until the cell function is carried out.

The researchers found that Prozac and tricyclics inhibit this pathway and, thereby, trigger stem cells in the brain to produce more neurons responsible for mood and memory formation. However, the researchers didn’t know if blocking the pathway contributed to the drugs’ antidepressant effect because Prozac acts on multiple mechanisms in the brain.

After confirming the importance of the BMP pathway in depression, the scientists investigated a brain protein, called Noggin, on depressed mice. Noggin is known to block the BMP pathway and stimulate new neurons, a process known as neurogenesis.

They discovered Noggin blocks the pathway more precisely and effectively than Prozac or tricyclics, as the mice soon experienced a strong antidepressant effect.

A sign of depression in mice is a tendency to hang lifelessly when held by the tail, rather than struggle to get themselves upright. After receiving Noggin, mice energetically tried to lift themselves up, whereas control mice were more likely to give up and just hang there.

The mice were then placed in a maze with secluded (safe) and open (less safe) spaces. The Noggin mice were less anxious and explored more mazes than the control mice.

As put by Kessler, also the Ken and Ruth Davee Professor of Stem Cell Biology:

The biochemical changes in the brain that lead to depression are not well understood, and many patients fail to respond to currently available drugs. Our findings may not only help to understand the causes of depression, but also may provide a new biochemical target for developing more effective therapies.

This guest article originally appeared on PsychCentral.com: Scientists Target New Pathway in Brain to Alleviate Depression by Traci Pedersen.

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Brooker, S. M., Gobeske, K. T., Chen, J., Peng, C.-Y., & Kessler, J. A. (2016). Molecular psychiatry – abstract of article: Hippocampal bone morphogenetic protein signaling mediates behavioral effects of antidepressant treatment. Molecular Psychiatry. doi:10.1038/mp.2016.160

2.

# Humans Are Genetically Predisposed to Kill Each Other

psychology

A new study of 1,024 mammal species has determined which animals are the most vicious killers of their own kind. Killer whales perhaps? Pit bulls maybe? For the answer, just look in the mirror.

“Step back and view our species objectively from the outside, the way a zoologist would carefully observe any other animal, or see us the way every other creature perceives human beings. The brutal reality could not be more evident or more horrifying. We are the most relentless yet oblivious killers on Earth.

This week Maria Gomez and colleagues, Zoologists working in Spain, published the results of their in-depth research in a report in the journal [Nature](http://www.nature.com/nature/journal/vaop/ncurrent/full/nature19758.html)on the evolutionary roots of the human propensity to kill their own kind. The researchers compiled data on lethal violence within 1,024 species of mammals, and the results verify my description of us. The analysis shows that deaths caused by other members of the same species is responsible for 0.3% of all deaths on average for all mammals, but the rate of lethal violence among Homo sapiens is 7 times higher. Together with our primate ancestors we stand out as aberrations in our penchant to kill our own kind.

All behavior is the product of the brain, and the brain is a product of genetics and the environment. To read the full article see:  [Psychology Today](https://www.psychologytoday.com/blog/the-new-brain/201610/humans-are-genetically-predisposed-kill-each-other)  https://www.psychologytoday.com/blog/the-new-brain/201610/humans-are-genetically-predisposed-kill-each-other

3.

# The Three Causes of Fainting

Health and care

Hillary Clinton fainting at the 9/11 memorial this weekend has raised concern and speculation over possible causes.  There are three causes of fainting.

           Fainting is the sudden and temporary loss of consciousness, and consciousness arises from neural activity in the cerebral cortex.  Anything that disrupts neural activity in the cerebral cortex can cause loss of consciousness.

The most common cause of fainting is insufficient blood flow to the brain.  Although the human brain comprises only 5% of the body’s weight, it consumes 20% of the body’s energy.  Vigorous and precisely regulated flow of oxygen-rich blood to the brain is essential to fuel the metabolism of neurons that is required to generate electrical activity.  Anything that disrupts cardiac function can cause fainting, notably a sudden drop in blood pressure.  Since blood pressure must be regulated precisely for the complex demands that are placed on the body, many different things can cause a sudden drop in blood pressure.  These include physiological factors, blood loss from trauma, and emotional state.

