Fundación
Innovación
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21 ENGLISH VERSION

Scientific and technological advances which increase and improve our human capacities.

Information, anatomical and biological capabilities to reach to be superhuman.

Analyzing the impact on our humanity.

Superhumans

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Elliot S. Maggin – Foreword to Kingdom Come

"Today's human is yesterday's superhuman. Look at the way we live (...) If a person from only a hundred years or so in the past could look in on our lives, that person would suppose that we were not mortals, but gods. He would be bowled over by what the most ordinary among us could do."

"Gentlemen, we can rebuild him. We have the technology. We have the capability to make the world's first bionic man. Steve Austin will be that man. Better than he was before. Better… Stronger… Faster."

The Six Million Dollar Man

Barack Obama kidding. Or not.

"Basically I am here to announce that we are building Iron Man. I'm gonna blast off in a second. This has been a secret project we've been working on for a long time… Now, really… Maybe! It's classified"

Antonio Damasio

University Professor, David Dornsife Professor of Neuroscience, and Director, Brain and Creativity Institute at University of Southern California and Prince of Asturias Prize

Current developments in science and technology are beginning to make the designation "super humans" less far-fetched than it may seem at first glance. Extending the powers of humans is not new. To some extent, inventions like radio and telephone have extended human abilities for a long time, as have lenses and simple prostheses.

So have computers, of course, both in terms of direct manipulation of data and of storage capacity, modern computation being a powerful extension of human memory and of human calculation ability. The scale, which modern science and technology allow for is, however, remarkably larger. The examples abound, some of them already a reality, some about to become reality, and some clearly possible in a foreseeable future. Prostheses, biological enhancements and synthetic biology are good candidates, as is the broad field of robotics.

It is already possible for fine sensors to monitor the state of multiple aspects of our organisms and transmit the sensed data to healthcare professionals and to computer devices, thus opening the way for more prompt diagnoses and medical interventions. Telemedicine is a reality whose time has come. Still, within the broad field of medicine, it is apparent that hearing aids, cochlear implants, insulin pumps, and cardiac implants, to name but a few, will become ever more refined and physically subtle in the near future. There is also the development of exoskeletons that can provide victims of spinal cord injuries with major paralyses with a means to walk again.

Robotics, too, has all sorts of major applications. Robotic-operated limbs will become quite effective and fairly widely available, but for robotics the main area of importance is probably the development of life-like devices that can extend and substitute human action. It is easy to envision life-like robots that can become aids as well as companions to older individuals whose sensory and motor abilities have been diminished.

Last but not least, there are human extensions that pertain to the social world, Google Glass being a prime example. The powers of computerized face recognition, combined with rapid data retrieval will allow, less and less obtrusively, a quick delivery of information that users would otherwise have to search for in their memories.

These and other developments in the areas of super humanity are likely to be welcomed or accepted, to varying degrees, depending on the perceived usefulness and need. However, not all developments are likely to sail smoothly without resistance or objections from the very humans for whom the devices are being developed. Nor, for that matter, are these developments without risks for humanity. Already the increased facilitation of data searching, while largely advantageous, can be seen as coming at a cost because the users need to rely less and less on their own intellectual powers in order to achieve results. Why should one develop and maintain huge personal memory banks in one's brain if all of that memory is accessible at the touch of a computer key? Why should one bother to learn multiplication tables when any current cellular phone will provide you with a rapid means to calculate?

More problematic even are the invasions of privacy that rapid data retrieval allow for and the fact that they circumvent the process of gradual human discovery that is characteristic of sociality, in favor of access to a data file that someone else has impersonally prepared. None of this means that one would prefer to live in a world without super human technological capabilities and return to the Stone Age. But it is important to think about the developments that are worth investing in and promoting, because they can pay off in terms of health and well-being, versus the developments that are largely toys and entertainment.

Antonio Damasio

Introduction

Human beings want to be more than human. Cultural expressions, ranging from religion to romantic comedies or comics, have forged an interesting habit in us: to set for ourselves unreachable references to then become frustrated with our own inability to meet the standard.

It doesn't matter whether we talk about Gilgamesh, Hercules, Achilles, Superman or Neo. And it doesn't matter either whether we talk about Hollywood actors or tabloid press celebrities. All societies have created their own superhumans and have then proceeded to establish a love-hate relationship with them.

I have been fascinated by our quest for the superhuman in pop culture my entire life. Things have changed quite a bit in the last few years! When I was young, I was a big fan of comic books, role-playing games and science fiction. In recent years, my childhood mythologies have drastically increased in popularity.

Ever since Disney acquired the publisher Marvel Comics and *Iron Man, Thor or the Avengers* became blockbusters, their somewhat marginal but popular characters have become pop icons through and through, recognizable by a large percentage of the world's population.

The sweeping success of the New Zealander director Peter Jackson and his trilogy *The Lord of the Rings* rekindled interest for Tolkien. The super-

There are more or less dramatic, vacuous or satirical stories about their -increasingly less- fantasy worlds

famous *Harry Potter* saga and its films unleashed an interesting phenomenon: every tiny literary saga for the youth with a fantasy touch and some success seemed to be intended for the movies. *Twilight, Percy Jackson, Shadowhunters*... They are very different from each other but they all share one common denominator: superhuman characters.

It is not a new phenomenon, although it is evidently on the rise. The renewed interest from the film industry in classic characters from Warner such as Superman or Batman dovetails with the great progress in videogames that explore superhuman abilities and their connection to social evolution, adopting in many cases cyberpunk codes. There are no homogeneous themes or treatments, they vary too widely. However, a significant portion of the fiction we watch shows superhumans as the main characters. There are more or less dramatic,

The fact that an institution focused on new trends such as the Bankinter Foundation of Innovation shows interest adds support to the idea that the zeitgeist is there for us to augment our capacities in the future

vacuous or satirical stories about their—increasingly less—fantasy worlds. From the deconstruction of the superhero genre in *Watchmen* to the sociopolitical commentary in the Jason Bourne saga and sheer action in *Blade* or the ingenious social comments in *Kick-Ass* there is a wide range of differences. But they all share the fine type. They drink from the same *zeitgeist.*

This brief digression on pop culture is relevant. I am very thankful to the Bankinter Foundation of Innovation for asking me to participate in their Future Trends Forum 'Preparing for Super Humans' and author this document, partly because this initiative proves an old theory of mine: we are not more interested in superhumans just because Hollywood suddenly said so; an appetite for this type of products existed already and the entertainment industry is simply catering to it.

I have read all sorts of analysis on this phenomenon; some boil it down to an infantilization of audiences. Alan Moore, who helped bring superheroes back to the spotlight in the late XX century, recently described as a "cultural catastrophe" the fact that grown-up men continue to attend movie theaters and watch fantasies designed for 1950s youngsters.

I do not believe so. I believe that these cultural artifacts help us imagine the next steps and adapt to them as technological advances enter our lives. It is not just a great wave of nostalgia. We are preparing as a society for what is coming next. The fact that an institution focused on new trends such as the Bankinter Foundation of Innovation shows interest adds support to the idea that the zeitgeist is there for us to augment our capacities in the future.

In his keynote speech, Dr. Antonio Damasio, director

Antonio Damasio

University Professor, David Dornsife Professor of Neuroscience, and Director, Brain and Creativity Institute at University of Southern California and Prince of Asturias Prize

of the Brain and Creativity Institute of the University of Southern California, brought up C. P. Wolf's 1959 conference The Two Cultures, which established a divide between intellectuals in Science and Liberal Arts. The gap between science and liberal arts may still exist—and may be even bigger. But our pop culture, increasingly global and universal, has bridged between both. Snow criticized liberal arts intellectuals for being unable to describe the concept of 'mass'. Nowadays he might be surprised to find out that The Big Bang Theory presents the superstring theory to a general audience. A Science intellectual might have not read Shakespeare, but Joss Whedon, the director of *The Avengers*, recently directed a very acceptable version of the Bard of Avon's *Much Ado about Nothing*. The common denominator is more widespread than ever.

This is the perfect breeding ground for the rekindled interest in superhumans, since it is universal across cultures. Dr. Damasio highlighted in his remarks how culture itself is another tool available to mankind to face increasingly complex challenges and fulfill its main function: "maintaining our integrity as organisms". Is the quest for the superhuman another tool in our individual and collective development? What type of supermankind is acceptable and which one poses dilemmas?

This is the perfect breeding ground for the rekindled interest in superhumans, since it is universal across cultures

The discussion touched on science, technology and challenges for investors, but also philosophy, ethics and the impact of superhuman in all types of relationships between human beings

The sessions were organized by the Bankinter Foundation of Innovation. They brought together a wide range of experts who made very interesting and varied contributions to the discussion. The discussion touched on science, technology and challenges for investors, but also philosophy, ethics and the impact of superhuman in all types of relationships between human beings.

"The issue of expanding the frontiers of human performance is more ambitious than others we have discussed in previous fora, because this is an earlier stage of its development", said Meyer in the opening session. Who came up with the idea? Apparently, it came from one of the Bankinter Foundation of Innovation's Trustees, Eden Shochat, who mentioned how the arrival of Google Glass was part of a broader phenomenon. "We realized there are many types of technologies that are expanding the frontiers of human development and changing not only how we live, but how we live together", pointed out Meyer.

In order to structure the discussion, the Future Trends Forum (FTF) divided capabilities or *superpowers* into three groups: informational, anatomical and biological. An effort was made in each of these groups to define the frontiers and challenges that are barely in the horizon today and the viable commercial initiatives already underway. The truth is that progress in the latter often enters the realm of science fiction for the non-initiated, turning out to be as surprising as or more than we could have imagined.

I hope you will enjoy, like I did, and marvel before all

Chris Meyer

Fundador de Monitor Talent y Patrono de la Fundación de la Innovación Bankinter.

Eden Shochat
Founder of Aleph & Trustee of Bankinter Foundation of Innovation

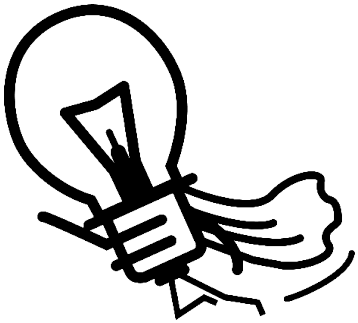
the realized and yet-to-be-realized potential. A change is relentlessly approaching. It is advisable to start reflecting on it before we are unable to react. While the Future Trends Forum (FTF) normally detects trends on what we do, in this case it discussed what we are, what we want or do not want to be and what we will end up being—whether we want it or not.

Informational Capabilities

Attendants were asked the following question during the Bankinter Foundation of Innovation sessions: What is your main superpower? It was a good question and one particular answer was noteworthy: "I carry a cell phone. I can tap into the world's knowledge in a matter of seconds with Google Scholar and Wikipedia".

We may **acknowledge our lives have changed ever since smart phones and tablets are part of our lives**, to the point of discussing the future survival of the PC as we know it. We are even creating new social habits around phones and their apps. We ask ourselves things such as: "When is it correct to search for information during a dinner party?" We have coined the word *phubbing* in reference to the rudeness of prioritizing the phone over human interaction. And we've seen a myriad jokes about Whatsapp, the "double *click*" and jealous couples.

And if this is the case with the adoption of the truly smartphone—a 5-year-old trend that started with Apple's iPhone—what will bring the in-



what will bring the introduction of Google Glass and other wearable-computing products?

troduction of Google Glass and other wearable-computing products? What will happen when we are constantly connected to our computer's intelligence, as brilliantly portrayed in Spike Jonze's movie Her? (A deep reflection on many issues we will discuss here and on love).

