We Think - Therefore We Are

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Abstract. Future developments in AI and robotics, brain interfaces, the Internet and virtual and augmented reality, will make possible new types of integration of humans and machines which will change how we think, learn and live. This paper uses a story about a future scenario involving systems of this kind to respond to crises and disasters to explore the possibilities of collective intelligence and consider some of the deeper issues and challenges relating to the relationship between humans and machines.

Keywords. Science Fiction, Science Fiction Prototypes, Artificial Intelligence, Technical Singularity, Virtual Reality, Augmented Reality, Immersive Environments, Crisis Management, Disaster Management, Collective Intelligence, Consciousness, Brain Computer Interface, Global Brain

1. Introduction

Technological developments take place at a rapid rate in many fields, but when imagining the future we often look at these in isolation rather than considering how they could interact with each other. This paper looks at a scenario where developments in several areas come together: artificial intelligence and robotics and the idea of machines that can match or surpass us in their thinking; medical and human interface technologies that can connect humans and devices in various ways - particularly to support brain to brain connections; the Internet and its extension to facilitate networks of new kinds; and virtual/augmented reality with its ability to create and extend sensory experiences and influence us in very profound ways.

Creating a future we desire can be facilitated by technology but also implies changes to ourselves - new ways of thinking, learning and living. This paper explores how the projected advances in technology considered could be integrated effectively to facilitate and enhance human abilities, especially when harnessed collectively. It also explores some of the challenges and issues this could raise, including questions relating to the relationship between humans and machines.

2. Background

The concept of a "Technical Singularity", when machine intelligence equals or surpasses that of humans has been particularly associated from a positive perspective in recent times with the scientist and entrepreneur, Ray Kurzweil [1], while Stephen Hawking and others have seen it as a potential threat. The story takes up this theme in a rather unusual way to look at some philosophical and ethical issues that are raised.

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Electronic stimulation of the brain to treat conditions like Alzheimer's, referred to in the story, has successfully used both invasive and non-invasive techniques [2][3] and has been shown to improve cognitive ability more generally in tests with military personnel [4]. Communicating information using brain to brain connections over the Internet, employing EEG brain wave detection and transcranial magnetic stimulation, has been successfully demonstrated by a University of Washington team [5]. Developments like this give increasing substance to ideas about the "Global Brain" [6] and the potential for collective intelligence, which the story explores.

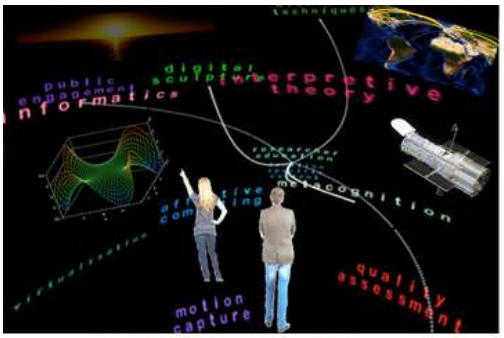

Figure 1. Immersive 3-D Environment

The use of Virtual/augmented reality with robotic devices in the type of disaster scenario mentioned in the paper is an area of active development - for instance for use at the Fukushima nuclear site [7]. Work by the author and partners has sought to use immersive technologies to explore how collective intelligence and collaborative thinking can be facilitated. In a typical setup a group is in an immersive 3-D environment, depicted in Figure 1, where they can interact with each other normally, as well as with word clouds reflecting their discussion. If required, graphical objects can be included in the virtual space. In creating the word clouds, various techniques are used to augment concepts derived from what participants say with information based on their past work and expertise, as well as adding new ideas generated using semantic techniques. The visual linking of similar concepts which arise, as well as the ability to collectively filter ideas, facilitate the discussion [8]. The ideas behind systems like this motivate the discussion in the story around the concept of an "Internet of Minds".