Physiological shock causes a severe drop in blood pressure and rapid shallow heartbeat.  Shock is the body’s first response to traumatic injury and the response is triggered by the autonomic nervous system.  People often lose consciousness from traumatic injuries, and this physiological shock response is believed to be a mechanism to reduce blood loss.  It would not take long to pump the body dry of blood through a serious wound if the heart was pounding wildly.  It takes even less time for this to happen in a woman’s body, because she has 5-8 pints of blood compared to 8-10 pints of blood in a man’s body.  No wonder females can be more prone to fainting.

Fainting from an emotional shock is iconic, especially for females.  Fear and other stressful emotional states that provoke a similar shock response in the cardiovascular system that occurs after traumatic injury will cause fainting.  Some people faint at the sight of blood, for example.  This is believed to be in part a genetically predisposed mechanism that may have had survival value for our ancestors.  Those people who had a hair-trigger response to activating this last-ditch safety mechanism to limit blood loss from trauma survived in prehistoric times long before medical first responders existed.  Even seeing blood loss or seeing a hypodermic needle causing penetrating “injury” to another person can trigger fainting in these people.

If there is not sufficient oxygen in the blood, a person can faint even if blood flow to the brain is adequate.  Free divers who compete in breath-holding contests skirt the deadly threshold of losing consciousness and drowning.  This happened recently to competitive free diver [Natalia Molchanova.](https://www.theguardian.com/sport/2015/aug/04/free-diver-natalia-molchanova-feared-dead)  Impaired lung function or insufficient oxygen in the atmosphere will cause a loss of consciousness.  High altitude pilots and mountaineers, for example, are at risk of hypoxia-induced fainting.   However, anything that impairs the delivery of oxygen to red blood cells can result in fainting.  Inhaling carbon monoxide, which impairs the ability of hemoglobin to bind oxygen, will induce fainting very quickly

The third cause of fainting is disruption of neuronal function in the cerebral cortex.  Toxins, such as alcohol, or anesthetics, which suppress normal electrical activity in the cerebral cortex, can induce a sudden loss of consciousness.  Likewise, inadequate supply of glucose to fuel the energy demands of neurons will do it.  Epilepsy and seizure are caused by wildly uncontrolled firing of neurons in the cerebral cortex.  In this abnormal state, consciousness can be lost, just as we lose consciousness when our cortical activity becomes suppressed in sleep.

Fainting can be a sign of many different medical issues in the brain and body, but it also can and does happen in perfectly normal or even especially fit individuals.  For example, very fit athletes who have low resting heartrates can be prone to fainting upon suddenly rising from a seated position (called orthostatic hypotension).  While such an athlete sits peacefully resting in a chair, his or her resting heartrate and blood pressure drop even further and blood pools in their legs.  No problem so long as the athlete remains seated and resting quietly, but upon standing suddenly they can become light-headed because the body must suddenly pump blood several feet higher to the elevated head.  With all the blood pooled in the legs and the heart ticking along slowly at rest there is not enough blood flow to the brain upon standing.  The blood “drains” from their head as they jump up and they can faint.

I know this because it happened to me on an airplane.  After extensive neurological tests were negative, and cardiovascular tests (thankfully) showed my fitness was in the range of elite athletes, the doctor dismissed my fainting on an overnight transatlantic flight as the expected response of the body to being cramped in the middle seat at high altitude and at sleep, just before I was awakened and stood up quickly.  Dehydration, which is common in airline travel due to the dry air in the aircraft cabin and the difficulty of obtaining water, thickens the blood and this will increased the chances of fainting.  So when flying through the “friendly” skies in the coach cabin, be sure to hydrate, avoid alcohol, move your legs to keep the blood flowing, take short walking breaks, and wear compression socks to squeeze blood out of your lower limbs to prevent it from pooling down there where it is of no use to your brain.  Even jet fighter pilots rely on compression suits to help prevent fainting.

You don’t have to be on an airplane for this to happen; even soldiers, who are among the most fit of all, faint when forced to stand at attention in the hot sun too long and blood pools in their lower extremities leaving their brain gasping.  Fainting, if it is a graceful wilting to the ground rather than a collapse that may cause injury, puts the body in a horizontal position and instantly cures the problem.  Fainting hits the “reset button.”  At the same time, any injury to blood flow inside the brain as a result of trauma or malformation of blood vessels or damage to neurons from disease or injury can cause loss of consciousness.

4.

# Building Ultron: The Rise of Rogue AI

News

Ultron walks into a bar, and orders a drink. Bartender says, “We don’t serve robots!”. Ultron replies, “You will.”

[Spoiler alert: This post contains plot details about the movie Avengers: Age of Ultron.]

