Rethinking Communication: Care Robots as Collaborative Assistants

This chapter has two main threads of argument. The first explores the creation of care robots, machines that are designed to help people who for various reasons find it difficult to live without assistance in their own homes. Currently, most research and development is directed towards the situations faced by people as they become older, and yet still want to live independently in their own space, but there is potential for care robots to be developed that could offer assistance to people of any age with a disability that makes living on their own difficult to achieve. In this chapter, the dream of the perfect humanoid care robot is interrogated by analysing the film *Robot & Frank* and comparing the points made in its narrative with developments in real-life robotics, including current designs for care robots.

The second thread rethinks communication systems and processes in light of the assumptions that are called upon when designing care robots, in particular the insistence that communication be based on what communicators have in common, and is designed to reduce the differences between them. This understanding of communication is supported in part by the etymology of the word communication itself (Chang, 1996; Peters, 1999). In addition, a reliance on commonality, and a drive to increase that commonality further can also be seen within a number of traditions of communication theory, as discussed in some detail below. However, an analysis of human-robot interactions, moving from considering the communication of humanoid robots to non-humanoid robots, offers a means of rethinking communication that supports the importance of difference as well as commonality. Attending to differences in world-view and understanding in a communicative partner may highlight new ways to understand situations and solve problems. This chapter notes in particular the importance of complementary skills and abilities present in human-robot teams within which humans and non-humanoid machines work together to carry out tasks more effectively than either human or robot could alone.

The success of some teams that combine humans and machinelike robots leads to the suggestion that humanlike form may not always be the best design path to follow when creating care robots, highlighting other possibilities and reasons why non-

humanoid form might work better for some purposes. In addition, the discussion below identifies the need for care robots to be more than machines that remind you want you should do next, or monitor you for distant family or human carers; instead, care robots with more individual personalities, although not necessarily humanlike personalities, that can act as collaborative partners might prove more acceptable to those being cared for. Non-humanoid robots might well be able to provide flexible assistance to people with disabilities who want to be as independent and autonomous in the decisions they make about their lives as possible without relying on human, or even humanlike, assistance.

Introducing *Robot & Frank*

The film *Robot & Frank* is about a man, Frank, who lives on his own at a distance from his children. Frank wants to continue to live in his own house in the country, but this is becoming difficult, as the onset of dementia has meant that his memory increasingly fails him. He has begun to take less care of himself and his surroundings, his house becomes increasingly cluttered and dirty, and he does not eat a healthy diet. His son visits him every weekend, but has his own life and family in the city, while Frank's daughter is travelling abroad much of the time. His son, Hunter, finds it increasingly difficult to make the weekly trips to the country, and also realises that Frank would benefit from help everyday, as opposed to only at weekends. Hunter therefore decides to buy his father a robot companion. The fact that this is possible, and the design of the robot that arrives in the country to help Frank, clearly places the film in the future. Robot carers are not found in people's homes in any general capacity at present, currently being introduced mainly into controlled spaces, often for testing and research purposes.

"Robot", Frank's new companion, is designed to look after him in his own home, keeping the house clean and tidy, making his meals and providing therapeutic care for his condition by establishing a clear daily routine involving activities such as gardening. However, as can be seen from Frank's expression in Figure 1, Robot's presence proves difficult to accept, and the idea of starting a garden in particular doesn't appeal! Indeed, Frank doesn't take well to what he sees as Robot's interference in his life, although after a period of resistance he appreciates the robot's

ability to clean the house and, while he would prefer to eat his own choice of less health conscious diet, does rely on Robot to cook his meals.

Figure 1: Robot and Frank in conversation (still from the film)

In real life, care robots that are as advanced as Robot are not yet available. However, some robots do exist that do look very similar to this fictional example, most notably ASIMO, the robot designed and developed by Honda over more than a decade. It is ASIMO's bipedal walking, running and stair climbing ability that has been the focus of Honda's research, and this robot does perform all of these actions in controlled environments, although there have been instances where the robot has fallen on stairs even during showcase appearances on stage.[1] In the film, Robot is shown as completely reliable and safe, as unlikely to fall as any human even when walking in the forest, but in real life walking robots that are stable and balanced in a range of environments are still being developed.

