Artificial intelligence and natural magic

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Abstract   Robotics with AI is part of a long tradition that has run from ancient times that treated the precursors of robots, the automata, as part of Natural Magic or conjury. Deception is an integral part of AI and robotics; in some ways they form a science of illusion. There are many robot tasks, such as caring for the elderly, minding children, doing domestic chores and being companionable, that involve working closely with humans and so require some illusion of animacy and thought. We discuss how the natural magic of robotics is assisted by the cultural myth of AI together with innate human predispositions such as zoomorphism, the willing suspension of disbelief and a tendency to interpret AI devices as part of the social world. This approach provides a justifiable way of meeting the goals of AI and robotics provided that researchers do not allow themselves to be deceived by their own illusions.

Keywords   Robotics · Artificial intelligence · Zoomorphism · Illusion · Automata · Androids · Animacy

1 Introduction

Deception is an integral part of Artificial Intelligence and robotics. In some ways AI is the science of illusion. This is not meant to downplay the scientific and engineering efforts of the practitioners and researchers. For those of us designing devices that operate and interact with humans or other animals, it is important that they seem human (or animal) in some way. Natural Language interfaces and robots with emotional expressions are good examples of communication that encourage perceptions of human qualities in a machine. Many modern robot tasks, such as caring for the elderly, minding children, doing domestic chores, being a companion, and assisting in the office, involve working closely with humans and so require some illusion of animacy and thought.

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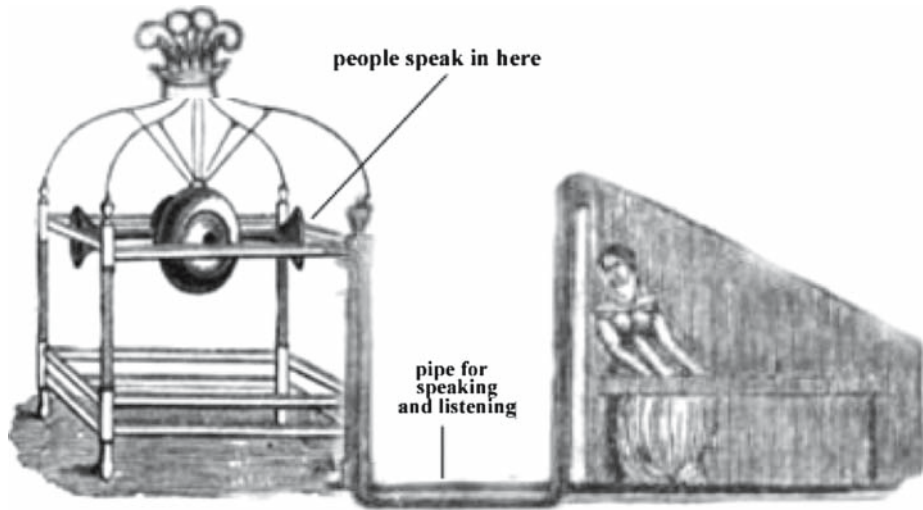e-mail: n.sharkey@dcs.shef.ac.uk

Fig. 1 The invisible girl. A 19th century question answering machine built by M. Charles (Nicholson 1806)

AI is part of a very long tradition that goes back to the ancient precursors of robots, the automata, as part of natural magic or conjury. The deceptive movement of artificial creatures was used to strike awe and wonder into the ancients. The moving statues in the temples of ancient Greece and Egypt were operated by the stealth of puppeteers to create the illusion of a manifestation of the gods. Powerful booming voices were emitted by priests from hidden tubes connected to the mouths of statues. Lucian (AD 125 to 189 approx.) tells of Alexander the false prophet (Harmon 1925) who convinced the gullible of his great power with an artificial serpent that had a humanoid talking head. He worked in low light conditions with the serpent wrapped around his neck and its head partially obscured beneath his arm. Horsehairs were used to move it and flick its long black tongue while an assistant spoke through cranes' windpipes connected to the head.