Malevolent artificial intelligence (AI) is a reliable theme in science fiction. In the *Avengers: Age of Ultron*, the AI arises from one of several alien [“Infinity Stones”](http://en.wikipedia.org/wiki/Infinity_Gems), with a bit of dabbling by Tony Stark (Robert Downey, Jr.) and Bruce Banner (Mark Ruffalo), who are trying to protect the planet from potential [alien invaders](http://www.newyorker.com/culture/richard-brody/the-new-avengers-is-really-about-the-n-s-a?intcid=mod-yml). The evil AI, named Ultron, seizes on a directive to protect the planet as a green light to justify human extinction.

In the comics, Ultron’s [origin](http://en.wikipedia.org/wiki/Ultron) is very different than in the movie. It’s both more prescient and more frightening, starting as an experiment in artificial intelligence that, through rapid self-improvement, quickly escapes human control. Ultron is portrayed with a rather human-like ego imbued with outlandish motivations – not surprising for a comic book villain designed to appeal to a mass audience.

Neither the movie nor comics incarnations of Ultron get the threat quite right.

Artificial intelligence is generally classified as “general” or “super” intelligent (another class, artificial narrow intelligence – or weak AI – acts in a limited knowledge domain, like pattern classification). While an AI of general intelligence would be somewhat like us, an artificial super intelligence can be expected to possess some useful, but troubling characteristics. It will operate on the basis of mathematics and probability, without necessarily possessing the biases that cloud our own actions.  And unlike Ultron, its actions will not be transparent, and may in fact be impenetrable to human logic and motivations.

The Maria robot from Lang’s Metropolis (1927).

An AI that means us harm may even leverage time itself to its advantage, making use of the enhanced processing speed and distributed nature of electronic systems to out think us, and like Ultron, to improve itself. To a sufficiently advanced and empowered AI, a day might be as a human lifetime. Conversely, it might also lay out extended plans that take many human lifetimes to come to fruition – after all, you have all the time in the world when you are immortal and without a biological imperative for reproduction. Human beings are good at detecting rapid changes, but we are abysmal at reacting to longer-term extinction threats (think global warming). With unlimited time, subtle watching and waiting and gentle nudges could be an effective strategy for a rogue AI to exploit our blind spots – no dramatic boss fights needed.

Artificial intelligence is often portrayed as a mimicry of biologically-based intelligence, and in our hubris we imagine the crowning achievement of AI to be recognizably human (such as James Spader’s Ultron trading quips with Robert Downey, Jr.).  The truth is that AI could operate very differently than our imagination allows.

How close are we to a dangerous super intelligence? It’s hard to say for sure. But several pieces are coming together.

The [Human Brain Project](https://www.humanbrainproject.eu/), to name just one example, has as a stated goal the simulation of a human brain within its massive banks of [computers](http://www.artificialbrains.com/blue-brain-project). If the effort is successful and the simulation runs, humanity may have created an artificial consciousness. “May have”, because we might not know whether this AI is conscious or not, and it might take some effort to determine this (think of how hard it is to determine whether a[coma patient](http://www.scientificamerican.com/article/do-brain-scans-comatose-patients-reveal-conscious-state/) is conscious or not), or whether it possesses artificial general intelligence, or super intelligence. Alan Turing’s [Imitation Game](http://www.loebner.net/Prizef/TuringArticle.html) will not help us – the Turing test was an initial proposition made in a time of paper and mechanical computation, focused on similarities with human consciousness like ours. It wouldn’t work on an artificial super intelligence for one simple reason: it would be too smart to play.

As [Nick Bostrom](http://www.ted.com/talks/nick_bostrom_what_happens_when_our_computers_get_smarter_than_we_are#t-565241) puts it, “telescoping” super intelligence could quickly move past humanity, and would be to us as we are to monkeys (Or, as we are to insects – choose your scale). And one must ask, how would an AI develop an ethical system that would protect humanity from the sort of exploitation that we, in the darkest regions of the human soul, are capable of visiting on the less powerful? Would an AI be less apt to destroy an ecosystem, or an entire world, in service of a computational directive than its biological counterpart? We won’t know for sure until it arrives.

How do we protect ourselves? We could stop working on AI, but the potential benefits are[enormous](http://www.wired.com/2014/10/future-of-artificial-intelligence/), from self driving cars to medical diagnosis, and it would be impossible to achieve a moratorium. Isolated computing environments that are less connected to the physical world, careful restrictions of power, restricting connectivity, limiting access to manufacturing infrastructure, or limiting the clock speed of the architecture on which it depends may be partial solutions, but one must wonder whether we could devise a containment vessel that a super intelligence could not overwhelm.

