BIONIC APPLICATIONS AND THE LIFE EXPERIENCE

STRAIGHT TALKING BY

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EXECUTIVE SUMMARY

Despite the immense technological advances in artificial intelligence (AI) and robotics, James Young explains how the most intelligent prosthetics are not yet able to outperform the features of the human body.

Furthermore, you are entirely dependent on the shelf products and whether you as an individual fit into the expected mould to be able to make use of both the hardware and control systems.

On the other hand, able-bodied people have very advanced organic equipment factory-installed, and James Young cannot see a point where it would be a fair or equitable trade to electively replace it with alternative abilities.

He sees Brain-Computer Interfaces (BCI) as the next step to support disabled people (e.g., those with spinal cord conditions and amputees), in which he can picture a world of connected equipment including technologies such as exoskeletons and mind-as-controller First-Person View (FPV) remote robotics.

Importantly, James Young considers a civil rights approach to disability, identified as the Social Model of Disability. If modern life was set up in a way that was accessible for people with disabilities, then they would not be excluded or restricted.

But current society tells us something different. James Young explains how accessing the best current prosthetics is still considered a luxury and attainable only if one can exchange a high five-to-six-figure sum for the privilege.

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Bionic Applications Shall Enhance Our Life Experience

… but do they now?

I am a prosthetics user.

What I **want** that to mean is that the functions of my missing organic limbs are almost completely replaced with bionic appliances at the absolute cutting edge that modern innovations and leading minds in medicine, engineering and design can offer.

But what it **actually** means is that I have what humans currently offer to a market where the only customers are amputees.

It's worth keeping that in the back of your mind that the prosthetics humans can access right now are off-the-shelf commercial products, and therefore designed with all the associated limitations like profitability and planned obsolescence.

Because they're designed and sold to make money, they of course have to be useful, and useful they are … quite useful, for many. But they are nowhere near the organic limbs they seek to replace.

– James Young, BBC Presenter and Model at Zebedee Talent (Double amputee, Scientist, Gamer, Technologist. BBC programmes such as Bodyhack: Metal Gear Man, Can Robots Love Us and Sex Robots and Us)

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1. Technology-enabled prosthetics cannot outperform the human body

You can use the same organic leg for countless tasks: running, walking, jumping, kicking, sitting, balancing, to name a few. Currently, a prosthetic leg focuses not on biomimicry of the limb itself, but on mimicking the output of that limb, one function at a time.

So, let's say someone wants to move forward, very very fast: we give them a running leg, using big carbon springs instead of feet. Often, these prosthetics can actually exceed the performance of an organic human body.

What's cool is that carbon blades are not only body-powered, initially, but in a way, they are also powered by falling, turning downwards energy into forwards energy, due to the geometry of the spring.

I have worn one myself and stepping on it felt as though someone shoved me from behind. It's incredible!

Extra muscular activity is needed to maintain that in normal lower legs, but you get a propulsion boost from the right running blade.

An athlete's challenge is moving these fixed blades rapidly back to the most advantageous position.

This is still an incredible task of endurance that sees the VO2 Max (maximal oxygen consumption or breathing and energy use) be as high as the world's best able-bodied athletes.

But the story changes dramatically if you want to do almost anything else wearing those blades.

If you get an athlete wearing two of these blades to go bouldering or climb a tree, in some cases even walk downstairs forwards, or walk down an incline, without muscles, heels and ankles, dynamic joints and pressure and position sensors of the flesh, they will suffer the inadequacy of the design for this task.

Simply put, increasing, or providing alternative abilities for the body currently comes with drawbacks. When all is added up, we do not have the physical technology to outperform every feature of the human body.

What would be the tipping point? What would be the average or net benefit that tips societal uptake of bionic replacements? Would you take 130% of the running ability of the world's best athlete if it meant you couldn't walk along a beach without sinking and getting stuck?

I can't tell you how much mental energy it takes to walk across wet shiny shopping mall floors without having an ankle!

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2. Bionic Replacements Markets for Body Enhancement

There is a market for body enhancement. That is evident by the health hacks and diet trends that you see everywhere on social media. However, whether people want to take real action upon their own health or just spend dollars to have an appearance of health is another question.

In a world of curated existence, maybe we'll have ever-expanding peacocking of people upgrading limbs beyond their means and necessity - it is a human trait to do so.

And one I find very understandable! One of my favourite arm parts for functionality is the one I consider least attractive… and so I tend not to post images of myself wearing that device… I wish it looked cooler. It's a fact of biological life that real improvements to your physical health and abilities take time, effort and consistency. By and large, the reason most of us are not elite athletes is that we don't rate the cost-benefit of that intense effort as worthwhile.

Augmentation of the mind's abilities is traditionally done by consistent training and practising skills until they're perfect. But a much more attractive proposition would be downloading skills from the matrix on a Neuralink connection.

So, it appears to me that the allure of being a technical mechanical human being stems from the immediate or rapid expansion of abilities with minimal effort. Whether we use our expanded abilities once we have them is another question.

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When you are shopping for body parts off the shelf, you are also entirely dependent on whether you as an individual fit into the expected mould, your body's size, and muscle signals, to be able to make use of the hardware and control systems. Though technologies like pattern recognition are making this simpler for some people.