The TV series *Intelligence* was recently released in the US. You may remember the main character, Josh Holloway, from Lost. By implanting a chip, he has become a *cyborg*, a half-human, half-machine organism. Even though it comes as a regular silicon piece, we could well imagine it is an out-of-reach system of a chip (SoC), a spin-off from the type of things companies such as ARM, Qualcomm, Intel or AMD are currently developing. The peculiarity of this chip is that it generates a perfect interaction between information from all sorts of networks and the host brain. So the human brain is the final solution to Big Data.

But what is Big Data exactly? It usually refers to a technological trend, but the truth is that it is a technological problem. As the volume of data increases around the world, it becomes increasingly harder to use it in order to draw conclusions. As the number of sensors capable of collecting information increases, it is increasingly harder to achieve Google's dream of 'organizing the world's information'.

In *Intelligence*, the main character's brain creates virtual scenes where each piece of information at his disposal takes a specific place. So all incoming data—structured or not—is made into an understandable situation. His brain allows him to turn his limitations into his greatest advantage (utilizing the brain's plasticity mentioned by Dr. Damasio). Young people have grown accustomed to interpreting the overflow of concurrent information through different windows and devices;

Even though home automation hasn't penetrated our households at the rapid pace forecasted, Google just bought a ticket to make sure it will not miss the train

hence the peculiar—but not completely unreachable—scenario presented by this TV series.

There are many companies working to **transform information into knowledge** in the real world. Google recently bought Nest, a popular thermostat and smoke-detector US company, not for its 300 million in turnover, but because it opens the door to home sensors and more information. Even though home automation hasn't penetrated our households at the rapid pace forecasted, Google just bought a ticket to make sure it will not miss the train. The possibility of telling our glasses to turn down the heating at home is a basic function among all that are coming.

However, Charles Arthur, from The Guardian, said that "Internet fridges is the zombie idea that will never, ever happen". He is wrong. His diagnosis on the challenges facing this technology is quite accurate, but he is wrong in his outright dismissal of it. According to Cisco, there are over 10 billion things—and counting—connected to the Internet around the world. According to the Internet equipment manufacturer, we will probably hit 50 billion by 2020.

How can we interact and learn from these objects? These issues were discussed at length at the forum.

Several videos illustrating various superhuman capabilities were presented during the meeting, and several *Iron Man* scenes were chosen to illustrate informational capabilities. The main character is Tony Stark, an extraordinary individual—flying armor and lightings aside. In *The Avengers*, Captain America tries to make fun of him and asks him what he is without armor and he instantly responds: "Genius, billionaire, playboy, philanthropist". Good definition.

Stark uses advanced interfaces to interact with his advanced marvels in all of the movies. Some of them are interactive, floating screens controlled through gestures, reminding us of Tom Cruise in Steven Spielberg's *Minority*

Apple wanted to stir things up in cell phone interaction with Siri; Google made an attempt with Google Now and Microsoft is expected to do the same shortly

Report. Aside from being showy, they do not seem to be unattainable: Microsoft already introduced Kinect to millions of homes (and companies and even operating rooms). Even a four-year-old can take the console off your hands and switch to cartoons without touching the remote. They just need to say: "Xbox, go to TV".

In a recent video, the multimillionaire Elon Musk, co-founder of Paypal and CEO of Tesla and SpaceX—and probably one of the entrepreneurs to shake up the most industries in the shortest timeframe—showed an interface to create space rockets similar to *Iron Man's* . Interestingly enough, the director of the first two *Iron Man* movies, Jon Favreau, has openly admitted that Musk, with his combination of genius, arrogance and busy social life, inspired him to create the character played by Robert Downey Jr. He was even invited to play a small part in the second movie.

Selecting *Iron Man* was very appropriate—not just because of the visually appealing and very easily attainable gestural interface. One of the reasons that makes Tony Stark a good example of what is coming is the fact that he communicates with his machines through a virtual butler: Jarvis.

Apple wanted to stir things up in cell phone interaction with Siri; Google made an attempt with Google Now and Microsoft is expected to do the same shortly, using Cortana's voice and personality—a virtual assistant named after the Halo videogame character (one cannot deny there are significant interactions between our reality and the worlds of our imagination). Jarvis is the sublimation of these ideas.

One of the speakers, Dario Gil, director of IBM's Cognitive Experience Lab, said the following in an interview with American media: "**We know more than any other generation** but we still struggle to keep abreast of ever-more complex information and understand the inherent meaning of the massive amount of information we acquire at increasingly faster speed.

Dario Gil

Director of Cognitive Experience Laboratory at IBM Research

IBM is working on how we will relate and associate with systems than can learn and interact and relate to people naturally

Creating technology expressly designed to learn and enhance our cognition will take us to a new era of individual and collective progress".

In his presentation, Gil regretted the lack of tools available "to enhance cognition and the complex world we have created". An example from the researcher himself: How many times must a top executive deal with complex situations in a matter of seconds? As Gil said, "Nowadays we all take decisions that are far from optimal, particularly when we enter the realm of possibilities". Even more so if we add to the list classic (and human) cognition failures, such as optical illusions or our own prejudices.

IBM is working on how we will relate and associate with systems than can learn and interact and relate to people naturally. Agents designed to enhance our cognition. They are called cogs. The researcher believes several trends are converging to ultimately take us to a society of cogs. What is a cog, exactly? It is a software agent, a cloud program created to help us solve issues, one with which we can relate through many interfaces, depending on the I/O (input/output) devices we are using. It will change depending on the sensors or connectivity or computing capacity available. The more eyes and ears the cog has, the more available gadgets, the faster it can communicate with remote computing platforms and the easier it can present relevant conclusions.

One may think of these cogs as an advanced application custom-designed for multiple purposes. They will not be tied to one single device, but to any device that is related to us. They will interact between them to serve us, just like Wall-E robots catered to all the needs of the Axiom spaceship crew.

Currently, the key is to know where to find knowledge as opposed to actually knowing. In the future, our human capabilities will depend on the type of cognitive agents available to us

Going back to the *Iron Man* analogy, Jarvis would be a cog with personal assistant functions, designed to fulfill certain tasks, one with whom Stark could talk from the lab, his armor or—everything else missing—his phone. We are talking about a world with not just one Siri, but a plethora of multi-device agents dedicated to any and every purpose.

According to Gil, we will reach a point when we may **interact with cogs at the speed of thought**, enabling us to take real-time decisions based on their information and conclusions. Currently, the key is to know where to find knowledge as opposed to actually knowing. In the future, **our human capabilities will depend on the type of cognitive agents available to us**.

Didier Stricker

Professor in computer science at the University of Kaiserslautern and Scientific Director at the German Research Center for Artificial Intelligence

Didier Stricker is Professor in Computing Science at the University of Kaiserslautern and Scientific Director at the German Artificial *Intelligence* Research Center. He made sure to mention augmented reality capacities in our daily lives. "We started working on augmented reality in 1998. I wrote my doctoral thesis about it. The change resides in the fact that it has reached the general consumer and it is free", said Stricker.

This scientist's presentation portrayed the great virtues of augmented reality not only in education, but in the industries as well. Google Glass may guide you in all sorts of complex processes, from fixing a car's engine to carrying out complex actions in a factory.

Do you want to teach a foreigner how to fix the washing machine? The technology Stricker is working on enables capturing a video with all the actions of an individual, uploading it to the servers to then segment

and structure it in different actions and download it to someone else's Google Glass. The system even checks correct actions with a green indicator and incorrect actions with a red indicator. How does the machine know what we are doing? Partly through the image itself, but it could know through other means, such as textile sensors.

Stricker talked about **the possibility of creating our own virtual model to execute actions correctly** and show us how to do it properly. The PAMAP project includes an example of his work. It is a module-based technological solution funded by the European Union. It combines algorithms, sensors and software to analyze physical activity, visualize it and obtain feedback from the patient. One goal could be to exercise at home for prevention or rehabilitation purposes. PAMAP may save costs because patients could avoid driving everyday to their rehab center. Exercise would be more effective and independent, and patients wouldn't have to explain their doctors what they did at home or when. Doctors would already have accurate data.

Let's say Just Dance, a dancing game through which users could send all their results to their doctor, as well as relevant info on their heart rate, temperature, etc. And the doctor corrects their dance moves based on the therapy they are following. That is what we are talking about.

Regarding apps already on the market, Mula Friedman's presentation was very interesting. At CES 2014, he presented the closest competitor of Google Glass: the Lumus DK-40. Its vision of augmented reality, running on Android's OS, is different from Google's product in several aspects. It aims to become an alternative in consumer electronics, in the long-term. The Israeli company has extensive experience in similar devices especially designed for the army, such as the devices embedded in a fighter pilot's helmet. It aspires to become one of the leading companies in this field. Other companies, such as Recon Jet, Vuzix, GlassUp or the Japanese company Telepathy One are engaged in this pursuit as well.

Google Glass may guide you in all sorts of complex processes, from fixing a car's engine to carrying out complex actions in a factory

Mula Friedman

Director of Display Systems at Lumus

Telepathy? Transmitting thoughts between people?
That is a superpower, no doubt. The founder of this last product, Takahito Iguchi, has highlighted how the product is leaning towards telepathy and how to make it happen. Showing the world what you see and do in streaming is tantamount to flashing, in a way, but is it telepathy? If we broaden the definition, the constant exchange of messages on Whatsapp could be considered a form of telepathy as well. I personally prefer to think it is one step further in the evolution of communication towards the direct exchange of thoughts—or the closest we can get.

The glasses by the company OrCam go a step further: these glasses provide a system to recognize objects and whisper what they are to a blind person's ear. Nothing short of a revolution

Doctor Venkman from the *Ghostbusters* franchise sought telepathic exchanges, but it was always clear that he was a fraud. Carl Lightman, played by Tim Roth in the TV Series *Lie to Me* was much more realistic. His ability to read body language and become a human lie detector made him an interesting character. And one with whom it was hard to share time, because the ability to lie to each other is, in many ways, the foundation of our structured society. We encourage you to read this interview to Paul Ekman on *Popular Mechanics*. The man behind the character explains the actual use of micro-expressions in someone's face to separate what is genuine from what is not.

And when we add augmented reality and the help of cogs mentioned by Gil? Glasses to know when we are being lied to thanks to an application connected to all sorts of sensors that, aside the micro-expressions mentioned, can detect the room temperature and connect it to the subject's perspiration? It sounds futuristic, but beautiful. In any case, Friedman suggests more mundane uses, such as the

Our phones are much more advanced than anything imagined by our elders

automatic translation of signs at an airport. He says the sky is the limit when thinking about new apps.

Besides, the uses for Google Glass-type devices are almost limitless. The glasses by the company OrCam go a step further: these glasses provide a system to recognize objects and whisper what they are to a blind person's ear. Nothing short of a revolution.

The truth is that there are a million reasons to excite our imagination. Anthony Lewis, from Qualcomm, mentioned an irrefutable fact: the US microconductor company sells 750 million chips per year, mainly for cell phones and tablets. "**This means that every year we have access to 10% of mankind**".

With *Intelligence* we saw silicon inserted into our brains. Lewis' work is just as amazing, since he works with microprocessors inspired by the brain and biology.

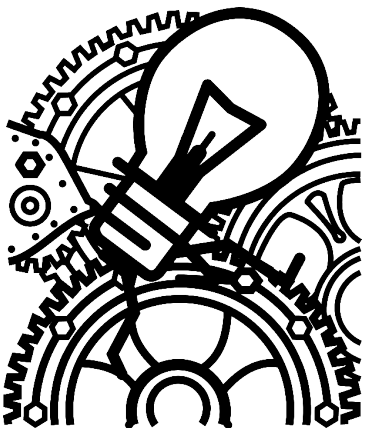
"Our phones are much more advanced than anything imagined by our elders. They can communicate with basically anywhere on the planet, they are a tactile computer, a personal GPS navigator, our main camera and a digital assistant. In short, they are just like C3PO or R2D2 from *Star Wars*. Smartphones are just like robots, except that they don't have limbs", he said.