A similar trick was pulled by Thomas Irson with a wooden head at the court of King Charles II. But he was found out when his confederate was discovered using a speaking tube in an adjoining room (Brewster 1835). There was even a famous 19th century variant called "The Invisible Girl" where echoes were used to deceive people about the direction of the voice. Figure 1 shows the stand-alone apparatus that fooled people into thinking that there could not be a confederate. They only heard the *invisible girl* answering their questions.

From the beginning, the ancient automata makers built machines that exhibited animal-like movements to grab the attention of crowds. Hiding people inside mechanisms as a deception had become so common in ancient times that the public had become suspicious. So much so that when Hero of Alexandria, around 60AD, described the first programmable robots (automata) he advised other engineers on how to maintain the illusion by restricting the size of the device:

"... for the spectacle, were it any bigger, would arouse the suspicion that someone was working these effects from the inside. Therefore, in both the moving and the stationary automata, you must be careful of size because of the resultant skepticism." (Murphy 1995)

Hero also advised on how to keep the actual mechanisms a secret—it was, after all, natural magic. Many of the best descriptions of the automata mechanisms can be found in old books on conjury and illusions. It was thought that by hiding the mechanisms, people would be more fascinated by the mystery of the movement. But this was not always the case. In his *Letters on Natural Magic,* Sir David Brewster (Brewster 1835, p.177) tells us that "Not content with imitating the movements of animals, the mechanical genius of the 17th and 18th centuries ventured to perform by wheels and pinions the functions of vitality." They wanted to impress the public by showing that they were the creators of lifelike machines. As an example Brewster gives the peacock of Captain Degennes that "could walk about as if alive, pick up grains of corn from the ground, digest them as if they had been submitted to the action of the stomach, and afterward discharge them in an altered form" (Brewster 1835, p. 177).

Vaucanson took this a step further by exhibiting some of the actual machinery. His artificial duck which is often considered to be the origin of biorobotics, was set up to accurately model the duck's digestive system. Food pellets given to the duck were seen passing into the stomach, being digested, moving into the intestines and coming out of the anus as little pellets. But this was an illusion. After Vaucanson's death it was discovered that the little pellets had actually been inserted into the duck's anus and had no connection to the rest of the digestive system.

Perhaps the best-known example today of using automata as natural magic is the chess playing "automaton", the Turk. Constructed in 1769 by Baron von Kemplen for the Austrian-Hungarian empress Maria Theresa, it played a strong game of chess against many human opponents, including Napoleon and Benjamin Franklin, over an 80-year period. It was even said to have inspired Jacquard to invent the automatic loom after it defeated him. But this was classic natural magic. There was person hidden inside who moved out of sight on a sliding chair while von Kemplen demonstrated the machinery before the game (see Fig. 2). The Turk was similar to the ancient deceptions in having a hidden operator. The big change was that von Kemplen's goal was to create a false belief in the technology rather than in the supernatural.
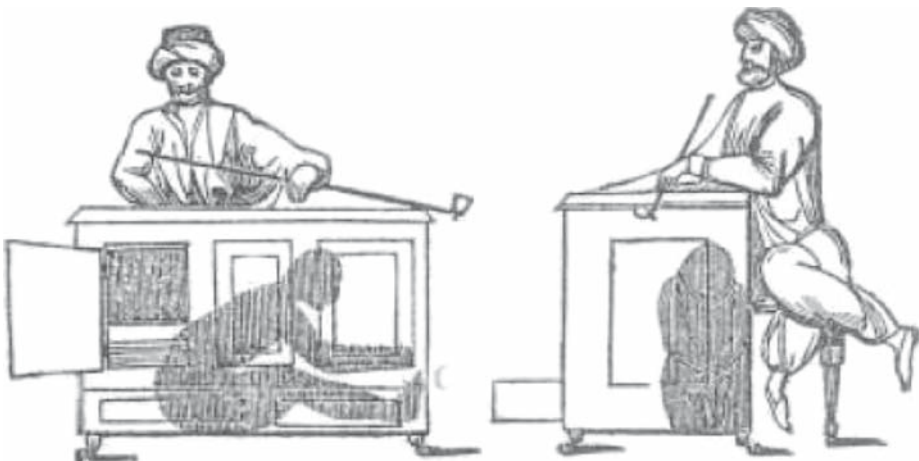

Fig. 2 The Turk chess-playing machine showing the hidden person inside

The illusions created by AI and robotics are more subtle. There are no assistants hidden inside and, apart from remote control, it is the mechanism that is doing all the work. The natural magic is about convincing people that they are dealing with a machine that understands them or that has feelings. The illusion relies partly on capturing features that people use to attribute sentience or animacy to other creatures.