The need for care robots to operate safely around people has led a number of designers to concentrate on wheeled designs with low centres of gravity. For example, the Mobiserv robot, developed in Europe by the company Smart Homes in association with a consortium of research universities, is shown in Figure 3.

[1] There have been a number of amateur videos online that show ASIMO in difficulty. More recently, ASIMO was introduced on trial as a museum guide and experienced problems differentiating between people with their hands up waiting to ask a question, and people who had their smartphones raised ready to take a photograph.

Figure 3: Mobiserv robot (still from a project video)

Although this particular care robot does not have articulated arms, these are seen in other robots such as REEM (PAL Robotics) and Care-o-bot (Fraunhofer), also developed by companies and researchers in Europe. The practical level of help that these real-life care robots can provide is constrained by their technical abilities. Those with hands and arms can pick up objects and carry them, but they are not yet able to clean the house, prepare meals or dig a garden bed effectively. In spite of their limitations, the general aims for the operation of these robots are similar to that of Robot in caring for Frank, since they are designed "to offer home care for (semi-)independent living with a focus on health, nutrition, well-being, and safety" (www.mobiserv.info/objectives). Mobiserv robots, for example, constantly monitor the people for whom they care, providing information and structure in their daily lives via speech and screen interfaces. These robots are designed to suggest when the person for whom they care should, for example, take a drink of water, eat some food, increase their physical activity or take their medication. They also provide a mobile teleconferencing service, bringing videophone calls to people, and allowing them to call others from wherever they are in the home. Fundamental to the operation of these robots is their ability to communicate with people, alongside their ability to provide a technological means for communication between humans at a distance. The combination of the speech interface and touch screen on the Mobiserv robot combines human communication with an increasingly familiar form of computer interface.

Robots and Communication

The design and development of robots can be analysed in many ways. Some scholars regard them as a type of new media, operating alongside television and computers in people's lives as forms of mediated life that people easily equate with real life experiences. This perspective, called "media equation" theory and developed by Byron Reeves and Clifford Nass, suggests that whatever their form, robots will be interpreted by people in "*fundamentally social and natural*" ways (1996: 5). While this theory supports the idea that people would respond and communicate with non-humanoid robots in social ways, it is clear from the example of *Robot & Frank*, and even from the less overtly humanlike designs of real-life, that visions of care robots nonetheless assume that robots of humanlike form might be easier for people to accept in their homes and lives. Indeed, as Kerstin Dautenhahn notes, while she feels that the drive to create humanoid robots should "be reflected upon critically", in many cases the focus for designers creating robots to operate in human spaces still assumes the importance of humanlike form to support people's acceptance of these machines (2013). Rather than thinking of robots and their behaviours in terms of media equation theory, it is therefore fruitful to analyse human-robot interactions in ways that position robots as communicative individuals in their own right, such that their communication can be analysed in terms of communication theory that more often applies to human-human interactions. It is also useful to step back from considering individuals as communicators, to regard human-robot interactions as systems of communication, in order to notice the meaning the emerges from within the system itself as human and machine work together.

The assumption that familiarity in form will support better relations between humans and robots has been a feature of science fiction for many years, from the first use of the term robot in Karel Capek's play, *R. U. R.* (*Rossum's Universal Robots*) to describe the "artificial humans" created by the character Rossum (1920/2006). Following this, Isaac Asimov articulated a number of reasons why humanlike form might be preferred for mechanical humans, as well as organic creations such as Rossum's robots, in his fictional narratives and also in non-fiction essays. In particular, Asimov suggests that people taking on "thinking partners—or, at the least, thinking servants—in the form of machines" will "more easily" relate to them "if they

are shaped like humans" (1977/1990: 419). However, the importance of creating humanoid robots to support relations with humans is also based on the assumption that their ability to speak in humanlike ways and, where their design allows, mimic human head, hand and arm movements, will make communication with people seamless.