Lewis emphasized the importance of the "constant sensor": the possibility of having sensors constantly tuned to the environment and adapted to an individual's behavior to process data smartly. According to him, the solution to one of the greatest hindrances of the cell phone (the short battery life) might be found in the brain. We might have the answer to

Anthony Lewis

Senior Director at Qualcomm

We might have the answer to a disturbing dilemma: whereas Moore's Law states that processing speed is constantly growing and it doubles every two years, this does not apply to lithium-ion batteries



a disturbing dilemma: whereas Moore's Law states that processing speed is constantly growing and it doubles every two years, this does not apply to lithium-ion batteries. Until a real revolution takes place in this field, any progress will simply be an evolution. Batteries do not keep up with the pace. To top it off, a revolution in this field is not foreseeable, since a miscalculation or lack of expertise when running tests could lead to hundreds of thousands of small bombshells in everyone's pockets.

Will processors based on our brains dream when they are on stand-by, just like we do? These are the type of questions that make us think of artificial intelligence, an issue to be discussed later, on the chapter about challenges and ethical matters.

James Olds

Director at Krasnow Institute for Advanced Study
- George Mason University

I spent the first week of December 2013 attending a very unique meeting in Madrid. Organized by the FTF, the conference brought together scientists from a broad range of disciplines, technology entrepreneurs and government funding agency representatives. The subject matter was what made the meeting really unusual: what will society do when the superhumans arrive? And, no it wasn't science fiction.

In this case superhumans refers, not to aliens, but rather to ourselves as we co-evolve with technology in the near future. In a sense we are already superhumans—the human genome has long been sequenced, our smart phones are far more powerful than the computers that sent man to the Moon, a human-made nuclear powered robot named Curiosity is exploring Mars, and we have just achieved an understanding of the first trillionths of a second after The Big Bang. That is a far cry from our ancestors who came down from the trees in Africa.

The meeting however was concerned with the next steps: when machine becomes truly interfaced to brain, when exoskeletons will enhance our physical strength, when parents may perhaps chose to purchase extra IQ points for their superchildren. There was a consensus among the group that such a future certainly requires a serious societal conversation about the ethical, legal and social issues raised by such potential.

At the same time there was much hope among the attendees. Perhaps the superhumans will learn to achieve lasting peace. Perhaps they will successfully manage the challenges of climate change and even colonize Space. Certainly they will have the potential to cure dread diseases such as Alzheimer's or cancer.

I am a molecular neuroscientist. I am focused on the complex sequences of molecular events that underlie learning and memory in health and disease. For me, the hope is that the superhumans can someday understand how our brain, a machine with 100 billion neurons, each with 10,000 connections to other neurons, that uses only 20 watts of power can do the marvelous things that it does—even in us non-superhumans.

Opportunities for Spanish Companies

Out of all capabilities discussed during the forum, informational capabilities may offer short term solutions for the general public. Spanish companies should tap into it now. In fact, many of them are already present in some of the milestones described.

Start-ups have contributed to the ecosystem of mobile apps and are now gearing up for Google Glass. However, we are still talking about names, rather than companies, such as an entrepreneur from Murcia, Julián Beltrán, from Droiders, who was part of the initial tester team, or Antonio Zugaldia, technical director of the US company Silica Labs. The company Zerintia has already launched the Madrid Tour application for Google Glass. This type of augmented reality applications in tourism, one of our main national industries, is worth considering.

Everything leads to thinking that if IBM is right to conceptualize a society of cogs, Spanish companies—ranging from big companies like Indra to more humble start-ups—will

Smart watches is the top-seller category in the short term, especially as the new flexible screens are added to current models: they will fit our wrists as never before

pay a role in its development. Besides, this cloud must be hosted in data centers and why not those of Telefónica or Gigas. The Spanish multinational is growing fast in this field. It already has one of the most advanced Tier-4-category data centers in the world in Alcalá de Henares, Madrid.

Regarding devices, I know the Spanish company Bq is working to bring device manufacture back to Spain, as is the Valencia-based iMasD. Having smartphones, tablets and 3D printers assembled in Spain, despite the many components manufactured in China, is a very real possibility in the short term. The Barcelona-based company Inbenta is working on natural language processing, seeking to create virtual assistants adept at extracting information stored in websites.

And then there are wearable devices. In a recent report for *Actualidad Económica*, I checked if there already exists a smart version of each and every accessory. And so it is.

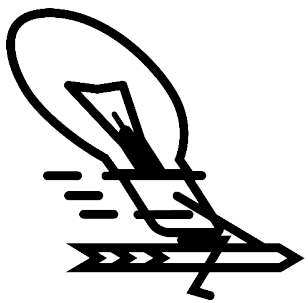
Smart watches is the top-seller category in the short term, especially as the new flexible screens are added to current models: they will fit our wrists as never before. Companies such as Samsung, Sony or Qualcomm are working on this already, although each big consumer tech company is looking for its own solution.

Interestingly, this product category is, to a great extent, based on a rumor. The simple fact that everyone was wondering how and when would Apple launch the iWatch led all competitors to hit this market niche. It is not a process of replication by example, as was the case with second-arrivers of the iPhone and the iPad, but rather some sort of pre-imitation: creating products based on overheard ideas about what your competitor has in mind.

According to the consultancy Juniper Research, the market for wearables will grow exponentially over the next few years, up to $19 billion in annual turnover and 130 million devices. This includes all sorts of products. From

quantifying bracelets (FitBit, Fuelband, etc) to others with features yet to be seen. Smart rings such as Smarty Ring will manage the relation with other devices, including the smartphone (a ring to rule them all?). Belts to correct posture, such as Lumoback. Socks that pair up by themselves and warn you—via application—when they are too worn. Shoes, necklaces, t-shirts... All industrial options are valid to develop hardware and create apps.

The Spanish company Callaghan developed smart shoes a while back: the Callaghan Adaptacion Vital. An example of how a traditional Spanish industry, shoemaking, can adapt to a new era and even be ahead of the pack. I wrote in that report that most wearable technology is still in an early-adopter phase and the general public will not see it until it hits Zara's or Mango's accessory section, big Spanish retailers that will develop their own strategies in this field.



According to the consultancy Juniper Research, the market for wearables will grow exponentially over the next few years, up to $19 billion in annual turnover and 130 million devices

Randall Alley

CEO & Chief Prosthetist at biodesigns, inc.

My Experience at the Future Trends Forum and my thoughts for the Future of the "Anatomical Man"

It was a complete surprise to read the email I had just received, stating that the Bankinter Foundationhad selected me to attend and speak at the 2013 Future Trends Forum in Madrid, and would be paying for my travel expenses as well. I searched the email for any indication that I needed to attend a presentation on time share ownership or fine print expecting there to be some sort of eligibility for a prize of some sort. After seeing no indication of the usual spam offerings, I emailed as well as the FTF manager to see if this opportunity was for real. To my great surprise, she said in fact "yes, it was."

What followed was a gathering of extraordinary minds at a superlative conference that greatly exceeded my expectations. I greatly appreciated Bankinter's foresight of gathering experts in the areas of information and anatomical technologies, ethical issues, biological capabilities and financial management/investment from around the world with the singular focus of preparing the Spanish economy for the onset of augmented or "Super" humans.

As for my thoughts on our present anatomical capabilities it is fairly obvious to me that we're at an important intersection where the interfacial boundary has finally become the focus rather than an afterthought, and where prosthetic and orthotic augmentation meets the exoskeleton and robotics. We've been dancing around the subject for decades but contact has finally been made. The line is officially blurred.

Regarding my predictions for what the future holds, despite the regulatory morass that hinders our innovation here in the States, we, along with other nations will soon come to regard the Superhuman as, if not the norm, then the commonplace. Anatomical enhancement will become so routine that depending on how far out we project, augmentation may in fact become an options list from which the average human may simply select multiple choices for any given activity and/or time period to fulfill his or her functional or recreational desires. This will be done in a similar way in how we currently choose a wrench or baseball bat or a ski, only this time it will be a robotic appendage or a computerized lens fitted to our eye, or a "strength suit" we don like a piece of clothing.

Anatomical Capabilities

James Cameron's *Aliens* were the guests of honor of the discussion on anatomical capabilities. Particularly, Sigourney Weaver atop a giant Caterpillar [1] P-5000 Powered Work Loader, ready to challenge the alien queen with her legendary: "Get away from her, you bitch!"

This scene opened a discussion mainly focused on **microelectronics applied to exoimplants and body-area networks** and the progress in exoskeletons and advanced prosthesis.

[1] Caterpillar, Yes, the popular American industrial machinery manufacturer that even inspired toys (still on sale).

Body-area Networks

There is a slight overlap between this first section and the first chapter, since we are discussing low-voltage, low-power microelectronic components that generate sensor networks around our bodies, the wireless body-area networks (WBAN). An intimate relationship with technology, a machine-human symbiosis of sorts that reminds me of the Egyptian plover feeding off food leftovers on the crocodile's gullets.

Actually, some products within the wearable technology trend could be included, at least in part, in this category. During the forum, we discussed truly amazing developments, beyond what is in the market now.

Vincent Peiris has been working for the Swiss company CSEM for several years. This company has put 400 scientists to work on low voltage, low power microelectronics. This scientist says that these body-area networks, made up of tiny sensor-nodes with different functions, are not only recording information, but also carrying out local processing

Vicent Peiris

Head of the RF and Analog IC Program at CSEM

tasks, making their sensors increasingly smart. Up until now they have been used in telemedicine, for example.

Peiris coordinates WiserBAN, a European project pursuing ultra-miniatures and other objectives with industrial partners in different areas. This project requires sensors to be really tiny. The RF link must use an insignificant amount of energy and both the antenna and the radio must adapt to propagation losses around the body. WiserBAN is clearly different from the *WPAN* (wireless personal area networks) technology, which includes wireless solutions such as Bluetooth or ZigBee. One of the differences is size: the solutions sought by WiserBAN must be fifty times smaller than *WPAN* and offer much better energy consumption and battery life, combining microelectromechanic technologies (MEMS) and submicrometric semiconductors.

WiserBAN, a European project pursuing ultra-miniatures and other objectives with industrial partners in different areas

In short, they are different from **today's wearable technology because they go a step further in integration and miniaturization**. They fit better with long-term technologies and very specific or experimental apps than with trends in consumer electronics. "It would be interesting to see how miniaturization is used", suggested Peiris.

Even though this type of systems will be used in the short term for cardiac implants or insulin pumps, this scientist wanted to focus on two areas related to hearing: hearing aids and cochlear implants.

Regarding hearing aids, Peiris underscored how WBAN will

It was even more impressive to listen to him talk about how microelectronics have enabled neurostimulating a rat with bone marrow problems: the rat regained control of its lower limbs

facilitate some functions, such as connecting hearing aids from both ears to enhance sound, or to digital audio devices, such as cell phones. Regarding cochlear implants, Peiris said that we are approaching fully implantable cochlear implants underneath the bone and linking the implant digitally.

It was even more impressive to listen to him talk about how microelectronics have enabled neurostimulating a rat with bone marrow problems: the rat regained control of its lower limbs. "The point is to introduce all the technology in the bone marrow along with a rechargeable battery and program the neurostimulation patterns remotely", he explained.

To stir up the discussion, Peiris said that even though uses currently pursued focus on restoring rather than empowering, personal area networks will undoubtedly facilitate the world of superhumans we are envisioning. With the right sensors and neurostimulation, could we create athletes on whom we can measure and process every gesture to seek perfection? Could we neurostimulate them to reach specific goals? There are connected golf gloves that improve your drive when playing golf. In fact, Peiris believes that integrating electronics into textile technology would facilitate the adoption of these technologies and avoid potential qualms.