Early AI conversational programs such as ELIZA (Weizenbaum 1966) and PARRY (Colby et al. 1971), explicitly employed semantic and syntactic *tricks* in order to appear to understand more than they did. Papert (1968) relates the story of someone unknowingly interacting with ELIZA via teletype and believing that they were talking to a real person via a teletype machine. And PARRY could not be distinguished from human paranoiacs by psychiatrists although it was thought to be slightly brain damaged. Nowadays conversational programs run on much faster machines and use statistical techniques that make it possible to search through very large data sets of language use to find appropriate expressions. It is possible to bring many more realistic conversational features into play to make the illusion of conversation more powerful.

As people and animals ourselves we intuitively know the sorts of features that will make people attribute animacy and sentience to objects—if it works on us it will surely work on others. In the following sections we will examine how the natural magic of robotics can be assisted by the cultural myths of AI and robotics together with innate human predispositions towards zoomorphism, the willing suspension of disbelief and a tendency to interpret communicative artifacts as part of the social world.

2 Zoomorphism and the robot

In the 1980s, when computer equipment was still new in the workplace, people would shout at their printers or slap their monitors. "Hurry up you stupid thing", was one of the milder exclamations when there were deadlines to meet. Were these offenders guilty of moral misconduct and should there be a machine discrimination act? It would be safe to say that most sane people would find these acts acceptable and even recognisable. Humans suffer from a condition called zoomorphism—the attribution of animal characteristics to non-animals. Some call this anthropomorphism—the attribution of human characteristics to non-humans—but the more general term zoomorphism seems more appropriate. People abuse machines in the way the might abuse a dog or a farm animal. We can attribute intentions to the simplest of objects even though we know it is absurd. Have you never seen a carpenter telling off that stupid hammer? Mostly we would be quick to admit the absurdity.

There seems to be an underlying scale of zoomorphism. Hammers and bicycles are at the low end because the chain of causation of their movements clearly originates from us. Computers are at the high end because the chain of causation is not so clear. They are programmed to perform their tasks by us but carry them out even in our absence. Add to this the notion of Artificial Intelligence and we may begin to impart imaginary intentions to our machines.

There is convincing psychological evidence of a human tendency to interpret technology in terms of the social world. Reeves and Nass (1996) studied how people naturally use their understanding of social relationships in their interactions with computers. Previous psychological studies unsurprisingly showed that people tend to be more positive in evaluating a person's performance when that person is present. Counter-intuitively, Reeves and Nass found the same pattern of results when a computer was being evaluated— respondents were more positive about the computer in its presence. In other words, people are similarly polite

to computers as they are to humans. They responded to the computer as if the machine were a real person with real feelings. Interestingly, it made no difference whether the computer had communicated by means of human speech or text.

Reeves and Nass provide many more examples to demonstrate that people need little encouragement to respond socially to artifacts. Their explanation is that during brain evolution "*only* humans exhibited rich social behaviours" (Reeves and Nass 1996, p. 12); the only things that acted socially were people and the only things that moved themselves were alive. Our automatic responses reflect this: "People respond to simulations of social actors and natural objects as if they were in fact social, and in fact natural." (Reeves and Nass, p. 12).

Zoomorphism is more compelling when it comes to robots. They allow us to suspend our disbelief in their animacy in much the same way as do cartoons. The odd thing is that robots are just as zoomorphically compelling even when remote controlled. One of the authors (Noel) witnessed extreme zoomorphism many times as a judge for the BBC TV series Robot Wars—a competition where contestants pit radio controlled robots in a battle to the death even though they were not alive to begin with.