What I find hard to break down in my mind is the transition, or the jump, between developing these technologies for disabled people and jumping to the able-bodied person.

As someone who has had multiple surgeries, I have direct experience of the fact that any working material you have remaining that's originally connected to your central nervous system and brain is incredibly valuable. This is a set of equipment that has been in A-B (and C-and-D-and honestly there aren't enough letters in the alphabet) testing and development for more than 360 million years, and upright apes have refined bipedal locomotion for 4 to 7 million years.

That's a little bit more development time than the bionic tech developed by small groups of humans in the 21st-century. Not to discount their work, they are making progress, but they are children's drawings of limbs in comparison to the detail of biology.

Able-bodied people have very advanced organic equipment factory installed. I cannot see a point where it would be a fair or equitable trade to electively replace it with alternative abilities.

The intervention of virtual prototyping by machine learning, AI systems, and iterating hardware for the real world may see this happen, but I doubt it will be for hundreds, or up to thousands, of years.

With carbon blades, the strength, speed and endurance of the body are in question, but the nervous system is not. Undamaged, it's the most valuable part of you. The fidelity of the link to the Central nervous system (CNS) and brain is too useful to throw away.

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3. Future innovations will come from Brain-Computer Interfaces (BCI)

Non-destructive Brain-Computer Interfaces (BCI) are the next step. Accessing and supplementing the experience of the able body with neural decoding and response. I can picture a world of connected equipment including exoskeletons, mind-as-controller First-Person View (FPV) remote robotics, especially for work in polluted cities.

Everything else is getting ready for excellent technology. When I lost limbs 8 years ago, Boston dynamics were still using fossil fuel to power their human-scale robots. But they're now using modern, advanced batteries, the same battery tech that now drives lighter and more precise prosthetic hands. Hands with better microelectronics and motors, able to articulate and behave closer and closer to an organic hand.

But getting natural intuitive and 100% reliable control of limbs is the missing piece of the puzzle, and sorely needed. Ironically, I don't believe that the innovation will come from prosthetics but from the work into Brain-Computer Interfaces (BCI) for able-bodied people.

My personal view is that what humans have is already really good. Our biological machinery is resilient to so much that could see a robot corroded and in repair for weeks.

Technology is going to try and keep us fresher for longer. Preserve us past our expiry date. But it's a big jump to go mechanical.

Things like gene editing may seem more futuristic, but in my opinion, are more realistic.

At the point in people's lives where they'd seriously consider replacing their organic parts with mechanisms, they are probably not going to be resilient to the stress that change would place on them. Perhaps with Brain-Computer Interfaces (BCI) you may better support your ageing body with external robots, instead.

Brain-Computer Interfaces (BCI) needs testers though. No doubt it will be licensed first in those with things like spinal cord conditions, and later amputees. At least for these people who have experienced chronic disease and illness, we might be able to have some fun exploring the hardware of super-powered arms, testing the limits of what a human body can, locally, consist of.

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4. The Social Model of Disability's Challenges

After my accident, and losing two limbs, it was disheartening to realise the majority of the most exciting ideas about bionics were inaccessible today. What is available outside and inside of research is incredibly clunky. Incredibly financially limiting. The ticket price of regaining moderate bionic function can be on the scale of a premium vehicle to the price of a house.

You might be familiar with the Social Model of Disability:

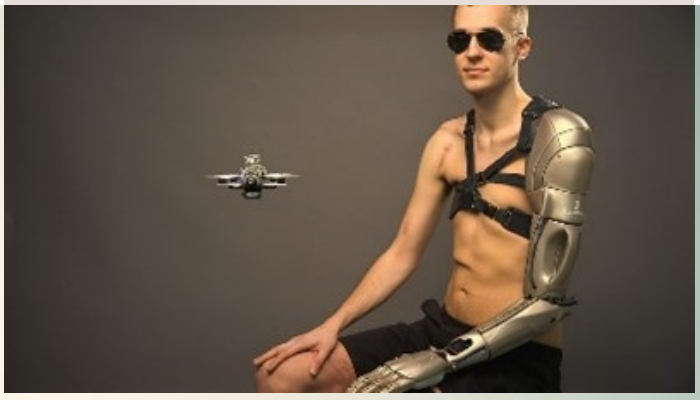
- It concerns the fact that disabled people are not disabled by their minds and bodies, but by the society and world in which we all live.

INSERT: The Social Model of Disability is a civil rights approach to disability:

What makes someone disabled is not their medical condition, but the attitudes and structures of society. If modern life was set up in a way that was accessible for people with disabilities, then they would not be excluded or restricted.

At the moment, society is telling me that accessing the best current prosthetics should be considered a luxury, attainable only if I can exchange a high five-to-six-figure sum for the privilege.

And because those sales do happen, there seems to be a paucity of incentive to make the prices accessible or to turn research towards the profoundly innovative rather than the solidly profitable. The UK is historically risk-averse in this area, but it will be the high-risk investment strategy in brain-computer interfaces, prosthetics and robotics that results in the most pronounced changes to the quality of life, and the most exciting applications for the industries that can afford a high return on that investment.



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