Exoskeletons

The movie *Elysium*, by the South African director Neill Blomkamp, casts Matt Damon as an ailing hero who must use an exoskeleton to gain the necessary strength to accomplish a difficult mission.

The suit, connected to the user's nervous system, is a "third generation HULC exoskeleton", according to the smuggler installing it. And as recognized by Blomkamp himself in an interview, it extrapolates technology currently developed by the US army.

The truth is that HULC (Human Universal Load Carrier) is trademarked. Berkeley Bionics presented the product in 2008 and developed it via a grant from the US Department of Defense. Interestingly enough, when it was presented they already said it was "the third generation of exoskeletons".

The company has evolved considerably over the last few years, even in its brand name. Since 2011 it goes by the name of Ekso Bionics. In 2012 it marketed a device, the Ekso, for rehabilitation purposes, as opposed to warfare. The HULC military technology was licen-

sed to Lockheed Martin in 2009 for its future development.

The real-life HULC is an anthropomorphic hydraulic exoskeleton offering users the possibility of loading up to 90 kilos for 200 km in a single battery charge, to be used on all types of terrains. It is designed to spare excess weight injuries to soldiers—one of the main reasons for sick leave in the US army. Its on-board computer enables the equipment to move in synch with its operator. The equipment is less than 30 kilograms and sells for under €100,000.

The real-life HULC is an anthropomorphic hydraulic exoskeleton offering users the possibility of loading up to 90 kilos for 200 km

Keith Maxwell, head of the exoskeleton program at Lockheed Martin, said in an interview with Bloomberg that we are in the early stages of this technology's golden age, ultimately to be applied in many industries. In fact, aside the HULC series, Lockheed is developing Mantis, an industrial version of HULC.

It is obvious that Hollywood and the entertainment industry are capitalizing the interest aroused by these machines beyond the examples already mentioned. *Pacific Rim*, a movie hit in 2013, was sold as a 'robots vs monsters' movie, but the *jaeger* (hunters) on the screen actually were giant exoskeletons. Additionally, two big premieres involving this technology are expected shortly.

Edge of Tomorrow, with Tom Cruise and his splendid exoskeleton lead the war against the aliens. And Titanfall, one of the videogames of the year, exclusively on Xbox One. The main characters include titans, giant war machines controlled by the players and created by a fictitious company called Hammond Robotics in the game's

we are in the early stages of this technology's golden age, ultimately to be applied in many industries

fiction. The game creators have tended to every detail in their own (and fictitious) website, blurring the line between reality and fiction. They have even created a false statement for their corporate social responsibility page.

Killing (and Healing) Machine

Russ Angold, cofounder and technical director of Ekso Bionics, spoke at the Future Trends Forum (FTF). In a way, his story has an echo of superheroes.

With a background in agricultural engineering, his professional career focused on exoskeletons. Back in the day he used to joke around with his brother (member of the Navy SEALs, the special op body of the US Marine Corps) about how one day he would launch something to help him in his dangerous job.

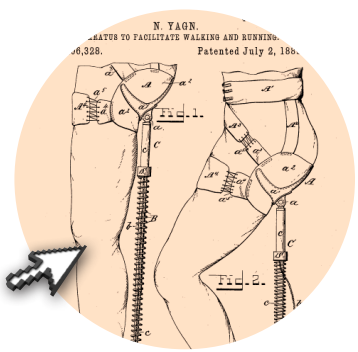
Russ Angold

Cofounder & CTO at Ekso Bionics

The seed for HULC was planted then. However, tragedy hit their household: a bone marrow lesion disabled his brother. Angold decided to support him in hospital, the same way he had intended to do in the battlefield, and focused his work on rehabilitation with machines.

What is the GPS but military technology? Drones were created for unmanned war missions. They are now used for inspections in industrial areas, recording pan views for movies, etc.

"Thanks to *Iron Man*, everyone today knows what an exoskeleton is, but that is a small curse, since everyone wants to fly and we're still far from that milestone", chuckled the executive. Angold shared some history on the evolution of exoskeletons, starting with a patent request back in 1890 (!) by the Russian scientist Nicholas Yagn, and General Electric's popular Hardiman in the mid-twentieth century. However, the big difference between those and current times is that progress in energy efficiency and battery life has led to powered, rechargeable machines.



But what can exoskeletons contribute to healthcare and why the renewed interest?

Angold reminded us that one of our greatest achievements is walking on two feet. You learn how to put one foot before the other. Once you are standing, you don't kneel again. That makes us humans and it is a binary matter: either you can or you can't walk. A bone marrow lesion involves very expensive technology. These solutions reduce complications and healthcare costs.

The Ekso manufactured by this company enables patients to stand and walk assisted by a physiotherapist. As opposed to struggling at the gym and coping with the doubts ("Will I ever walk again?"), patients walk again, aided by this type of machines, pure and simple.

During Ekso's presentation at the *Fundación del Lesionado Medular* in Madrid, their chief of medical staff, Natacha León, pointed out that "standing up is essential, it is very beneficial to regulate intestinal transit, improve blood flow or bone density, for example. Besides, this exoskeleton helps improve joints and provides psychological benefit".

Transitioning from the military to other industries is a classic move. What is the GPS but military technology? Drones were created for unmanned war missions. They are now used for inspections in industrial areas, recording

Panasonic's robotics division, Activelink, is based in Nara, Kyoto. They are working on their own exoskeleton too, the Power Loader; designed to maximize the efficacy of different types of professionals from construction workers to emergency services

pan views for movies, etc. Even Amazon claims it will mass deliver packages via drones, even though many experts question the feasibility, mainly because of air space regulation in big cities.

Invisibility is another interesting superpower funded by the military. This technology enables soldiers to camouflage from the enemy. It is reminiscent of Harry Potter's magic cloak to wander around Hogwarts with his friends. The Canadian camouflage clothes company Hyperstealth has been somewhat successful, and very publicly so.

Going back to fiction and exoskeletons, we should mention Ken Levine's masterpiece, the videogame saga *BioShock*. In the first game, players face Big Daddy—men wearing exoskeletons, a powerful reminder of General Electric's Hardiman. In the sequel, *BioShock* Infinite, the likeness was even more remarkable: the enemy's name was simply Handymen.

Panasonic's robotics division, Activelink, is based in Nara, Kyoto. They are working on their own exoskeleton too, the Power Loader; designed to maximize the efficacy of different types of professionals from construction workers to emergency services. They are priced fairly reasonably, even below the €10,000 mark.

"During the 2011 earthquake and tsunami and after Fukushima, many Japanese people wished they were more powerful", said Motoki Nakano, whose videos on the Power

Loader, to be marketed in early 2015, were a hit during the forum. The company believes these exoskeletons and its future fully automated versions will be useful in very different fields, from radioactive tests to freeing survivors from a collapsed building and building the skyscrapers of the future, or carrying out tasks underwater and in outer space.

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Prosthesis

RoboCop: "They'll fix you. They fix everything".

For many years now comic books have embraced prosthetics. There was a Native-American character, Forja, among the X-Men, created in 1984. He had lost an arm and a leg in Vietnam. Being a mutant, he developed robotic prosthesis to lead a normal life (he even had an amorous relationship with Storm, played by Halle Berry in the movies).

Director Paul Verhoeven created the RoboCop movie in 1987. In a way, the character brings together many trends reflected in these pages. "Half man. Half machine. 100% cop", read the ads promoting the film at the time. Now we could say, "In a way it is an exoskeleton: most of it is prosthetics, almost all of it android". The movie sequel has premiered recently. Its intellectual message is much more diffuse than in the first movie and there are just a few casual references to corporate America and the advent of drones. RoboCop currently represents most augmented human capacities. If we constrain ourselves to the prosthesis and the issues discussed in the sessions, we will see how substituting 'natural' for

His High-Fidelity Interface Systems technology captures and controls residual bone, clearing heat and increasing stability, energy efficiency, control and the overall experience

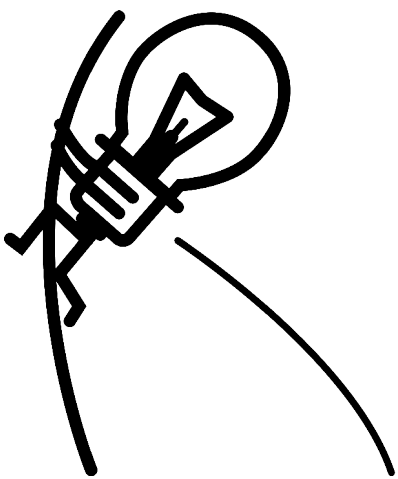
'artificial' can lead to augmentation, to 'super'.

Christopher Meyer brought up the exciting Ted talk by Aimee Mullins, the athlete and model who lost both legs when she was one year old but still ran the 100-meter sprint in 15.77 seconds. Her prosthetic legs made from solid ash have been designed by Alexander McQueen. According to Wikipedia, she measures 5 ft 8in or 6 ft 1in depending on the legs she decides to wear.

In her talk, Mullins shared how **she asked a room full of children what special abilities would they choose if they had artificial legs like hers**. Their reaction surprised her deeply. Very excited, the children came up with kangaroo or toad legs, or extendible limbs like Inspector Gadget's.

"The children didn't see a disabled person before them, they saw someone with a potential their own bodies lacked", she said.

The truth is that there is a long list of super-cripples in fiction. A classic DC superhero, Aquaman, lost his hand and had it replaced with some sort of harpoon—not exactly a subtle nautical metaphor. *Cyborg*, from The New Titans, was made a superhero by his father in the aftermath of a terrible accident. The precedence to this character is Rotwang, the mad scientist in Fritz Lang's Metropolis. Both Darth Vader and his son Luke were assisted by machines. The term "Luke's hand" is commonly used in prosthetics nowadays as a synonym of excellence, a goal to pursue.



Lieutenant Geordi La Forge from *Star Trek* makes up for his blindness with VISOR technology (Visual Instrument and Sensory Organ Replacement), combining the augmented reality glass trend and prosthetics. Interestingly enough, a competitor of Google Glass is called LaForge Optical.

Captain America's movie *The Winter Soldier*, coming soon, will feature the superhero's old sidekick, Bucky Barnes, with an extraordinary mechanical arm after having suffered considerable body injuries. And in the *Evil Dead* saga directed by Sam Raimi, Ash's hand is replaced following its amputation with a mechanical saw.

Jason Barnes' story recently caught some attention in the media, especially YouTube: he is a drummer who lost an arm due to an electric shock.

Another interesting project at DARPA is RE-NET, a reliable neural-interface technology created in 2010. It aims to create high-performing interfaces to control complex functions of advanced prosthetic limbs

Thanks to the Georgia Tech Center for Music Technology, he is now the proud owner of a marvelous prosthesis and plays drums with two drumsticks. The musician's arm controls the first drumstick physically and electronically, through electromyography. The second drumstick listens to the music being played and improvises based on that input.

Professor Gil Weinberg, founder and director of this institution, believes that this type of robotic synching will be used in the future, enabling humans to control a third arm. **It is not hard to imagine an astronaut, a specialized worker or a surgeon using one of these devices to perform complex tasks**.

And of course Dr. Otto Octavious (a Spider-Man villain whose tentacles used a very similar—although fictitious—technology back in the 1960s) must have immediately come to the minds of comic fans.

Randall Alley participated in these sessions. He is one of the foremost experts in prosthetics worldwide. Most of his work has focused on developing a socket—the prosthetic components around the stump

This technology, unlike others, does not connect directly to the brain. It reads brain signals that are still circulating in local nerves and muscles

Randal Alley

CEO & Chief Prosthetist at biodesigns, inc.

that interface between the patient and the prosthesis.