Examples abound of children being upset when their favourite robot was tipped upside down, axed or set on fire. Of course giving the robots names had a lot to do with it. One of the BBC's robots called Matilda, an arena guard driven by in-house special effects experts, was a particular favourite with children and many adults. In one Robot Wars' contest, when Matilda got badly smashed up by a competitor there was a visible gasp of emotion from the 2000 strong audience. Children were weeping out loud and there was a loud buzz of anxiety as the audience waited for news of Matilda from the wings. So strong was the sense of loss that the shell of Matilda had to be strapped to another robot, covered with bandages and driven out to calm the audience.

More surprisingly when the US originator of Robot Wars, Mark Thorpe, watched an ill-matched contest where a powerful robot with a spinning disk reduced the competitor's robot to a pile of rubble, he became visibly disturbed saying, "we've got to stop this, how can they let this go on". He said that he would never have let this happen in the US and that there should be a change in the rules to let people throw in the towel. The producers of the show did not agree. Herein lie the roots of a false ethical dilemma concerning the mythical robot.

Stories are beginning to emerge of the same sort of phenomenon occurring in the battlefield of Iraq with hardened soldiers displaying loyalty and emotional attachment to their radio controlled robots. Rodney Brooks, a Professor at MIT and founder of iRobot, a company that manufactures military robots, tells the story of a soldier becoming so attached to his radio controlled robot after several missions together that when it was destroyed he wanted to have it fixed rather than accept a new one.[1]

There is even a story, told to the Washington Post by robotics manufacturer Mark Tilden, about a US army colonel who was in charge of a test of one of Tilden's legged robots in a minefield. The robot, modelled on a stick insect, successfully detonated a number of mines and lost a leg each time. It was dragging along very successfully when the distressed Colonel in charge stopped the demonstration because he thought that the test was inhumane.[2]

Does this sound like craziness to you? Maybe it is but it doesn't stop there. A report in the military strategy pages,[3] titled the Baghdad Droid Hospital, discusses soldiers' attachment to their "wounded" robots. Some soldiers have gained a reputation as droid mechanics and

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[1] Sunny Bain's web blog http://sunnybains.typepad.com.

[2] Bots on the Ground, *Washington Post.*

[3] http://www.strategypage.com/htmw/htmurph/articles.

the Joint Robotic and Fielding Activity centre that repairs around 400 robots a day is referred to as the "droid hospital". The report states that every day ". . . the staff there will have to deal with one or more teary eyed troops, carrying the blasted remains of their droid, and wanting to know if their little guy can be rebuilt."

Again the Washington Post reports on soldiers who are robot handlers (the similarity of the title to dog handlers is not accidental) and who give battlefield promotions to their robots and even medals. What might seem crazier is that soldiers in Iraq take their robots fishing in the river Tigris—the robot holds the fishing pole in its gripper while the soldier rests. But it is not so crazy. Zoomorphism peaks when a robot is part of team and saves your life.

It seems that zoomorphism and its relation, anthropomorphism—the attribution of human qualities to non-human species, inanimate objects and gods—is part of what it means to be a human. It is endemic in our species. Take one large ball of snow and put a smaller ball on top. Take a carrot and two lumps of coal to make a nose and eyes and we have a snowman even though it looks nothing like a man; the carrot is nothing like a nose and lumps of coal do not really resemble eyes. Put in a bit of unpredictable movement in and we are left wondering, "is it alive?"

3 A cultural myth of robotics

In fact the tale of the zoomorphic snowman is not unlike the tale of how the first modern electro-mechanical humanoid robot of the 20th century was created in the 1920s. It was only a few years after Karl Capek had first shown his futuristic play Rossum's Universal Robots in 1921. The play, where the word "robot" was first used, was an instant hit throughout the civilised world and our screens and books have been filled by a futuristic vision of ultra smart robots ever since. But was this really the source of the "tin man" robot so popular in Science Fiction and Artificial Intelligence circles? There is a different story to tell about how the press and the public created the modern robot. It begins in 1927 with Roy James Wensley (Kaempffert 1927).