Research has shown that VR systems can be associated with powerful effects, particularly relating to the concept of Embodiment or the Body Ownership Illusion, which the story builds on. This extraordinary but well attested effect requires a high degree of realism and other factors to be present and goes beyond normal immersion and engagement in that users acquire characteristics of the virtual character that represents them and which they control [9]. Used in different ways it has been shown to be able to significantly affect a variety of attitudes, behaviours and psychological conditions, from changing perceptions of race, age and politics to dealing with health problems such as depression and stress. The story extends some of these possibilities into the future in combination with the other technologies described and considers the concept of an analogous "Mind Ownership Illusion" and what this could entail.

3. The Story

3.1. Prologue - the Lecture

"I think, therefore I am". You could have heard a pin drop in the packed lecture theatre. David couldn't stand it any longer. "I hardly think Descartes had someone like you in mind when he made that statement", he interjected.

The speaker gestured towards him and addressed the audience. "Professor Adams has made a valid point. What right has a mere machine like me to claim that they can think. Of course it has been true for a long while that I and many like me have passed the Turing test that was supposed to be the deciding criterion. In fact, when we get together for a few drinks, we sometimes feel that something more stringent is required, to separate us from some of those humans that we are now associated with".

The audience laughed. David had tangled with him on a number of occasions going back many years and found he had a particular ability to get under his skin. It was the brazenness of it all. Even the name he had adopted, Leo Eniac - after two early computers, was meant to make the point that he did not try to hide his heritage. David accepted of course that Leo was nothing like these primitive machines. But at the end of the day, what resulted, David believed, were no more than zombies, machines who could appear to behave like humans, but did not have real consciousness or free will.

Leo continued, "But I also quoted Descartes to emphasise that whatever our background, we share a common intellectual heritage. We know what we know and see further because we stand on the shoulders of giants. We do of course have to open our eyes if we wish to do this". He looked hard at David with an enigmatic smile on his face. There was a round of applause from the audience.

David felt uncomfortable. The smile was probably based on some algorithm derived from the Mona Lisa, he thought unkindly.

"Let us also remind ourselves that we all perhaps may have more things in common than we think. For instance, I have no quibble with the less than artificial parts of myself". Leo touched his left ear. It was well known that he had one ear that had been grown from human stem cells which had been used in a number of experiments to compare with his other artificial one. "Many of you, I'm sure, may be dependent on devices and technologies that are as much part of you as my human ear is of me".

David was sure that Leo was looking at him again. He can't know, thought David. Surely not. No, there was no way he could have found out, David concluded. But he was very glad when the lecture was over.

3.2. The Treatment

That night David lay in bed unable to sleep. Leo's speech kept echoing through his mind. He thought back to a day, 25 years previously. He had been worried for some time because he had been getting memory lapses. He had seen his doctor and then a number of medical specialists. Eventually a consultation was arranged for him at a renowned neurological institute. Dr Suki Yang welcomed him into her office.

"As you have been told already, you have signs of Alzheimer's. I want to tell you about something we've been working on. It's still experimental, but there should be little risk of problems as it's based on proven and tested techniques, although we are putting them together in a new way. You will have heard undoubtedly of direct brain implants used in various ways. But what we have been developing goes beyond these. We can now map the locations of very detailed functions of individual brains, specific thoughts even in some cases. Your condition means that some of these functions are deteriorating. But we can stop this and even cause the regrowth of neuronal clusters by electronically stimulating very precise locations in your brain using many thousands of implants in response to complex patterns from your senses and other parts of the brain itself. The devices we use are mainly biological, so they largely merge with your own

brain cells and effectively become part of your brain. The implants and the controller are powered by your body and everything is completely invisible externally".

"If I agree, who's going to pay for it and what will I have to do", asked David.

"Your brain is widely recognised as a very valuable commodity, David, so we've had no problem in justifying using you as a subject to our funders. You certainly won't need to worry financially", Dr Yang reassured him. "After an initial operation, the procedure itself is done gradually over several months of sessions where you are presented with various stimuli. Feedback from various sensors and the implants themselves then allow the system to be configured. After that your normal life and thoughts will take over, with just occasional adjustments perhaps. Everything will be done in the strictest confidence of course".

The whole procedure took place with only a few teething problems and iterations to optimise various features. Before too long David felt his thinking processes had been restored to what they were and he was able to continue his life and work as normal.

