of Leonardo, Kismet and their ilk all down to sophisticated aesthetics and creative programming with just about anything that moves, is the Asimov, Dick and other AI fantasists rubbing their hands in anticipation? Are modern robots still anything more than machines? Their creators certainly think so.

*My Friend the Robot**

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Worried about being all alone in your old age? A robot companion could be the solution. While roboticists focus on developing humanoid robot helpers for the elderly, other researchers are as interested in building robots for use as human companions and challenging attitudes towards machines as they are in providing practical support for elderly people. But what might be the consequences of giving machines more status?

The baby boom in advanced capitalist economies is long gone; the population is set to age and keep on ageing. In the next 45 years in the US, 20 per cent of the population will be aged 65 or over. By 2050, the proportion of elderly dependent people in Europe is expected to increase to more than 51 per cent. Japan is likely to see one of the largest rises in the elderly dependents ratio, estimated to reach 71 per cent by the year 2050. In light of these forecasts, roboticists see elderly support and care by robots as an important area of their work.

Honda's Asimo (Advanced Step in Innovative Mobility) could be one such robot. It is the size of a small adult, has a humanoid form and is often photographed assisting people—such as collecting a newspaper or delivering the tea. Asimo is held up as an example of robots to come. In the US, researchers at Carnegie Mellon University have developed Pearl, a robot specifically designed to help the elderly. Pearl is about 1m tall and has a mobile base, a video-screen in the place of a torso, a grey face and a hefty price tag—more than $100,000 (£50,800). Its human-like face is designed to encourage the elderly to interact.

* This article is from a British publication and contains some British spellings.

Robots such as Pearl and Asimo could have many uses for ageing populations, reminding them to take medication and assisting with chores. One US-based roboticist explained the advantages of designing robots in humanoid ways.

As human-like robots reflect aspects of the human physical, emotional or communicative repertoire, researchers hope this will make users feel comfortable, safer and able to interact with the technology without any specialised training. A robot with multiple skills, including mobility or communication, might have advantages over technology produced with one specific, inflexible role.

Yet some in the field want robots to be viewed as more than just sophisticated working appliances. Others resent their use as "servants" or "slaves." They talk of developing robot companions that encourage relational bonds between humans and machines. One area where the use of robot companions is under way is among the elderly community, where isolation and depression are major problems.

Japanese researchers lead the way in robotic healthcare for the elderly. As well as funding research in this area, the Japanese Government bestowed an honour on the makers of the robot Paro in December 2006. Paro, which had been in the making since 1993, was developed by the National Institute of Advanced Industrial Science and was one of many robots at the Government-sponsored Robot Awards 2006.

However, Paro cannot help with chores or assist the elderly with mobility issues. This is because Paro is a furry seal-like robot. Its makers refer to it as a "mental commitment robot," or companion robot. Paro was trialled at care homes in Japan, and the results are said to demonstrate how human and machine bonds are possible. The researchers looked to human-animal relations to study human bonds with other kinds of species.

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"We have to be careful how we use the term 'relationship'," says Kerstin Dautenhahn, professor of artificial intelligence at Hertfordshire University. "I have a 'relationship' with my car, but it is not the same as a relationship with a human. Robots are not sentient creatures." But do robotic innovations blur these boundaries? Scientists interviewed in a recently published report sponsored by the UK Government think so.

When surveyed about the future of technology, some scientists thought robots might one day demand rights. In Europe, "robot ethics" is a growing area of research. In fact, studies are under way that examine the treatment of robots by humans. An exhibit at the Boston Science Museum in the US showcases research that addresses this question. Ada Brunstein, a science researcher at the Massachusetts Institute of Technology, says: "It has been reported that children do possess a sense of moral responsibility to Aibo (a robotic dog made by Sony), but this could easily be because kids recognised that Aibo was an expensive and fragile toy, while a stuffed animal is clearly more durable."

Is the very process of humanising machines enough to call into question the boundary between a human and machine?

Dautenhahn thinks not. "Interface" is the term she chooses to explain why she uses humanoid features in her research. "In my work, I employ some humanoid aspects in the design of the robots, but this is mainly as an interface. People like to know where to speak and look when talking to a machine." Yet much research is focused on imparting human behavioural qualities to machines.

The Cognitive Robot Companion, or Cogniron, project aims to design machines with manners. Cogniron researchers believe that a robot with manners could help humans relate to it more comfortably. In addition to "robotiquette," other researchers have embarked on making robots that can trigger human empathy. At the University of the West of England, roboticist Peter Jaeckel is studying how to get a person to feel empathy with a machine. Jaeckel's human-like robotic platform Eva (designed by David Hanson at the University of Texas) does this by mimicking facial expressions. Jaeckel wants Eva to perform the expected facial responses to humans who interact with it.

But can companion robots benefit the elderly? In studies of elderly-robot relations, a person's biographical details often reveal a complex picture, with the elderly-robot relationship positively affected, often directly, by illness or feelings of estrangement from the person's family. Sherry Turkle, professor of science, technology and society at MIT, was until last year a distinguished supporter of robot care for the elderly. In her work, she has examined the therapeutic role of robots as relational objects. The robots' use as an outlet for anger or loneliness were some of the positive results found in studies such as Turkle's, but these results cannot be separated from the challenging situations that many elderly people face.

This should not diminish the use of robots as therapeutic tools, but still, a therapeutic tool is quite different from a machine alternative to a human companion.

Robot companions may, in the short term, ease the problem of loneliness in much the way that pets do, but can these robots work over longer periods and connect with deeper human yearnings? For some roboticists, there may be little difference in quality between a human and machine, but for others a human-like robot is nothing more than a machine with a face.

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I think the following examples symbolise the inherent problem in equating robots and humans. While conducting fieldwork at MIT, I was shown a photograph of a robot pushing a wheelchair; behind the robot were several adult males pushing the robot. In another case, a similar scenario was played out when I saw the robot Asimo. The physical form and human mimetic performance of Asimo did seem eerily human-like. But when one steps back from the visual effects of the robot the illusion is revealed.

In a recent UK television commercial, Asimo can be seen walking unaided, but Asimo is remote-controlled and requires an army of highly skilled researchers to make it work. Metaphorically speaking, both examples illustrate the ineffective, confused and illusionary nature of the research. Put another way, in the absence of a human-centred vision, the technology's benefits to the elderly will be uncertain and limited.

If researchers apply ethics to machines, the potential of the technology will be overshadowed by an uncertainty about who and what it is for. In this sense, machines might be judged less on what they can do and how they are useful and more on how they look, behave and how we relate to them—a very useful sticking plaster, in fact, for our own feelings of alienation from, and responsibility to, other human beings.