Alley explained how his company, Biodesigns, is progressing towards developing this key component. His High-Fidelity Interface Systems technology captures and controls residual bone, clearing heat and increasing stability, energy efficiency, control and the overall experience. "We preserve movement of the skeleton. We were focusing on the wrong place; the key was to replicate the neuroskeletal connection. But we want the prosthesis to be really part of you, not something you add", he explained. "To this end, compression doesn't need to be very intense. Patients currently feel something similar to having their pants a little bit loose. Thanks to our research, some patients are already reporting that there are times when they do not feel the prosthesis".

Alley is also consulting for DEKA Research in the Revolutionizing Prosthetics Program of the Defense Advanced Research Project Agency (DARPA). This program seeks to develop a new generation of upper limb prosthetics for the US Army.

It is directed by Geoffrey Ling, present in the forum as well. He believes **the advances in anatomical capabilities will be clearly reflected in the world's largest group of disabled people: the elderly**. "Grandmas don't want to use a wheelchair or smell of urine in front of their grandchildren. They want to dance with them. It is such a big market that there is no doubt about the acceptance capacity. The opportunity lies in offering an 80 or 90 year-old person to go skiing, playing tennis or golf. Get them out of bed or they will die. This type of technologies are game-changing", he highlighted.

Geoffrey Ling

Deputy Director of the Defense Sciences Office at DARPA

Another interesting project at DARPA is RE-NET, a reliable neural-interface technology created in 2010. It aims to create high-performing interfaces to control complex functions of advanced prosthetic limbs. To this end, they are developing the technologies needed to extract information from the nervous system.

This technology, unlike others, does not connect directly to the brain. It reads brain signals that are still circulating in local nerves and muscles. In fact, they are the same signals behind the phantom limb effect. It could be said that the phantom limb *occupies* the prosthesis and makes it more real.

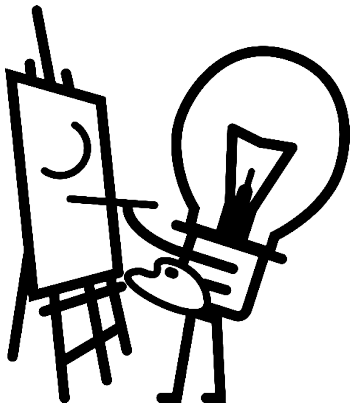
This project started with research from the Nicolelis lab using hair-thin, flexible sensors that had been implanted into the brains of rats and monkeys

Do you think these technologies are futuristic? Something you will never see in everyday life? Brazil's Soccer World Cup may change your mind. In a display of showmanship, a young Brazilian boy paralyzed from the waist down will do the initial kickoff with a mechanical exoskeleton controlled by the brain.

In an interview to the Washington Post, the leader of the Walk Again Project , Miguel Nicolelis of Duke University, said that "with enough political will and investment, we could make wheelchairs obsolete", and "we want to galvanize people's imaginations".

The Duke University Center for Neuroengineering, the Technical University of Munich, the Swiss Federal Institute of Technology in Lausanne, the Edmond and Lily Safra International Institute of Neuroscience of Natal in Brazil, the University of California Davis, the University of Kentucky and Regis Kopper of the Duke immersive Virtual Environment are collaborating in the Walk Again Project.

This project started with research from the Nicolelis lab



The young Brazilian boy doing the inaugural kick-off will be trained in Virtual Reality to control technology that will eventually allow him to kick the ball at the World Cup, thanks to a headpiece that detects brainwaves

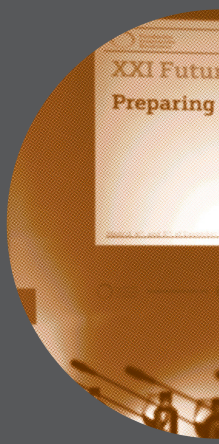
using hair-thin, flexible sensors that had been implanted into the brains of rats and monkeys. These sensors can detect electrical signals generated by hundreds of individual neurons distributed throughout the animals' frontal and parietal cortices. The young Brazilian boy doing the inaugural kick-off will be trained in Virtual Reality to control technology that will eventually allow him to kick the ball at the World Cup, thanks to a headpiece that detects brainwaves.

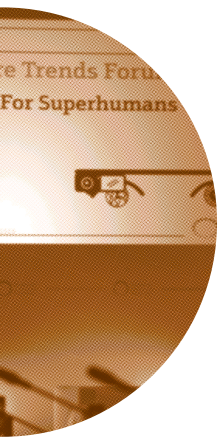
Opportunities for Spanish Companies

FTF Members tried to guess what opportunities will open up for Spanish companies in this segment. One very original opportunity revolved around how Spain is the perfect country to retire.

The potential tourism of super-seniors could prove very profitable. Could Spain become a destination for European retired elders to correct their age-related limitations with technological advances in good weather conditions? This makes a lot of sense, based on Ling's statements and his belief that the senior market is one of the biggest drivers for future anatomical capabilities.

Biological Capabilities





The movie *Limitless* portrays a writer, played by Bradley Cooper, who finds about some miracle pills, NZT, to redirect your life. Overcoming writer's block, learning with ease, remembering basically any input your brain received in the past…

A nearly magical drug that reflects a very common situation nowadays: finding solutions to any type of problem through chemistry.

Eddie Morra, the film's main character, faces problems common to most individuals. He overcomes them by changing his brain's chemistry. Time magazine analyzed the actual Science behind the movie and the possibility of actually developing this type of miracle pill.

On the one hand, the film is based on an incorrect statement: **the well-known myth that we only use 10% of our brain capacity**. It is an urban legend with its own Wikipedia page and many rebuttals. The truth is that we use most of our brain and we do so most of the time.

The late Barry L. Beyerstein gathered some arguments to shatter the 10% myth.

- **Research on brain damage shows that there is basically no area of the brain that maintains skills once damaged.**
- **Brain scans show that our brains are always active up to 45%, regardless of what we are doing. There is no part of the brain that doesn't work.**
- **Considering how much energy the brain demands (it takes up 20% of the body energy despite accounting for only 2% of its weight), Evolution would have long done away with excess parts. Pointless expenditure makes no sense.**
- **PET scans and MRIs monitor the brain's activity. They reveal how all parts of the brain are active, even when asleep.**
- **The brain uses different areas for different information processing tasks. There is no area without a purpose.**
- **Unused brain cells tend to degenerate. If we didn't use parts of our brain, we would be killing it slowly.**
- **Researchers use micro structural analysis to insert an electrode in the brain and monitor the activity of one single cell. If 90% didn't work, this technique would fail one in ten times.**

The ability to concentrate of Adderall users improves significantly. It is not uncommon for some individuals to seek prescriptions to take advantage of short-term benefits, instead of to solve a previous defect

But leaving aside the fact that this movie is based on a wrong concept—however many people are familiarized with it—the truth is that there are all types of therapeutic and recreational drugs to change how the brain functions. Even though there is no panacea as shown in the movie, some results portrayed by the movie seem feasible, albeit at a very high cost.

Over the last few years, the number of Adderall—the drug used against narcolepsy—prescriptions has tripled in the US. Symptoms are usually diagnosed under attention deficit disorder or depression in some cases. The number of monthly prescriptions in the US reached 14 million in 2011.

Neurobiology is receiving massive investments from governments because it is easy to sell: everyone has an acquaintance with a brain disease

The ability to concentrate of Adderall users improves significantly. It is not uncommon for some individuals to seek prescriptions to take advantage of short-term benefits, instead of to solve a previous defect.

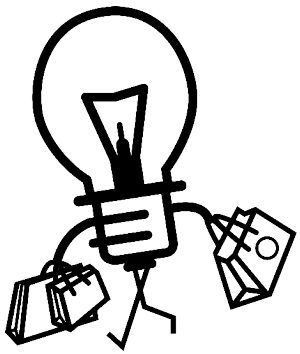
The truth is that biological capabilities are the mother of all superheroes. You only have to take a look at some precursors in this genre. The pulp hero Doc Savage, who became popular in the 1930s, had been raised to be extraordinary. He had extraordinary biological capabilities acquired through education and effort. Superman also dates back to that period. He obtained his biological powers from the exposure to our Sun.

To fight the forces of the Axis, comics gave life to Captain America, a superhuman created through a "supersoldier formula" that made a well-built fighting machine out of a feeble young man.

Hourman fought against the Nazis as well in a different publishing house. This colorful character obtained surprising, 1-hour-lasting powers from the Miraclo pill. This superhero grew in complexity and eventually became addicted to the pill, which compromised his life. Performance-boosting drugs have their limitations even in comic books. We will discuss this further in the chapter about ethics. Surprisingly, whoever tries to alter the competition by acquiring extraordinary capabilities via unsportsmanlike methods is systematically persecuted in the fight against doping.

Back in the 1960s, Stan Lee created the Marvel superhero mythology, in which characters had obtained their mostly biological capabilities through different means. Oftentimes they had been exposed to various types of radiation (Spiderman, Hulk, the Fantastic Four). But they obtained them genetically too. That is the case of the X-Patrol mutants.

The indomitable Gauls in the Asterix series drank a magic potion to gain superhuman strength (by the way, it was



The Board of the Flow Genome Project are working to understand exactly what flow states are many athletes or videogame players refer to it as "being in the zone", the optimal awareness state when humans simple work best

considered a doping substance in *Asterix at the Olympic Games*). Obelix was not allowed to drink any, since he had fallen in the druid's cauldron as a baby.

In *Ender's Game*, the popular novel by Orson Scott Card, the birth of the main character merely serves a purpose. In a future world with strict birth rate policies, authorities allow his birth because he is considered to have the necessary skills to destroy an invading alien army. Another book of the saga unveils that another character, Bean, was part of an experiment to equip a group of babies with augmented intelligence. The mad scientists achieved their goal, but in doing so, they had to drastically reduce the lifespan of the subjects. In a way, Bean had fallen into the cauldron as well.

A distinguished forum attendant, James L. Olds, directs the Krasnow Institute for Advanced Study, which is **strategically focused on the intersection between neuroscience, cognitive psychology and computational science**. Mr. Olds is an expert on the molecular base of learning and memory and son of the mythical scientist James Olds, who co-discovered with Peter Milner the reward system of the brain and the role of dopamine in the chemistry of pleasure.

"Think about surfers riding 100-feet waves. It is something human beings should not be able to do. A simple mistake may be fatal. Besides, the wave changes dynamically and the surfer must adapt. Super athletes do incredible things all the time and it is important to understand how they do it", explained Olds.

James Olds

Director at Krasnow Institute for Advanced Study - George Mason University

The scientist sits on the Board of the Flow Genome Project, which studies the neurobiology behind flow states. Steven Kotler and Jamie Wheal have co-founded the program. They are working to understand exactly what flow states are—many athletes or videogame players refer to it as "being in the zone", the optimal awareness state when humans simple work best.

An *article on Huffington Post* regarding this matter is supported by some interesting facts, such as a McKinsey study showing how top executives are five times more productive when they are in the zone. This simply means that if human beings were able to increase their time in the zone by only 20%, their productivity would double. It is impossible to spend the entire time in flow, because a state depends on a cycle, but we could be in that state longer, and in doing so, we could become capable of undertaking more complex, harder tasks.

This simply means that if human beings were able to increase their time in the zone by only 20%, their productivity would double

The Flow Genome Project intends to create centers to research and train on flow states. Kotler has already published two books on the zone, including *The Rise of the Superman*, his research with hundreds of extreme athletes. This research is obviously influenced by Mihaly Csikszentmihalyi's work, especially *Flow, the Psychology of Optimal Experience.*

But let us spend a moment on this scientist's description of 'flow': "Being completely involved in an activity for its own

The brain is the most complex machine discovered in the whole Universe. Besides, it is very slow, compared to computational circuits

sake. The ego falls away. Time flies. Every action, every movement, and thought follows inevitably from the previous one, like playing jazz. Your whole being is involved, and you're using your skills to the utmost."