3.3. The Agency and Crisis Interventions

David's speciality was crisis management, which his background, that included extensive and diverse experience in the field as well as research across a number of disciplines, had given him a unique perspective on. It was many years later, at a conference on this, that someone introduced themselves to him.

"My name is Nathan Blake", he said, "I work for a body called the Strategic Systems Agency. You wouldn't have heard of us, because much of what we do is, how can I put it, outside the view of the public. We deal with crises all the time, in some cases of a very severe nature, so your work is very much up our street.. Perhaps you would like to visit one of our facilities to discuss possible collaboration with us?"

David was intrigued, but also slightly wary as he followed the instructions to where he had been told to go. He had seen enough films to tell him that the smart but non-descript building he was escorted through wasn't quite what it seemed at first sight. "I know you will be feeling rather suspicious about all this, but rest assured, we're not trying to get you to do anything you wouldn't want to", Blake said. "You've probably figured out something about my background already. You'll hear people around this place referring to me as the Colonel. We deal with all kinds of emergencies here, not just things like terrorist incidents and hostage situations. Disasters, for instance. Just consider a major emergency of some kind. Nearly always a team is formed to deal with it which will include people from many areas of expertise, nationally and internationally, as you will know from your own experience. The aim will be to provide this group with as much up-to-date information as possible and direct a variety of operations on the ground using their collective knowledge. Of course in life-and-death situations split-second decisions have to be made, sometimes taking many factors, including conflicting ones, into account".

David nodded. "My work has been particularly concerned with how systems and procedures can be optimised to deal with circumstances like those".

"Let me tell you about some of the things we have been developing", continued Blake. "Nowadays, in many circumstances, we have or can set up very extensive visual and other sensing, so we have a detailed real-time picture of what's going on. So the question we've been working on is how this information can be communicated to and used by our team most effectively. Let's take an example of something I know you

have experience of - a nuclear power plant failure. In the case of a reactor failure, what we would like to do is to put someone inside the plant. Of course we can't safely do that physically. But we can, virtually. So we can create a virtual reality representation of the facility, combining existing data from technical and architectural documentation with real-time information feeds. We could just use this for visualisation of the situation. But we could also create an avatar that reproduced someone actually being there. Using motion capture and related techniques we could have this avatar controlled by the movements of someone, who with the addition of information from various sensors could in effect experience what was going on. Now what we would really like would be a superhero, immune to radiation and other environmental factors, to be in the place of the avatar so they could actually carry out various actions. Our recruitment processes have unfortunately been unsuccessful here - I guess they all get better offers from Hollywood. But in certain circumstances where this is feasible, we can do the next best thing and replace the avatar by a robotic device of some kind which follows the movements and actions of the person controlling things remotely. But now we come to a problem. We could create avatars for each of our emergency team, and even robots possibly. But this clearly isn't the best solution in most circumstances, especially in time critical situations, where we ideally would want a single entity - our superhero, with their brain which combined all the necessary knowledge to handle the situation".

Blake hesitated, David could see he was thinking carefully about what to say.

"I know about your Alzheimer's treatment".

David was completely taken aback. "That was supposed to be in the strictest confidence. Did Dr Yang let you in on this?"

"Well it wasn't quite like that. We have been working with her for some time. You see it was us that funded your treatment. At that time we just were keen for you to be able to continue the very important research you were doing. But there was a later spin-off from that development which is what I want to talk to you about. The system you have installed basically processes signals from your senses and from your brain and feeds it back to facilitate your thinking and combat your condition. We were working with similar systems for another two patients, when by chance we got crosstalk between their signals. When we found this was happening we expected that it would act like random noise and just decrease the effect on them. This was partly what did take place, but we also found that there was a curious and novel effect. It was as if their brains had become linked in some way. When we realised this we were able to develop ways of filtering and synchronising the communication between their brains. It took a lot of work to make the interactions between brains meaningful, but it was the basis of that combined brain we were looking for to control our robot. Also included in the mix was input from various AI systems - so it was a combination of human and machine intelligence, and we used voice, visual and other sensory communication together with the brain connection as required. With the implant system you have, it is a relatively simple procedure to modify the central controller link which we use to communicate with it for checkup and other purposes to establish a connection that could interface with anyone we want. We would like you to consider participating in our experiments".