Wensley worked for Westinghouse Electronics throughout the 1920s as an electrical engineer and showed a spark for inventing the unusual such as a lab door that only opened when it heard "open sesame". In 1927, without awareness of the media attention he was about to receive, he developed an ingenious mechanism for controlling electrical substations. This was simply to be another of Wensley's labour saving devices.

The normal mode of operations for an electrical substation at the time required the controller to phone a worker at the station and tell them which switch to open. The worker would open the switch and then report back on what they had done. Wensley's clever idea was simply to replace the worker with a bank of relay switches that could be opened and closed by calling them on the phone. The relay device would then report which switch had been opened and give meter readings.

Calling the machine Televox, Wensley had no idea that it was to form the basis of the modern robot. How could he know that the media would use it to create a "real" artificial human? The device consisted of two boxes. There was a large rectangular box with a smaller rectangular box sitting on top of it, both full of electronics. This is not what anyone nowadays would consider to be a robot. But the Westinghouse publicity team knew about the Capek effect and realised its media potential. According to Wensley,[4] they said, "Why you have a

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[4] From a talk and performance by Wensley and Televox at Harry Hartley's house in Indianapolis, 6th December, 1928.

Fig. 3 A cartoonist's impression of Televox in the New York Times, 1927

mechanical man here. This is a good story for the newspapers. I am sure that we can get a few publicity articles in a few of the New York Newspapers." It was not unlike a rectangular, and warmer, version of a snowman without the eyes and nose.

Wensley was duly sent to New York for a press conference and next morning was disappointed not to find the story inside the papers. Then he noticed the front page, "Inventor shows mechanical servant solving all the housekeeping problems of the age." It had not even been recognisable to him as his invention. The story went everywhere throughout the world and, according to Wensley, each new place added new abilities to the robot—it was anthropomorphism gone rampant. There were even cartoons of Televox throughout the world that gave it legs and arms to complete the picture (see Fig. 3).

Thus the modern robot was born out of media fantasy. The story was so compelling that it even spread to respectable journals:

> The club woman with Televox in her home may call up at five o'clock, inquire of Televox what the temperature in the living room is, have Televox turn up the furnace, light the oven in which she has left the roast, light the lamp in the living room, and do whatever else she may wish. Televox comes near to being a scientist's realization of a dramatist's fantasy. (Zorbaugh , 1928 p. 313)

We can't just blame the newspapers for this new cultural myth. It fulfilled a need in the public. With superstition being put down by science every day there was a need for a public face for the many new technological and scientific breakthroughs of the day. What better way to reify the modern world than with a mechanical man? It was the perfect match and the robot still fills that need today.

But the role of the media was pivotal in the production of the spiraling self-fulfilling prophecy of robotics. The publicity had been tremendous for Westinghouse and expectations were high. Pressure was now on Roy Wensley to go out and give public talks and demonstrations of Televox. The problem was that he knew that all he had was a bank of relay switches operated by telephone. So he took inspiration from the cartoons of Televox and cut up wallboard to give it arms, legs and a body and he drew a face on the head (see Fig. 4). It looks like a ridiculous stage set for a pantomime, but the cartoon version is still the stereotypical robot. The public loved Herbie Televox and the world's first electro-mechanical robot was created.

Roy Wensley and Herbie Telvox became household names within a year and Westinghouse knew that it was on to a good thing. Katrina Televox, complete with maid's outfit appeared briefly in 1931 followed soon after by the three-dimensional metal man, Willie Vocalite. Then for the 1939 World Trade Fair, Westinghouse produced their last and greatest robot, Electro and his dog Sparko. The public was hooked. There were many "robots" by now but they were all very dumb. Anything that had a sensor was called a robot. Traffic lights were robots because they used an "electric eye" to sense cars and pilotless aircraft had iron pilots even though they were guided by gyroscopes. All these devices were talked about as if they were artificial beings.

Fig. 4 Roy Wensley with
Televox

It is clear that people were not fooled into believing that the early "Tin Man" robots
were alive. That was not the intention. In fact we are naturally accurate at discriminating
whether something is human or not, or alive or not. Even infants can distinguish between
biological and non-biological movement (Fox and McDaniel 1982). Five year olds can make
living/non-living distinctions, seeing both animals and plants as alive (Inagaki and Hatano
2002).