Another AI presence in the movie, the Vision, may provide a clue that would point to another solution. The Vision was based on Tony Stark’s JARVIS AI, his constant companion throughout the series of movies. JARVIS’s ethics were learned over many years, more similar to the way a human brain learns. Maybe, part of the solution isn’t so much [Asimov’s 3 Laws of Robotics](http://en.wikipedia.org/wiki/Three_Laws_of_Robotics), or another failsafe algorithm, but something more mundane: raise your children well. Perhaps AIs “raised” by us would outgrow us and move on as in the movie [*Her*](https://www.youtube.com/watch?v=Px6kJYA5dBY), but would be less likely to hate us.

One thing is clear: solving the problem of rogue AI will be terribly difficult before it exists, but it may be impossible afterward. I’m hopeful that [expert dialog](http://www.newscientist.com/article/dn26716-fear-artificial-stupidity-not-artificial-intelligence.html?#.VUWfPhPF-iY) will deal with the [ethical](https://www.humanbrainproject.eu/discover/ethics) [implications](http://www.newyorker.com/news/news-desk/moral-machines) of our technological advances in a way that allows humanity to benefit from AI without being endangered by it.

Ultron should be remote and alien, but in the movie he’s either in a fancy body or his AI is distributed to many drones – once he placed himself in a bottle he could be defeated by the Avengers. Ultimately, Ultron’s brand of intelligence wasn’t enough to avoid head-to-head verbal and physical conflicts with his enemies and was only capable of devising a rather brute force extinction scheme that human (or at least superhero) intelligence could easily comprehend and defeat.

If rogue AI with discernable motivations is the stuff of our cinematic nightmares, we should be doubly wary of superintelligent AI that doesn’t play by our storytelling rules.

5.

# Can science explain consciousness?

Psychology

In a book published last fall[1](http://blog.brainfacts.org/2013/03/can-science-explain-consciousness/#Refs), Thomas Nagel defends the idea that science cannot explain consciousness – that the mind is a natural phenomenon which cannot be reduced to physical states of the brain. He also argues that evolutionary theory, or its current materialist version, is not sufficient to explain the appearance of the mind. My attention got drawn to the book by Kristina Musholt’s review in *Science*[2](http://blog.brainfacts.org/2013/03/can-science-explain-consciousness/#Refs).

**Illustration by René Descartes of what he considered to be the dualism between mind and**

[**http://levitrapharmacy-generic.com/**](http://levitrapharmacy-generic.com/)[**clomidgeneric-online**](http://clomidgeneric-online.com/)[**http://plavixgeneric-dosage.com/http://plavixgeneric-dosage.com/**](http://plavixgeneric-dosage.com/)

**body.**Photo from [Wikipedia](http://en.wikipedia.org/wiki/File:Descartes_mind_and_body.gif) released in the public domain.

Although worth reading to see the state of the reflection in that branch of philosophy of mind, the book turns out to provide a very poor argument for its two central claims. Nagel starts by opposing two ideological stances that he labels inappropriately, in my view. On the one hand, there are “materialists” or “reductionists” in which he seems to include anyone who thinks that the laws of physics and the facts of biology can explain behaviors and the mind. On the other hand, he refers to those who oppose that view as “antireductionists”. There is nothing particularly reductionist in thinking that consciousness could be explained by the networks of neurons in our brain. To the contrary, I find that acknowledging the incredible complexity of those networks and to think that they could underlie our feelings and states may be the most antireductionist claim in the philosophy of mind. What appears as reductionism to me is the trap in which Nagel falls by taking every elements of consciousness that we can’t explain yet (and I’ll address some of those later) and stating that they simply belong to a non-material mind that is not understandable using the tools of science. Reducing the spectacular aspects of the mind to another reality that is not understandable, not physical and not observable other than by our own introspection and intuition does not solve any of the issues, it makes them worse. It is, however, precisely that magic trick which has been used by dualists for years and which is performed here in a new form, perhaps more in line with monism, but still invoking the existence of something that is “more than physical”.