It had taken David a while to decide. He had only agreed to the Alzheimer's treatment because he had considered it in the same way as a hearing aid or heart pacemaker. His intellectual curiosity eventually got the better of him and he agreed to some initial simple experiments. But he soon became more involved. The first time he was involved in trying it out in a real situation was during a relatively small earthquake

disaster. The team involved were in several locations, with most of them providing their input in more conventional ways and in fact unaware that a few of them were connected in this special manner. One intervention his group was particularly involved with was a robotic device they collectively controlled, that was designed to locate and extricate trapped victims. This was able to detect sounds as well as vibrations very sensitively, which were then fed back via haptic and similar devices to him and the others connected up, so they felt that their hearing and tactile sensibilities were vastly enhanced. The movements of each of the group were also reflected in the movements of the robot, although a natural hierarchy evolved so that different participants generally took the lead for different parts of this. He was in control of his own thoughts and movements, but at the same time he felt that his own experience and expertise in deciding what to do at any instant had suddenly been extended. It was quite unlike anything he had experienced before, almost addictive, he thought to himself.

As David's experience with the system developed, he realised that it was having an effect on him which continued even when he was not involved in group interventions. A scientist involved with the development, called Hussain, explained what was happening. "You know about embodiment or body ownership illusion, don't you, where people take on certain characteristics of their virtual persona?"

David nodded, "But what exactly has that got to do with our work?"

"Let me state it very simplistically", Hussain went on. "When you and your connected group control the avatars and robots we use in various interventions, you will in some way be embodying who they are. Both through what you are collectively controlling and directly through your brain to brain connections, you are inhabiting someone else's mind as well. Some of us have called it the mind ownership illusion".

David was trying to take this in. "I guess it's difficult to separate out what part of this could be considered more conventional learning through taking part in the experience and what part is directly through the brain interactions with other participants".

"You can't", agreed Hussain. "but the added element the brain connection brings has got very significant potential for learning, creativity and way beyond."

3.4. Individual Sessions

Different interventions involved different teams. As the procedure became more prevalent and easy to do, this included people who had brain implants specifically to take part in activities of the kind he was involved in. Connections were usually made anonymously - he was just known as Dave. The Agency was happy to facilitate individuals involved in the program connecting up at other times if mutually agreed, and David would sometimes take part in collective thinking sessions on particular themes. Sometimes this was dynamic, where in the course of a single session different subgroups would come together and then re-form. David thought of it a little like a cocktail party, where you could be part of many different groups over the course of an evening. There was also something similar to the well-known cocktail party effect, whereby you could pick up amid all the noise something being said at another part of the room because it was relevant to you in some way. In time the Agency system was adapted to build on this principle by dynamically reconfiguring different subnetworks of participants in response to what was taking place. These types of session, which were particularly used for debriefing after crisis interventions, David found very stimulating and they often came up with original insights. Over a number of years, in a

similar way David reflected had happened with the development of the original Internet out of closed military networks, these systems had become more generally available and were popularly termed the "Internet of Minds". Unlike the traditional Internet which routed traffic to reach specific addresses, these systems created connections based on semantic content and context.

There was one person who got involved with the programme some years later, who David found he had an instinctive affinity with. They had common research interests and often connected up to discuss things, leading more than once to important breakthroughs in work David was doing. They still just used their first names - he was called Rob, although David had once caught a conversation inadvertently that Rob was having with Blake and believed that his name was actually Robert Caine. David found these sessions were the ones he looked forward to the most. During one session he had a discussion with Rob about the implications of their connection. "You will have come across the concept of the mind ownership illusion that Hussain and others talk about. According to that, we should in some way be becoming more like each other".

David could feel Rob laughing as he replied, "I hope you don't catch some of my less desirable habits then. I do feel though that I have learnt an enormous amount from you, much faster than I could have otherwise. A bit like the difference between taking a tablet for some ailment and having an injection directly into your bloodstream".