If explicitly asked to judge whether something is intelligent, or alive, people are usually
able to do so. They can be confused when their exposure is brief—most of us have had
the experience of briefly mistaking a shop dummy or waxwork for a human, and having to
rapidly realign our expectations as we do so. It is also possible that there are some invol-
untary responses to robots that might indicate our acceptance of them as social partners, or
our awareness of their differences. Accordingly, studies of human–robot interaction often
make use of indirect measures such as length of unbroken eye contact time (MacDorman
et al. 2005) or interpersonal distance measures (Walters et al. 2006), in order to find evidence
of participants' attitudes to and opinions of robots and their similarities or differences from
humans.

Sometimes such measures are used to show that people are aware of the differences
between humans and human-looking robots: for instance, MacDorman et al. (2005) showed
that humans would stare at the eyes of a human-like robot for much longer than they would
look at the eyes of an actual human. But even though we may be aware that a robot, or
a program, is not alive, we may still choose to form a relationship with it. And there are
various ways in which we can be encouraged to do so. Sherry Turkle uses the term "rela-
tional artifact" to refer to "artifacts that present themselves as having 'states of mind' for

which an understanding of those states enriches human encounters with them" (Turkle et al. 2006, p. 347).

The cultural myth of the robot creates active participation in the deception of animate thinking artifacts. We "play along" and act as if robots, or other examples of technology, are animate, although if explicitly questioned we will admit that they are not. This is the "willing suspension of disbelief for the moment" described by Coleridge (1817, p. 314): although people watching a play know that it is not real, they still enjoy and actively participate in going along with the illusion. The psychoanalyst, Zizek (2002) describes the way in which, in play, people can chose to act as though something is real, "I know very well that this is just an inanimate object, but none the less I act as if I believe this is a living being" (Zizek 2002). It is even clearer when you think about our response to watching cartoons such as the Simpsons or Futurama. Such suspension of disbelief is surely implicated in the accounts given earlier of the attachment that soldiers have to their inanimate robots. And there is likely to have been an element of this even in the ancient appreciation of automata.

But people can go further than the willing suspension of disbelief that such artifacts are real, and begin to actually believe that they have minds. The cultural myth of the robot got a new boost in the 1950s with the introduction of the computer and with it AI. The robots could now be thought of as super-intelligent even though AI was still in its infancy. The public was told that robots with computers would soon be able to think for themselves. The new natural magic was to create the illusion that artifacts could think. This was fuelled by the propagation of myths about the achievements of AI.

It is reminiscent of ancient natural magic where the public was tricked into believing that artifacts were inhabited by gods. But there is a significant difference. The ancient temple priests knew that they were intentionally creating the illusion because they or their confederates spoke down tubes or trumpets connected to the mouths of statues and busts. This would be similar to queries typed into a computer being secretly answered by a person. But in AI, it is a program that the researcher has written that does the responding. In this way, even the researchers can be fooled by their own illusions.

At the beginning of AI, appearances got pushed into the background. Turing (1950) suggested that there was "little point in trying to make a 'thinking machine' more human by dressing it up in such artificial flesh" (Turing 1950, p. 434). He sidestepped the issue in the Turing Test by stipulating that it should be housed in a separate room and communicated with by teletype. But the illusion is more pronounced when we exploit human predispositions towards features of animacy and sentience to trick them into attributing these to objects. By combining this with the cultural myths of AI and robotics, we can trigger the active participation by the public in the suspension of disbelief.

There is now a growing industry devoted to creating androids that resemble humans as closely as possible (MacDorman 2006). Hiroshi Ishiguro, in his work on human-like robots, has focused on the creation of human-like appearance and movement—the robots themselves can be viewed as extremely sophisticated puppets. They have minimal cognitive and sensing abilities and are mostly remote controlled. There is no attempt to create something that could actually be said to be intelligent, only something that resembles humans. But such attempts are getting closer to the appearance of reality. Ishiguro (2006) reports experiments in which people saw either a human or an android for 1 or 2 s, and were subsequently asked if the figure they saw had been human or not. In a static condition 80% of participants noticed the android, but when the android was moving (micro movements) 76.9% saw it as human following 2 s of exposure. With longer exposures (5 min) participants became aware that of the android's artificiality.