The idea of creating points of commonality between humans and robots has therefore been embraced in robotics as a means of creating machines that are familiar and easy to communicate with. Robot, in communication with Frank, is a good example of a potential goal for care robotics, demonstrating the idea that such robots need to be precise in their actions, and able to speak clearly to convey their meaning. Robot's communication can therefore be understood from the perspectives offered by what Robert Craig has identified as the cybernetic and semiotic traditions of communication (1999).

The foundation of the cybernetic tradition is in the work of Claude Shannon and Warren Weaver (1948), as well as Norbert Wiener (1948) and Alan Turing (1950). This tradition of communication theory therefore arose from early research into systems and information science, artificial intelligence and cognitive theory. As Craig notes, the assumptions that support this type of theory relate to understanding all communication processes in terms of information transmission or exchange (1999). Robots can broadly be thought of as embodied computer systems, and their internal operations depend upon programmed processes that form archetypal cybernetic systems. While the presence of internal programs is linked with the use of computer code, it is important to note that even Robot's external communication with Frank is carefully coded, but this time in semiotic terms that relate to the precise use of human language. Listening to the film, Robot's care in choosing and enunciating words when talking is clear. Robot's communication with Frank therefore illustrates the close relationship between the cybernetic tradition's idea of communication as information processing, and the semiotic tradition's conception that human agency can be collapsed "into underlying or overarching symbol-processing systems" (Craig, 1999: 142). It isn't only in fiction that the communication of robots is portrayed in this way, the communication style of real-life care robots being very similar to that of Robot in the film. All of these robots speak in ways designed to reduce various kinds of

“noise”, to use the cybernetic term, such that communication with these machines is rarely misunderstood, although it may seem rather dry, flat in tone and lacking in personality.

The lack of nuance in Robot’s tones, shared by the voices of real-life care robots that speak, is exacerbated by the lack of facial expressions, although robots with heads and necks, arms and hands, can use gestures to communicate in familiar humanlike ways in support of what they are saying. In general, care robots do not seem to be designed with persuasive influence in mind, and Frank’s resistance to Robot’s well-meaning suggestions illustrate the difficulties that might arise because of this. From the perspective of the sociopsychological tradition of communication, which theorises communication success in terms of “expression, interaction and influence”, Robot and real-life care robots would seem to likely to experience considerable difficulties. In spite of this potential lack of persuasiveness, from a sociocultural perspective, the calm and unflappable characters of these robots, and the patience they show in repeating requests when they are initially ignored, are nonetheless clearly positioned within traditions of care. These robots can therefore be understood to conform to well-established understandings of communication between those who care and those who are cared for, thus producing and reproducing a particular sociocultural framework and communication style (Carey, 1992).

Creating more expressive robots and the problems of framing robots as human

One solution to the issue of whether current care robots, and even Robot as portrayed in fiction, could become more effective and persuasive carers might be seen in the work of researchers into social robotics. Two pathways of design have been followed in the main. The first involves the creation of robots that are virtually indistinguishable from humans, as seen in the work of Hiroshi Ishiguro in Japan, who has created a robot double of himself, and David Hanson in the America, the creator of a robotic head that resembles Einstein, as well as other almost lifelike human heads. The problem that some people see with this type of robot is that, as they approach a state where they can hardly be distinguished from a human, people’s perceptions of them tend to fall away into what has been described by Masahiro Mori as the “uncanny valley” (1970). Mori’s theory suggests that, as robots become more humanlike they are accepted as increasingly familiar and liked up to the level at

which their appearance and behaviour is almost, but not quite, exactly that of a human. At this point these robots suddenly seem zombielike, and their appeal of drops away rapidly.