"Neurobiology is receiving massive investments from governments because it is easy to sell: everyone has an acquaintance with a brain disease", says Olds. In any case, this field is in its early stages. It hasn't had an Einstein and it hasn't developed a full theoretical framework like Physics. "The brain is the most complex machine discovered in the whole Universe. Besides, it is very slow, compared to computational circuits. This makes it even more extraordinary, given what it is capable of. And it runs on low energy.

Olds imagines **a world where human brains will interact with machines, which will in turn interact with other human brains at the speed of thought and without a language interface**. What advantages would this type of tools offer? Scientific progress, for one. In a world where scientific disciplines have grouped in niches with their own jargons, thus hindering collaboration, using this type of tool without a language interface to destroy barriers is an idea worth entertaining, to say the least.

Santiago Ramón y Cajal

"Knowing the brain is like knowing the material course of thought and will, surprising the intimate story of life in its constant struggle against outer energies".

"When set to it, every man can become the sculptor of their own brain".

Javier de Felipe is a well known Spanish neuroscientist, leader of the Cajal Blue Brain project. The main axes of this project focus on the anatomical and functional microorganization of the neocortical column and the development of biomedical technology (basically computational). This project was the foundation of the European Human Brain Project, launched in October 2003. This scientist is involved in the European project as well.

His goal is to **obtain detailed biological simulations of the human brain and develop supercomputational, modeling and IT technologies** to carry out this simulation. It is a multidisciplinary approach engaging scientists from different fields.

In a way, De Felipe embodies the outcome of Spain's rich history in Neuroscience, initiated by Ramón y Cajal. He even worked for NASA, analyzing the impact of space travel on the brain. "We analyzed the significant change produced in synaptic connections of rats that had flown for two weeks. The change was permanent. This means the brain adapts to outer space. In a distant future with permanent space colonies, a new human species might be generated since their brains will change", he explained in this interview.

In a way, De Felipe embodies the outcome of Spain's rich history in Neuroscience, initiated by Ramón y Cajal. He even worked for NASA, analyzing the impact of space travel on the brain

During the sessions, he remarked how important it is to know the brain—a forest made up of millions of trees (neurons) with branches (dendrites)—to find the cure to disorders like Alzheimer of schizophrenia. What are the possibilities entertained by neuroscience regarding the evolutive change of the brain? De Felipe trusts brain plasticity not only to adapt to outer space exposure, but also to learn to write and read. To what extent do changes in the way we interact with the world and technology imply key differences in our project?

Juan Ruiz, Operations Director of the Spanish biological company Digna Biotech raised future challenges and fueled the discussion on ethics with suggestive and/or worrisome possibilities.

Javier de Felipe

Research Professor in the Instituto Cajal (CSIC) and Leader of the Cajal Blue Brain project.

"We can accelerate evolution", he said, in reference to how better genetic information could enhance our abilities. "This is the Stone Age of genetic augmentation. For the time being, it is not accurate or well-defined, but it provides a broad view of future possibilities", he said.

Ruiz imagined an environment where parents can choose increased capacities for their children, a type of selection that reminds us of Andrew Niccol's *Gattaca*, a film on the social risks of this type of genetic selection and the implications on human nature.

In a distant future with permanent space colonies, a new human species might be generated since their brains will change

Some applications on embryos raise all sorts of ethical questions, particularly because experimentation stages—with the logical failures of any similar process—do not seem acceptable. How many parents would let geneticists play with their embryo just to enhance their aerobic or intellectual abilities? Genetic changes in adults are a different matter.

Genetic therapy requires a vehicle or vector to transfer genetic material to a specific cell. Viruses are one method, since they have evolved to transfer their genetic material to cells and hence replicate themselves. It is as simple as doing away with pathogenic consequences of viral replication by eliminating some or all the genes of a virus and replacing them with beneficial genes. Non-viral synthetic vectors, or plasmid DNA, would avoid the immune system's response. They are less efficient than viral vectors but offer greater success possibilities when applied with electric pulses, ultrasounds, laser or magnetic particles after an intramuscular injection.

The videogame *BioShock* by Ken Levine was already mentioned on the exoskeleton section. Let us discuss it

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again, since plasmids play a significant role in it: the vending machines in Rapture, the underwater city, sell genetic upgrades that grant players all sorts of special abilities.

There is talk of genetic applications in doping that already seem viable and are inspired in other therapies. Genetic therapy has put its hopes in Duchenne's muscular dystrophy, or DMD, a hereditary disease that prevents patients from synthesizing dystrophin, a necessary protein for the muscular tissue. Victims are affected since childhood: muscular tissue—including cardiac muscle tissue—degenerates and life expectancy is reduced to barely 30 years of age. Considerable progress has been made to insert in the DNA of mice a normal, dystrophin-generating gene. Of course this is presented as a solution to a problem and it becomes a genetic augmentation possibility for individuals who want to increase their muscle mass, like some athletes or body builders. Blocking myostatin, the protein that inhibits muscle growth, also offers reasonable hope in muscular dystrophy and opportunities for those who never have enough muscle.

Digna works in a European consortium, AIPGENE, against porphyry. The Dutch company UniQure is part of this consortium as well. The later owns the global rights to the vector to be used in the first clinical trials. In 2012, this company was the first to be granted the EU approval of a product for genetic therapy: Glybera, using viral vectors to add to a

Juan Ruiz

Chief Operating Officer and
Medical Director at DignaBiotech

patient's DNA a lipid-processing enzyme—the lack of which may lead to severe diseases such as pancreatitis.

In general terms, **genetic therapy is progressing tremendously with trials for Parkinson's patients, some types of blindness, HIV, melanoma, hemophilia, etc.**

Geoffrey Ling, Deputy Director of the Defense Sciences Office at DARPA, explained how this office regards governmental investment in projects such as those in the framework of the Brain Initiative, promoted by Barack Obama's executive team.

"We believe the best way to make the most of research is to start with the goal, imagine the use-cases and challenge scientists to comply with them. Selecting the best scientists in the world, giving them the resources they need and setting a deadline to obtain results. And knowing from the beginning how this research will be brought to the general public", highlighted Ling.

Success will in part depend on how the reward system is reevaluated. "I'd love to see a young doctor purchasing a BMW or a Porsche and motivating others to follow suit. And doing so without taking our innovators out of their labs, forcing them to start up companies—for which they are not prepared sometimes—and maximizing the return on taxpayer money".

He believes there is great potential to develop biological capabilities, provided that they are focused on maintaining quality of life. "DARPA does not agree with augmenting abilities, but rather, preserving them and avoiding severe diseases. We are not comfortable with the idea of someone interfering with or directing birth a certain way", he highlighted.

He was just as clear about a NZT-like drug: "No drug is just one thing and that is why they are regulated. The perfect drug does not exist", he said right before reminding us that the average lifespan of an NFL player is 55 years.

Christian Macedonia, Program Head at DARPA, made a call to respect the DNA complexity and highlighted the importance of understanding it as a whole. "For the last 50 years we have been looking for a bad gene, but DNA is a very complex system, we must treat it with respect and humility. It

Blocking myostatin, the protein that inhibits muscle growth, also offers reasonable hope in muscular dystrophy and opportunities for those who never have enough muscle

Christian
Macedonia

Program Manager at the Defense Advanced Research Projects Agency (DARPA) in the Defense Sciences Office.

He believes there is great potential to develop biological capabilities, provided that they are focused on maintaining quality of life

is an orchestra, a symphony of genes. Our focus right now is to look for patterns, rather than individual genes. We are trying to understand how the network of genes works". Additionally, he said that DARPA is not focused on short term investments, but rather long term opportunities. "We'd rather invest on the foundation, on a combination of big biology and big data that we believe will be very profitable for companies".

And maybe even eternal life? Immortality is another biological superpower than mankind has daringly pursued, as portrayed by a myriad myths and legends. It has been so important in our fiction that many stories warn against inherent risks. In Jonathan Swift's *Gulliver's Travels*, the main character runs into some peculiar human beings, the Struldbrug, immortal yet not eternally young humans.

This type of character is constant and the categories are almost limitless. Some characters never die (such as the highlanders in the movie), others can regenerate (*Doctor Who*), others are not affected by life's troubles or sin (*Dorian Gray*), others reincarnate while preserving the traits of their conscience (*The Cloud Atlas*) and other obscure characters live for centuries (Stoker's Dracula being the best-known case).

Google leads one of the most original, real-life adventures in the fight against death. In September 2013 the informa-

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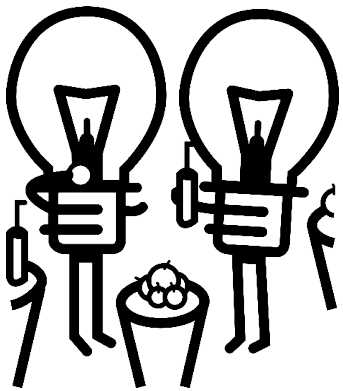


tion giant launched Calico, a company seeking to drastically extend life expectancy with extraordinary approaches.

In an *interview to Time magazine*, Larry Page, Google's CEO, even said that the cure for cancer is just shy of his ambitious goals. "I realized that even if you solve the cancer problem, you're just adding three years to life expectancy on average. When you step back and gain perspective, you see there are many tragic cancer cases and that it is very, very sad. But the truth is that it wouldn't be the great progress you would think". "In the long term, I believe we can enhance millions of lives if we think outside the box in healthcare and biotechnology. It is just impossible to think of someone better than Art, one of the main scientists, entrepreneurs and executives in his generation, to make it happen".

The new company, Google's bet against death, is lead by Arthur D. Levinson, chairman and former CEO of Genentech and chairman of Apple. Tim Cook, Apple's CEO, said of Levinson that "it is one of those crazy people who believes things just don't have to be that way", that the lives of our beloved shouldn't be cut short and their quality of life vanish.

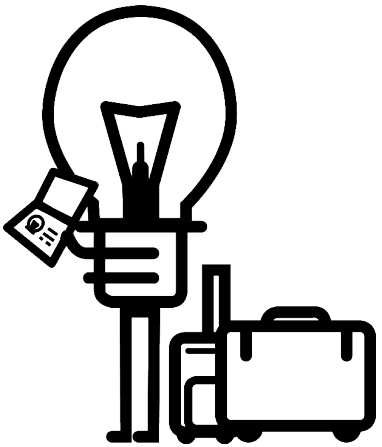
Opportunities for Spanish Companies

An article about leaps forward in genetic therapy, published by *El Mundo*, recently listed several genetic therapy trials carried out by Spanish companies and organizations.

In the article, Jesús Prieto, from the *Centro de Investigación Médica Aplicada* (CIMA) made a call to policy-makers to promote research in this field. **"Spain has a unique opportunity to innovate in biopharma and treat multiple diseases"**, he said.

According to the *Journal of Gene Medicine*, Europe ranks second (25.8%) in number of gene therapy trials performed, second only to the US (63.9%). The most chased-after disease? Cancer, with 1,274 trials worldwide.

The pharma and biotech industry has a long tradition in Spain. According to biotech companies grouped in the professional association Asebio, all the accomplishments of the last few years are running the very severe risk of disappearing. The turnover of Spanish biotech companies accounted for 2.98% of the GDP in 2008 and 7.15% in 2011, according to the latest data



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from this association. They underscored that employment grew by 23.7% in this time-period, up to 202,250 workers.

But Asebio itself recognizes a threat in the lack of financing—especially central and regional State funding.

This could bring about a doubly negative effect. First, no new companies would be created and second, companies with very slow maturations would be hindered: these companies had public support in their early stages but could even disappear, not because their business isn't potentially very profitable, but because many regional governments are not providing unwavering support. It undoubtedly is one of the problems ensued from leaving relevant decisions in the hands of regional governments, instead of designing a well-funded, proper national strategy. As is the case in other situations, this break-up does not contribute to create the ecosystem needed for this type of activity. Very few regional governments have been up to the standard. The Basque Country may be one of the few exceptions where bioscience is part of a strategy, not a dispensable whim.