Another powerful factor in the natural magic of robotics is the apparent emotional response of an artifact. There have been various efforts to create robots with convincing emotional expressions. Kismet is one of the best known of these (Breazeal 2000). In interviews, Breazeal has discussed how the robot was "explicitly designed to tug on your emotional heartstrings", (Breazeal 2006), and with its characteristic infant-like features, and responsive emotional expressions it draws people in interact with it. Other robots have been built that are designed to encourage interaction and engagement. Paro, a robotic seal, was designed to provide a therapeutic style experience for its elderly users (Shibata et al. 1999). It makes an implicit request to be taken care of through its cries and utterances. These examples and others are designed to elicit the desire of people to nurture the robots. They exploit a disposition in humans to willingly believe that if something is expressing emotion then it must be feeling it.

4 Conclusions

The Natural Magic of robotics and AI can create an illusion of sentience and thinking in artifacts by exploiting the cultural myth of the thinking robot and the human predisposition to zoomorphism. AI researchers are often so entrenched in the details of their work that they do not realise their mastery of illusion. They can be fooled by their own natural magic. For a scientist to accept participation in natural magic may create seeming moral and ethical problems. Deceit is certainly ruled out by the scientific and engineering codes of conduct. But it should be remembered that accepting AI as a science of illusion satisfies the codes as long as we are aware of what we are doing and make this clear in our research papers and reports.

We should not be concerned if, by means of Natural Magic, AI succeeds in allowing people to feel that a machine they are interacting with is intelligent and perhaps is even experiencing emotion. This is one of AI's most significant goals. As Rod Brooks has commented, "I'll eventually feel we have succeeded if we ever get to the point where people feel bad about switching Cog X off.", (Brooks 2006). One of our jobs is to put artifacts into the human world that operate seamlessly and communicate in a direct way with conversation and body language that humans can naturally understand. Such effects can be entertaining and engaging as well as being useful. Surely it doesn't matter if we imagine that the robotic therapist we consult is actually able to understand and empathise with us.

Nonetheless, there is something disturbing in the idea of an elderly parent thinking that their robot pet or carer actually loves them, or is deserving of love. The same idea is expressed by Turkle (2006, p. 360), "If we value authenticity in relationships, the fact that our parents, grandparents and children might say 'I love you' to a robot who will say 'I love you' in return, does not seem completely comfortable; it raises questions about what kind of authenticity we require of our technology. Do we want robots saying things they could not possibly 'mean'?" Our argument is that it is better to be explicit about the fact that we are engaged in Natural Magic and to make people aware of it. It may not affect the illusion too much. Certainly cartoon animators do not feel the need to sell their cartoon characters as truly thinking beings. Like them, we can let the active participation of people and their willing suspension of disbelief do the work for us.

Being honest with ourselves and others such as policy makers and funders takes on an urgency at present with military strategists buying into the cultural myths of AI to the point of suggesting we give decisions about lethal force to autonomous robots (Sharkey, in press). Should we trust autonomous robot soldiers to be able to make the right decisions about who and when to kill on the battlefield? We certainly wouldn't allow a ventriloquist's dummy

to make such decisions. It is the moral responsibility of AI and robotics researchers to be truthful about the research output today rather than what it could be tomorrow. If the device is to all intents and purposes creating the illusion of intelligence, they should say so, even if they believe that in principle one day machines may be truly intelligent.

Encouraging the belief that robots or computers can understand our world, as opposed to doing what they are programmed to do, is likely to accelerate our progress towards a dystopian world in which wars, policing and care of the vulnerable are carried out by technological artifacts that have no possibility of empathy, compassion or hate. The myth created by the media in the 1920s is still playing itself out and cycling back to the scientists to generate more self-fulfilling prophesies.

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