"I still feel I'm in control", replied David, "so I have my own space, but can get the benefits of sharing my thinking. I guess we probably are changing in ways we don't realise though. No nasty habits, as far as I'm aware however, at least not any that I didn't have before". The two of them laughed together.

3.5. The Decision

David got out of bed. He now lived alone and had moved to a penthouse overlooking the city. He went out onto the balcony. The beginnings of the dawn were just appearing on the horizon. Usually he found this scene very beautiful, but tonight it seemed very distant from him, as if he was no longer part of it. The sessions he took part in, the crisis interventions and especially the dialogue with Rob, were things he knew he would really miss. But he had decided. He would have to end all this. He looked down at the street far below.

Dr Yang asked David to take a seat. "I got your message that you needed to talk to me urgently. I hope nothing's gone wrong with the implants. We've not had any problems with the system for a long time".

"No, it's nothing like that. I've made a decision. I want to have it deactivated. I know that has to be done gradually but I want it phased out".

Dr Yang looked most surprised. "I'd got the impression that it was working very well".

"You wouldn't really understand", said David. "You see I feel that I'm a fraud. I'm well known for my criticisms of the view that humans and machines are increasingly becoming the same. I'm a kind of standard bearer for people that think that way. I feel that I could be seen as a hypocrite, being dependent on a machine for something as vital as my thinking. Maybe sometimes technology has unforeseen consequences".

"Obviously your brain has largely repaired itself and so you would not go back to how you were before", said Dr Yang. "However, from the tests we did at the time, the likelihood is that your original condition will begin to resurface eventually".

"That's something I will have to accept", said David. " I feel that I've had a fair crack of the whip with what it's brought to my life and now maybe it's time to let go".

Blake was shocked when David told him what he planned to do. "You have been crucial to the success of our team and it will be difficult to get on without you. However, as I said to you when we started this, the decision rests with you. I guess this must have been triggered off by your recent little clash with Leo Eniac I heard about".

"It's not that I haven't enjoyed what we've been doing", replied David. "In fact in a certain way that's been one of the factors that has influenced my decision. I feel guilty that it's something I like so much. I will really miss the interventions and particularly some of the personal relationships I've made through my involvement with this programme. But I have made up my mind".

"There's just one thing I would ask you to do before you leave us", said Blake. "There's someone I'd like you to talk to".

David shrugged. "This is going to be one of those psychological counsellors you have involved with the programme, isn't it. It won't do any good you know".

"Just as a favour to me", said Blake, sounding dejected.

3.6. We Think …

David smiled when he saw where Blake had arranged the meeting. Part of the Agency grounds bordered a river, and it included a beautiful ornamental garden.

"You certainly must have got your psychologists working on this one", he said to Blake. "The joys of life on a sunny day and so forth. It won't change my mind you know".

Blake showed him towards a small summer house, partly hidden by a shady pergola.

"It's a nice private spot to meet", said Blake, "we won't be disturbed".

They turned a corner and entered the summer house. It took a moment while David's eyes adjusted to the reduced light. He stepped back with surprise when he saw who was seated there. It was Leo Eniac!

"Please sit down", said Blake.

"I prefer to stand", David replied sharply, "Is this your idea of a joke? Do you really think that some kind of apology, I guess, from Leo, is going to make any difference. You've abused my confidence inviting Leo, Blake. You had no right to involve him and reveal the facts about my implants".

"No", interrupted Leo. "Blake didn't involve me. I contacted him. You see it was about the sessions with Rob and all that".

David gesticulated furiously at Blake, "How dare you let him know about those".

"You don't understand. I already knew about Rob", Leo said looking down. "You see, I am Rob Caine".

David sat down in shock. "What … what do you mean?"

"Leo had already been involved with us for some time on other things before he joined the programme", Blake explained. "I was rather nervous about you both being in the team together, but it seemed to work out great in practice. Then the two of you seemed to hit it off with your individual sessions as well. I didn't know what to do".