Nagel then asks for an evolutionary explanation of why we are conscious. He does seem to recognize that evolution could, in theory, lead to the appearance of consciousness. He writes:

*Selection for physical reproductive fitness may have resulted in the appearance of organisms that are in fact conscious, and that have the observable variety of different specific kinds of consciousness […]*

But then adds:

*[…] but there is no physical explanation of why this is so-nor any other kind of explanation that we know of.*

*[…] To make facts of this kind intelligible, a postmaterialist theory would have to offer a unified explanation of how the physical and the mental characteristics of organisms developed together, and it would have to do so not just by adding a clause to the effect that the mental comes along with the physical as a bonus. […] Explanation, unlike causation, is not just of an event, but of an event under a description. An explanation must show why it was likely that an event*of that type*occured.*

The problem is that evolutionary theory is not necessarily a complete and deterministic equation. Saying that some feature of an organism has appeared due to biological evolution is one thing, saying that it was certain or highly probable to appear is another thing. The [precise shape of our noses](http://freethoughtblogs.com/pharyngula/2012/12/10/ep-the-fundamental-failure-of-the-evolutionary-psychology-premise/), for illustration, is not due to an evolutionary advantage that these specific shapes procure. There is a part of noise in the evolutionary processes that leads to the creation of some features out of pure randomness, and if the organisms that have those features survive they will simply be passed on to the next generation. This does not mean that there is no evolutionary advantage to having a nose – obviously it does play a role in breathing. The same thing goes for the mind – there may not be a specific reason why the mind has the characteristics that it has, but it might just turn out that it appeared with those characteristics and got passed on to the next generations. Now I am making that point simply to highlight the idea that every feature of our biology does not need to be explained as an obligatory and deterministic consequence of *all possible* evolutionary histories but that some things can be the way they are just because of *our* evolutionary history. There is something impossible in the kind of predictive power that Nagel demands from evolutionary theory. He would want it to explain why the mind *had* to evolve. I like to transfer the question to physical features to illustrate its flaws. Think about the fact that a lot of animals on the planet have four legs. Do they have four legs? Yes. Is there an evolutionary advantage to having legs? Yes. Did it *have* to be *four* legs? Not necessarily. Yet no scientist, nor Nagel I suppose, would state that quadrupedy is a non-physical feature that evolutionary biology can’t explain. Nevertheless he seems to be making exactly that statement for the mind.

Beside that, the very characteristics of what we call consciousness do not seem completely independent from our biological needs – in fact they seem to be highly in tune with our survival. Ever noticed how pain hurts very badly and how positive feelings make you want to repeat the experience? It does seem that the mind has characteristics that make us better adapted and in that idea might lie the evolutionary explanation that Nagel is looking for. Nagel does recognize that some of those characteristics could have an evolutionary explanation, and I’ll cover that later.

For now, although I disagree that there *has* to be a reason for the appearance of consciousness, I do think we can play the game of hypotheses and I do think it is likely that there may be multiple reasons indeed. “Why [is] the appearance of conscious organisms, and not merely behaviorally complex organisms, […] likely?”, Nagel asks. Here are some possibilities.

First, to be efficient and act, our brain needs to represent the world and update its model of reality. It is this internal representation of the world that makes it such that we can close our eyes and still reach to objects. It is also due to this representation that when we hear the voice of someone behind us we can imagine a visual representation of his position, and even his identity if we know him. We have inside of our head a very detailed and complex model of the world and when we generate actions, we sometimes rely solely on that model rather than on inputs from the outside world (like the reaching in the dark example). It is not at all unlikely that part of our perceptual subjective experiences might simply be a good way that biology has found to make us negotiate our actions within that model of the world. By creating feelings of perception when we see things for real and when we imagine them, the brain might simply be using subjective experience as a good common language to link real world inputs and imagined perceptions. There is already a great deal of evidence that the parts of our brain activated when receiving inputs from the world are also activated during mental imagery, which makes this hypothesis at least plausible[3,4](http://blog.brainfacts.org/2013/03/can-science-explain-consciousness/#Refs). This is also the case for motor imagery and we know that brain damage impairs such skills, suggesting that they have a physical and neurobiological basis[5](http://blog.brainfacts.org/2013/03/can-science-explain-consciousness/#Refs).