If Spain wants to play a role in the world, one way or the other it must be linked to the activities described in these pages. Asebio's chairwoman, Regina Revilla, recently mentioned that biotechnology is "experiencing technological, demographic, economic and social change. Add the still-insufficient inflow of private capital to this scenario and you'll need the public Administration's support more than ever, because this

If Spain wants to play a role in the world, one way or the other it must be linked to the activities described in these pages

is the closest we've ever been to success... and to the failure of many projects that are technically and financially competitive, but that need access to funding, a stable, innovation-sensitive regulatory environment and the right incentives".

In short, now more than ever, this country needs this type of company—and any company dealing with the technologies we have discussed on these pages. We must lure talent and build an ecosystem where innovative companies can work comfortably. As Unamuno would say today, "Let others expand the frontiers of human abilities!" It is pointless to talk about *superhumans* or a *supermankind* if we cannot be a *supercountry* too.

Mark Changizi

Director of Human Cognition at 2ai Labs

One reliable way to make top scientists and technologists sound like your grandparents is to ask them about how contemporary advances will affect what it is to be human in the future. The just-revealed and on-the-cusp engineering developments – like today's exoskeletons, Google Glass, and ubiquitous computing – have a knack for sounding romantically futuristic. But…in a few years these sci-fi techs will seem no more likely to contribute to a future of super-humans than the invention of the "Electric Telescope" (an early name for "television"). We shouldn't get over-excited about new technology. They're simply new tools.

But there have been new technologies that are more than mere tools. These are the big ones, the rare gems, and they truly did transform us.They aren't invented by any person or company, and so we often don't view them as technologies at all. Instead, because they fit us so well and become so central to what we now are, we tend to believe they were part of our human nature all along.

The two most important examples of these super-human technologies are… writing and language.

We know we didn't evolve by natural selection to read (it's much too recent), but aliens would be surprised to learn this, given the degree to which we're effortlessly able to do it. But the reason we can read so well is not because we evolved for writing, but because – as I have shown in my research and book, The Vision Revolution – writing culturally evolved over time to fit us. Letters across human writing systems have come to be shaped like natural scenes, just the shapes our visual object-recognition system evolved to recognize. And in my book, Harnessed, I make a similar case for spoken language. …and even for the crown of the arts, music. In each of these cases – writing, spoken language and music – our brains are good at them not because the brain evolved to fit them, but because they culturally evolved to look or sound like now-uncoverable aspects of nature, so as to fit our brain.

Writing, language, and music are so central to our modern human identity that many scientists have, I believe, duped themselves into believing these are part of what it is to be genetically human. That we were designed by nature for them. That we have language and music instincts.

But they're not instincts. They're technologies, just not the run-of-the-mill technologies that Grandpa confuses as revolutionary.
Truly revolutionary, super-human-making, technologies do, then, exist. They did change who we are.

And, importantly, we now know how these super-human technologies do what they do to us. They "nature-harness" us, as I call it: they look or sound like facets of nature that we apes had already evolved over millions of years to process. These revolutionary techs are revolutionary only because they exploit the genius of natural selection's algorithms. Ironically, they raise us to super-human by fully embracing our human nature.

Now that we know the secret mechanism behind these technological gems, we can set out to design them on purpose rather than waiting for cultural evolution to blindly do the next one on its own.

And when we do it right, we'll feel as if we humans were always meant to have been doing it.

Informational Capabilities

1. Access to information through smart devices: phones, chips and wearable computing products

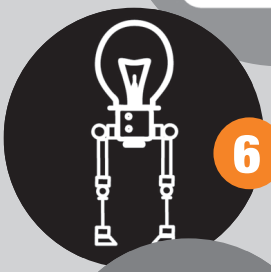
2. Smart interfaces to interact with devices around us (virtual assistants).

3. Smart systems that learn from and interact with human beings (cognitive computing).

4. Combination of augmented reality and sensors to recreate reality in a virtual world.

Anatomical Capabilities

5 Body-area networks made of tiny sensors integrated into our bodies to enhance and strengthen our capabilities.



6 Exoskeletons to enhance physical skills and help the disabled regain their mobility.

7 Prosthesis, particularly, developing sockets as an interface between the patient and the prosthesis to increase the control and neuro-skeletal connection to the prosthesis.

Biological Capabilities

8 Neuroscientific developments to augment our brain capability, achieving the optimal state of brain capabilities.

9 Genetic therapy to preserve health and avoid severe disease.

10 The combined use of medicine and technology to augment quality and life expectancy.

Ethics

The quest for the supermankind is brimming with all kinds of ethical hurdles. In reference to Icarus's myth, this is a clear warning of what mortals who aspire to become gods can expect.

Prometheus' myth suggests as well that helping improve human beings might be frowned upon. During the sessions, there was a lengthy discussion about the ethical risks implied by the technologies being analyzed. However, if we had to choose two discussion threads, they would be **the struggle between what is possible versus what is right** and the **capabilities that level the playing field versus those that give some—and not others**—an advantage.

Genetic Engineering

The first section clearly defined the red lines mentioned by Professor Antonio Damásio. Several speakers voiced serious ethical qualms in certain scenarios, mainly related to altering the DNA of fetuses in the pursuit of objectives other than normalizing them or curing a disease.

This position coincides with the thesis of the Catholic Church, which only approves of this type of intervention when they intend to preserve life, but regards with reluctance changes that involve additional advantages for the fetus.

In general, the scientific community agrees that genetically improving a human being's abilities beyond its predetermined abilities when still a fetus would involve several actions hardly acceptable from an ethical perspective. Before it yields clear advantages, it would require experimenting with many fetuses, which entails problems of all kinds. What parent would allow this type of experiment? What government would sanction the regulation? Dr. Frankenstein's experiments with corpses to breathe new life into its creature pale by comparison.

Of course, the problem is that no-one can guarantee that all

The scientific community agrees that genetically improving a human being's abilities beyond its predetermined abilities when still a fetus would involve several actions hardly acceptable from an ethical perspective

governments and scientists will abide by the rules. If the former German Democratic Republic won many medals thanks to doping, who can say that unscrupulous wealthy governments won't command superathletes genetically modified in-utero? We have discussed Bean from the Ender saga, by Orson Scott Card. His creation was the result of an exceptional situation and a Government's decision to do whatever was necessary to obtain the supergenius they needed. Is it such a far-fetched scenario?

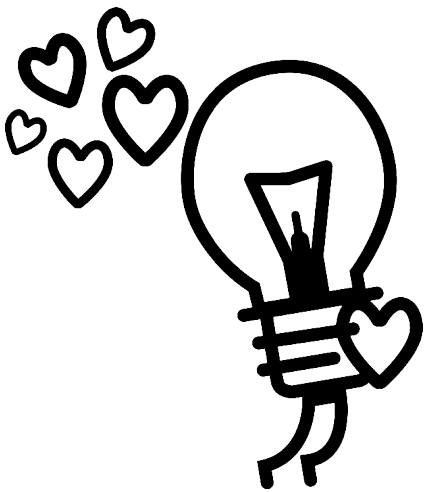
In-vivo modifications of a human being well aware of the risks are quite a different matter. A deaf person with cochlear implants regains normality, but his community considers him a dissident with superhuman capabilities. Those who undergo laser eye surgery will become superior human beings compared with the myriad short-sighted people suffering from astigmatism too.

We live in a society that punishes doping because there is an understanding that sportsmanship means competing in equal conditions against our peers. However, having been born free and equal before the law doesn't guarantee we will enjoy similar athletic skills. Pau Gasol, the Spanish centre player, is fitter than I am to play basketball. This difference is part of what makes us humans.

There is an excellent movie, Gattaca, directed by Andrew Niccol. It portrays the story of Vincent Freeman, a human being conceived naturally in a society used to eugenics and constant genetic profiling. In the movie, enhancements on human beings are not superhuman; they just maximize the result of the parents' union. Vincent's parents regretted having conceived Vincent naturally, because his genetic profile indicated there was a very real possibility of mental disorders and life expectancy barely above thirty.

His younger brother, Anton, was conceived according to the ruling normality.

A game played by both brothers summarizes the gist of the movie. They both swim as far as they can into the sea until they are exhausted. After a childhood marked by his genetic inferiority, Vincent successfully challenges his brother as a teenager. Years after, they meet again and race each other one more time. Vincent wins again. Anton simply cannot comprehend how that happened and Vincent acknowledges that he won because he didn't save any energy to swim back to shore. The overwhelming strength of his spirit of self-improvement, the desire to improve against all odds, the will to face the unknown and meet the stars were stronger than the obstacles along the way, genetic hindrances included. A poetic way of recognizing that the best of human nature does not lie in our abilities—augmented or not—but in how we face our faults.



A deaf person with cochlear implants regains normality, but his community considers him a dissident with superhuman capabilities

The poem If by Rudyard Kipling doesn't say that augmented abilities make us human. It urges us to "dream—and not make dreams your master" and "meet with Triumph and Disaster/And treat those two impostors just the same". "If you can force your heart and nerve and sinew/To serve your turn long after they are gone,/And so hold on when there is nothing in you/Except the Will which says to them: 'Hold on! (...) If you can fill the unforgiving minute/With sixty seconds'

A poetic way of recognizing that the best of human nature does not lie in our abilities -augmented or not- but in how we face our faults

worth of distance run,/Yours is the Earth and everything that's in it. And—which is more— you'll be a Man, my son!". You can well picture Vincent whispering those lines as he swam into the ocean, pursuing his dream despite the social belief that it was impossible.

Access to Superpowers

The sessions included as well a heated debate on the role of education in a world of advanced abilities. How far along can the full employment of our physical and intellectual innate skills take us on the road to supermankind? Isn't it peculiar to discuss *superhumans* when there is so much room for improvement in many areas based on the simple use of our current abilities?

Let us not forget inequality. Many technologies we have analyzed require sizeable investments. **The type of advanced prosthesis or exoskeletons analyzed at the FTF are not available, in the least, for the general public**, and very likely, it will be impossible to make them widely available in the short to medium term. *Elysium* describes a very likely scenario: part of the population receives universal healthcare and all sorts of support while there is a class of desperate workers with scarce resources and unacceptable economic, ecologic and lifestyle situations. In a way, it is already true.

But let us not rule out the ability of technology to permeate through different social classes. There was talk at the Mobile World Congress in Barcelona of the launch of actual

The type of advanced prosthesis or exoskeletons analyzed at the FTF are not available, in the least, for the general public, and very likely, it will be impossible to make them widely available in the short to medium term

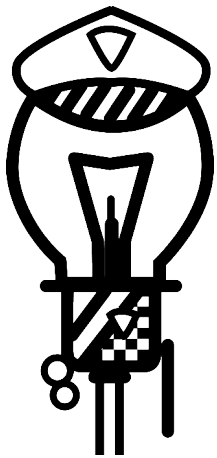
smart phones for $25 apiece in emerging countries. But even mobile phones running technologies now considered obsolete, such as SMS, on the ancient operating system Symbian, have had colossal impact in many communities. M-Pesa mobile money in Kenya has empowered many vulnerable villagers. Women save their money in their personal, password-protected phone, from where undesirable partners cannot steal it. Migrants avoid long, unsafe trips from the city to deliver money in their village. A simple wire transfer for us oftentimes means a long, unsafe journey for them.

In any case, the challenge of inequality is present in Western communities, where most citizens do not have (and will not have) resources to access certain augmented therapies or devices, and in rich and emerging countries. How can we reach the American dream of upward mobility or respect being born equal when children can be enhanced in different ways based on their income? Education used to be the great equalizer, but as our abilities and skills become dependent on devices, the exposure to similar stimuli will hardly yield similar results.