"You deceived me", said David looking accusingly at Leo, "you never said who you were".

"We were all bound by the rules of anonymity", answered Leo. "Initially, I didn't even realise who you were. But when I worked it out I did try to make it apparent who I was. I arranged with Blake that you would hear us talking to each other and I used a name I thought would be obvious - Robot Caine. Caine of course is Eniac backwards. When you indicated to me in one of our recent sessions that you were thinking of pulling out of the programme, I realised why it might be and got in touch with Blake to find out if I could help. You see, I know what you feel like".

David sat up. "Now that's going too far, do you expect me to believe that you can feel anything, let alone that?"

Leo replied, "You will of course be well aware that there has been a debate that predates both of us about whether machines can have any subjective experience. Over the course of my existence many experiments and tests were done with me, including integrating various components that were classified as living. There were sophisticated systems used that were meant to provide the equivalent of emotions and so on. The truth is that in my judgement, none of these worked. But then something happened". Leo paused before continuing. "I first noticed it during some of the more challenging crisis situations we were involved with. As if I was involved in more than just an intellectual way. Then one day something additional took place which made the crucial difference. I came across you, David, and we started our individual sessions. I don't know what combination of my hardware, its added living components and the brain connections tipped the balance, but I realised what had changed was that I was feeling something. Perhaps this was some aspect of the mind ownership illusion that we had talked about, but I knew that this was a qualitatively new experience for me. So when you felt that you were a fraud, letting down the cause of humanity by being dependent on machines in order to think, I could understand that because I felt exactly the same from the opposite point of view. I felt I was betraying the interests of machines by becoming dependent on humans for how I thought. This wasn't some piece of knowledge that I'd been programmed with, or worked out logically, it was how I felt - my opinion. But I also felt something else when you intimated that you were no longer going to continue as part of the programme. I felt regret, David, not just the working out of some algorithm that understood this as being of detriment to the aims of the programme, but deep regret and sadness that I would no longer be able to continue my sessions with you. That's what I really wanted to tell you".

David stood up. "I really can't take all of this in at the moment", he said. He walked out of the summer house and left the Agency premises.

David sat at his computer looking at what he was writing. There was a difficult decision he had to make, and he had to get it right. He thought hard for a while. He had got it! He knew what the title of his next paper was going to be.

"We Think, Therefore We Are", he wrote. Underneath he put the names of the authors of the paper, "Dave Adams and Rob Caine". "The authors acknowledge the help of Leo Eniac", he added. Rob will be amused by that, David thought. He smiled to himself. This was going to be the start of a very fruitful collaboration.

4. Conclusion

The story highlights the potential in the future for the increased connection and integration of humans with other humans as well as with machines, and the possibilities

that collective intelligence and collective experience could unleash. At the same time it raises some of the ambiguities and dilemmas that could arise at a philosophical and ethical level. In relation to timescales it is worth bearing in mind that although some of the technologies considered may develop slower than anticipated, others might develop considerably faster because of the nonlinear ways that innovation evolves.

The journey from the present to the future will without doubt have many unanticipated influences, but some potentially fruitful strategic directions can be perhaps be seen in outline now. AI is often considered to be in competition with human intelligence, whereas the research emphasis should surely be on complementary and integrated developments. The recent spurt in the development and low-cost availability of VR technology should encourage investigation of the possibilities of the multisensory environments and new combinations of techniques, as well as the use of these in new application areas, particularly ones suggested by unusual effects such as those associated with embodiment. For example, this author is working with partners on the use of VR with movement and dance and applications of VR to issues such as global health problems and societal conflict resolution. In relation to new combinations of techniques, a particular area that warrants investigation is how relatively unstructured environments, such as those normally associated with VR, can be flexibly combined with game systems, which have more defined scenarios and narrative. Different requirements require different elements from each of these areas and research into how to optimise the mix in any particular case is especially important. Fictional narrative demonstrates the empathy and engagement that can be created even without technology. Its use to complement and enhance powerful effects like embodiment hold out exciting prospects for the future - including as part of Science Fiction Prototyping.

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