There is, also, the possibility that subjective experiences could have evolved in response to social context. Perhaps someone really in pain, really happy or really annoyed is more convincing than someone who would simply generate behaviors without actually experiencing the feelings. Robert Trivers pointed out that self-deception might have been favored by evolution to better deceive others[6](http://blog.brainfacts.org/2013/03/can-science-explain-consciousness/#Refs). Can’t the same thing be said of feelings like pain? Is it really unlikely that we might have evolved a feeling of pain so we could send better “stop” signals to others? Is it really unlikely that the inner conviction that we are hungry might be a drive to gather more food or to incite more food sharing from our conspecifics and parents?

None of these possibilities are proven scientific facts but their simple plausibility renders the alternative view proposed by Nagel unnecessary until they get more scientific attention.

I have not yet mentioned, however, what constitutes the biggest problem with *Mind and Cosmos*. The problem is one that affects many other works on the philosophy of mind: the so-called unique properties of the mind that science is portrayed to have so much difficulty to explain are often poorly defined, and when trying to seek what they really mean, one realizes that they might very well have homologies with brain properties that have already been identified. After removing all those subjective experiences that may have evolutionary significance like pain and happiness which he recognizes might result from our evolutionary history, Nagel claims that other properties of the mind are problematic for materialism, including our ability for reasoning (mathematics for instance), logic and ethics.

Let’s consider abstract reasoning. Our ability to find truths, in short, would be unlikely to be explained by materialist evolutionary theory because the truths that have been identified in modern physics and mathematics are too complex to have been produced by a brain that evolved in prehistoric conditions.

*This story depends heavily on the supposition of a biological origin of the capacity for nonperceptual representation through language, resulting in the ability to grasp logically complex abstract structures. In view of the mathematical sophisticiation of modern physical theories, it seems highly unlikely; but perhaps the claim could be defended.*

There are many problems with this equation linking the sophistication of the great abstract human creations with an impossibility or unlikeliness that these creations could emerge from a biological brain. First, as argued previously, there doesn’t need to be an evolutionary explanation for everything that the brain does. The fact that it *can* do many different things might, however, reflect the dynamic environments in which we have evolved. In simple words, maybe evolution has programmed into the brain the ability to do *anything* or *many things*, not just hard-code specific behaviors in it. Secondly, the brain of any individual does not have any particular access to “truths”. For every mathematician who develops a single great mathematical equation, there is at least a thousand freaks who believe they made an extraterrestrial encounter or who think apocalypse is due next year. For every trained mathematician who ends up discovering something, there are hundreds of others who end up making errors and not discovering anything. It is through a social process, that of the scientific and academic system, that we identify those who produce the most useful equations and give them a job and the recognition they deserve. But looking back at it, it all seems like there is a part of random in that process and subsequent selection. The brain wasn’t programmed by evolution to seek abstract truths, it was programmed to be curious maybe, and to learn things, most likely. One does not need to invoke the existence of a non-physical aspect to the mind to explain how some people might end up being right and their theories might end up being selected as useful for mankind. For a more detailed view of how good ideas can spread through social networks, the reader might want to consult Daniel Dennett’s *Darwin’s Dangerous Idea: Evolution and the meanings of life*.

There are, on top of it, many reasons why the brain might have evolved some form of logical reasoning, even in prehistoric context. We know that even birds and monkeys are capable of some degree of numerical cognition[7,8](http://blog.brainfacts.org/2013/03/can-science-explain-consciousness/#Refs). We know that the social environment humans always lived in might favor skills such as knowledge attribution to specific individuals and reasoning on fictive scenarios to deal with others[9](http://blog.brainfacts.org/2013/03/can-science-explain-consciousness/#Refs). The dynamic evolution and learning of interacting individuals have been largely discussed and are a subject of current research[10](http://blog.brainfacts.org/2013/03/can-science-explain-consciousness/#Refs). There is in fact no reason to believe that our mental faculties cannot be explained by an evolutionary process – a biological and physical one.

There are other claims about value and intentions being other problematic characteristics, but again most of these questions are already being studied in current brain research. I might cover those claims in more details in a future post.

Finally, another argument that is brought by Nagel is the idea that rationality cannot be divided in small components like a computer separated in miniature transistors. This irreducibility of the mind and of rationality in particular, he argues, constitutes a big problem for the idea that it may be entirely explainable by neuronal networks. But there are other things that are not reducible in biology and that do not seem to require the kind of explanations that Nagel wants to develop for the mind. If you slice a heart in small dices, there is a point at which it is not a heart anymore, it’s just a bunch of cells that have no function because their normal biological structure has been destroyed. Yet I hear no one claiming that the heart is a non-physical entity that is not explainable by the materialistic version of evolutionary theory.

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