The book *The Time Machine*, by H. G. Wells, portrayed a world similar to *Elysium*, with privileged Eloi and underground Morlocks. The often scorned movie *Demolition Man*, with Sylvester Stallone, lays out a similar scenario. They are frequent in the literature and explicable in a world where some men were considered more human than others and men enjoyed more rights than women in some situations created by society.

Let us analyze how the already mentioned videogame *BioShock* brilliantly discusses some key concepts about supermankind. The first game unveils Rapture, an underwater city created decades ago by Andrew Ryan, a genius who invited others to join him in his precious underwater

utopia, with evident echoes of Any Rand's John Galt and deep ties to objectivism. "In the first game we were talking about genetic manipulation and objectivism tied together. You might think that's a strange combination, but we tried to thematically connect them in the sense that it's about people being these sort of supermen, looking at themselves as supermen, and then actually changing their bodies to reflect that, the intellectual superhuman-ness they had in their head", explains Ken Levine in an interview to New Statesman.



An interesting thought. **Are we pushing the limits of human abilities because we feel superior or we want to feel superior thanks to these new abilities?** In any case, his dystopia of a world exclusively regulated by the will and the genius of individuals is not very attractive.

They are frequent in the literature and explicable in a world where some men were considered more human than others and men enjoyed more rights than women in some situations created by society

Regarding informational capabilities, Spike Jonze's movie Her raises all sorts of questions on the ultimate meaning of our interaction with technology. It basically is an odd love story, but it is also a tale of dejection in a society that doesn't care enough to connect among each other. Theodore Twombly, portrayed by Joaquin Phoenix, accepts the love of a machine because it makes him happy and better. But a feeling of pity is sensed when he sees his peers interact in their own bubbles. It opens the question of whether his peers will regard him with the same condescendence. This movie

This movie strikes the chord of a classical science-fiction phenomenon too: technological uniqueness, a scenario where creating superhuman artificial intelligence drastically changes the way we understand the world and the human being

strikes the chord of a classical science-fiction phenomenon too: technological uniqueness, a scenario where creating superhuman artificial intelligence drastically changes the way we understand the world and the human being.

Transhumanism

Superhuman ethics cannot be discussed fully without mention to an increasingly prominent movement. This movement has spent considerable time and effort answering these questions and facing sharp intellectual criticism: Transhumanism.

Transhumanism has always been the opposite of Luddism or Amish Mennonites. This is an **international cultural movement with the goal of fundamentally transforming the human condition by developing technologies that greatly enhance human capabilities.** They strive to develop each and every concept discussed on these pages.

But beyond reflecting on capabilities, their paradigm rejects the idea of a constant human condition. They believe that innovations such as language, printing, medicine or computers have changed in some way what we are and what we do. These changes are nothing compared to what the future holds.

Their quest for posthuman—a human being with expanded capabilities—has stirred mixed attitudes. For some it reflects idealistic, brave and imaginative human aspirations. For others, it is one of the most dangerous ideas in the world.

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Francis Fukujama, opposed to the idea, made a sharp criticism of the movement in the magazine Foreign Policy. He points out some problems we have discussed here, such as equality. "The first victim of transhumanism might be equality. The U.S. Declaration of Independence says that 'all men are created equal,' and the most serious political fights in the history of the United States have been over who qualifies as fully human. Women and blacks did not make the cut in 1776 when Thomas Jefferson penned the declaration". He suggested as well what legal consequences could result from changing the human condition: "If we start transforming ourselves into something superior, what rights will these enhanced creatures claim, and what rights will they possess when compared to those left behind? If some move ahead, can anyone afford not to follow?"

In short, Fukuyama demands better understanding of what we are before venturing down adventurous roads. "We need a similar humility concerning our human nature. If we do not develop it soon, we may unwittingly invite the transhumanists to deface humanity with their genetic bulldozers and psychotropic shopping malls".

Nick Bostrom, founder of transhumanism, responded to Fukujama and insisted on how the goals of his movement hold individuals as ultimately responsible for their decisions. He warned of a threatening bioconservative agenda that would prevent human beings from improving their lives by enhancing their biological capabilities.

"Fukuyama's objection is that the defense of equal legal and political rights is incompatible with embracing human enhancement: 'underlying this idea of the equality of rights is the belief that we all possess a human essence that dwarfs manifest differences in skin color, beauty, and even

intelligence. This essence, and the view that individuals therefore have inherent value, is at the heart of political liberalism. But modifying that essence is the core of the transhumanist project.' "His argument thus depends on three assumptions: (1) there is a unique "human essence"; (2) only those individuals who have this mysterious essence can have intrinsic value and deserve equal rights; and (3) the enhancements that transhumanists advocate would eliminate this essence. From this, he infers that the transhumanist project would destroy the basis of equal rights", argued Bostrom to then discuss each of these points in depth.

Despite the occasional rhetorical overreaches by some of its supporters, transhumanism has a positive and inclusive vision for how we can ethically embrace new technological possibilities to lead lives that are better than well

The philosopher claims equality is not based on "the literal sense that all humans are equal in their various capacities, but that they are equal under the law". Therefore, augmented humans should be equally subject to the law. "There is no reason why humans with altered or augmented capacities should not likewise be equal under the law, nor is there any ground for assuming that the existence of such people must undermine centuries of legal, political, and moral refinement".

In any case, he recognizes the need to "worry about the possibility of stigmatization and discrimination, either against or on behalf of technologically enhanced individuals". Genetic discrimination was forbidden in the movie Gattaca, but it was a fact of life, as unfortunately is gender, race or sexual-orientation discrimination nowadays. "Social justice is also at stake and we need to ensure that enhancement options are made available as widely and as affordably as possible. This is a primary reason why transhumanist movements have emerged (...) Despite the occasional rhetorical overreaches by some of its supporters, transhumanism has a positive and inclusive vision for how

we can ethically embrace new technological possibilities to lead lives that are better than well".

The playwright Dorothy Marcic, professor at Columbia University, wrote a brief play for these sessions, presenting a specific scenario about the **risks of the superhuman condition.**

training

A 5 minute play

By Dorothy Marcic

CHARACTERS

Melissa: *late 20's, not socially smooth. Dresses in business casual. She is an aspiring actress.*

Kate: *Melissa's boss, late 30's. Head of HR at Amazon, at warehouse in Chattanooga, Tennessee. Dresses in formal business attire. She has high need for control.*

Kate: Come on in.

Melissa: I hope I haven't done anything.

Kate: No, don't worry. Just a few

Melissa: It's just that when Glenda asked me to come in, I got worried. I mean, I've been trying, but maybe

Kate: Nothing ominous, I promise.
[She is looking around on her desk]
[Calls offstage]
Glenda, bring me that folder we talked about this morning.
[To Melissa]
I thought I had it right here.

Melissa: You have a folder on me?
[Kate is rooting around some more]

Kate: Oh, here it is.
[Calls offstage]
Never mind, Glenda, I found it.

Melissa: It looks thick.

Kate: Let me ask you, Melissa, which training programs have you been to? You know, our company has been cited by *Training* before it went under a few months ago. --well, they said we were, are, on the cutting edge of employee development.

Melissa: Wasn't there something posted on the bulletin board? I think it was the week I had this big audition at The Choo-Choo Theater and I probably didn't really think about it much.

Kate: I hope you aren't expecting Amazon to subsidize your acting dreams, because you know how few make it in THAT world, don't you? But here, in the warehouse, we can offer you a great future in our bubble-wrap packing department. I assume

you've taken advantage of the incredible opportunities we offer in our training department.

Melissa: I've been to a couple. Maybe three.

Kate: MAYBE three? How long have you been here?

Melissa: Almost two years.

Kate: We expect our employees to have attended at least, I mean AT LEAST, six during that period.

Melissa: No one said

Kate: It's in the manual, Melissa.

Melissa: That 160-170 page thing?

Kate: Thing? You calling it a thing? Do you know how many people spent months, or actually, years, working on that publication. HR Bulletin rated it one of the top in the country.

Melissa: It's just a lot to go through. Very dense.

Kate: Dense is what you'll seem to the powers-that-be if you don't read it.

Melissa: I've been trying. But I have a lot on my mind. My agent says I need a new photo shoot.

Kate: Do you have attention problems or something?

Melissa: I'll try harder.

Kate: If you want to be successful here, you'll have to… You do what to be successful, don't you?

Melissa: That's why I work so hard. I…

Kate: Because if you don't, we have the slow track

Melissa: I've got a lot of bills to pay and I want to do a good job, Kate.

Kate: [Clears her throat.]

Melissa: I mean, Ms. Stoaker. I am not interested in anything to do with slow.

Kate: I didn't think you were, Melissa. But what conclusions can I draw from your lack of attendance at sufficient training events? And your unwillingness to read the manual?

Melissa: I guess I really didn't understand it was so important.

Kate: So, I take it you won't object to me signing you up for a communications seminar. I think that's the one you need the most right now.

Melissa: I've already been to one, but I can go to another, if you think I should.

Kate: If I think you should? Can't you see that you've not been listening properly around here? Or it is that your mind wanders?

Melissa: You mean, like "monkey mind"?

Kate: You calling me an ape?

Melissa: No, it's just a figure of speech.

Kate: We don't take kindly to derogative name-calling around here. I'm also going to sign you up for our diversity training program.

Melissa: Sure, Great.

Kate: You know we've been voted one of the top companies with competent employees by Human Resource Executive. You don't want to be the cause of us falling to the bottom of the rankings, do you, now?

Melissa: No.

Kate: You know, I like you, Melissa, and I can see myself in you. Just think about what you could do if you set some realistic goals. Give up your pipe dreams and commit to Amazon, so you can be part of the future. But you've got to focus, young lady, or you'll never get anywhere. The best advice I ever got was from my manager when I was first starting out at the company, back when I worked in Seattle, before they transferred me to Chattanooga. Chattanooga! But I digress. My manager told me I was too distracted and suggested I get some help.

Melissa: You mean go into therapy or something?

Kate: More like chemical therapy.

Melissa: Huh?

Kate: I've got the name of this very discreet doctor, just across the border in Alabama—you know how easy it is to get prescriptions in the South. Anyway, here's his name. You do this right away, you hear?

Melissa: Is this legal?

Kate: You haven't exactly been popping the bubbles around here, if you know what I mean. This is your one chance, Melissa, and I can almost guarantee you'll be on the fast track.

END

After reading the play, the speakers proposed different scenarios, many of them revolving around how to integrate superhumanity in our everyday lives.

In comic books, superhumans have generally been isolated from the rest of society. Some wore masks, like Spiderman—'great power entails great responsibility' is a hallmark of superhero ethics—or Superman, who couldn't play football in high school because it wouldn't be fair. Captain America— the superhero created by men through very genetically intrusive methods—experienced happy times as a comic draftsman in his native Brooklyn.

Other characters excluded themselves voluntarily, like the mutants in Patrol X, who lived in a world "that fears and hates them"—the truth is that Stan Lee always saw in the mutants a tool to analyze inequality at a time when the struggle for civil rights in the US was fierce. Even the Fantastic Four, with public and open identities and powers, lived in a bubble, the Baxter Building, the only place where they could live as a relatively normal family.

The community of wizards and witches in Harry Potter lived hidden away from humans. Same applies to the Shadowhunters saga. When Tony Stark acknowledged to being *Iron Man* at the end of the first movie, his shameless step out of the super-closet surprised everyone.

In the first pages of this report, we discussed how a certain type of fiction involving augmented capacities was increasing in popularity. Interestingly, it brings an implicit warning about what expects the man who approaches the status proposed by transhumanism. There is no ethical discussion, no moral objection that has not been previously discussed in film, comic books, TV series or science-fiction books. They offer many answers to questions that we are just starting to ask ourselves.

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