While some roboticsts see this as a fatal flaw in the design and development of very humanlike robots, others, such as Hanson, argue that it should be possible to overcome this effect simply by building more aesthetically pleasing robots (2006). However, roboticists that are concerned by the uncanny valley effect tend to follow an alternative pathway for social robot design seeks to bypass the issue entirely by creating robots that operate as caricatures of human form, with expressive cartoon-like faces (Breazeal, 2002). The faces of these robots are designed to engage people emotionally, and therefore to act in persuasive ways that influence people's expressiveness in interacting with the machine. The communication of machines such as Kismet, shown in Figure 3, can be understood in terms of the sociopsychological tradition of communication, where it is the effect of the communication that is regarded as key (Craig, 1999: 142-144). Kismet was designed to encourage people to comply with its wishes, drawing them closer by craning its head towards them so that it could more easily engage them with its exaggerated expressions. People communicating with this robot would prefer to make it smile than to elicit its expression of deep sadness, mouth, eyebrows and ears lowered.

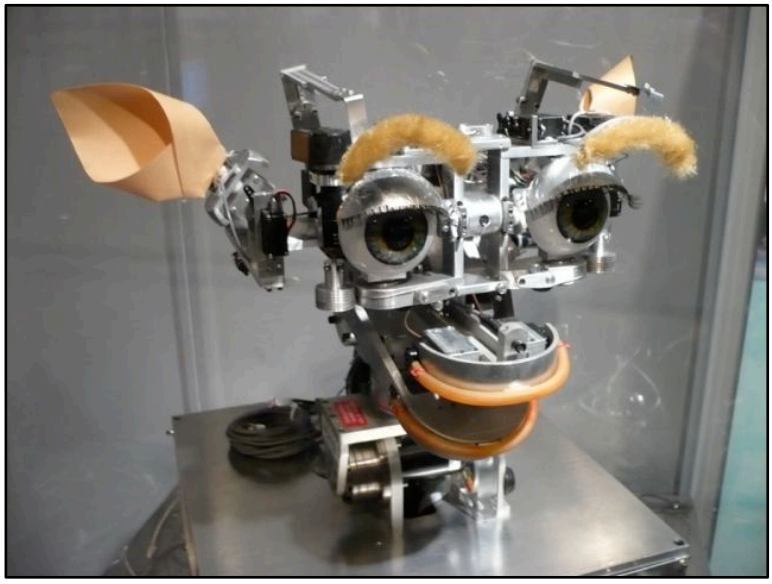

Figure 4: Breazeal's robot Kismet in the MIT museum
(photographed by the author)

Kismet is also positioned carefully within a particular sociocultural frame as an infant, with human participants in interaction therefore playing the role of caregiver or teacher. This encourages people to use extremely clear tones of voice, very happy, sad or angry when talking to the robot.

In terms of care robots, while the pursuit of humanlike form might seem appropriate, not only does this promote particular expectations in those that come into contact with the robots, but also it reinforces the questions around whether such robots should be designed to replace human caregivers. For many people, including Sherry Turkle, the suggestion that robots could, or should, be used in place of people's access to human companionship and care is highly undesirable and ethically unacceptable (2011). This perspective on robot carers is also raised in the film *Robot & Frank*, when Frank's daughter, Madison, returns home, horrified that her brother has handed care for their father over to a machine. Madison takes an ethical stance that humans should care for human, rather than relying on robots; however, even she eventually turns to Robot to clean the house, which has become very untidy again since her decision to switch it off. It seems that Madison's displeasure at the presence of the robot is somewhat undercut by the fact that it uncomplainingly completes tasks that most people find boring and hard work to complete, this being one of the main reasons that Asimov cites for creating robots to replace humans at work (1977/1990: 417).

It isn't necessary to position robots as replacements in this way, although a considerable amount of science fiction and fact does do this. If robots are to live and work with humans, instead of replacing them, they might offer new forms of practical, social and living support. It is therefore worth considering that rather than expending development effort making the robot more personable in human terms, it might be more important to identify ways that humans and robots can work meaningfully together. This might seem a strange suggestion when writing about care robots, but *Robot & Frank* provides a believable illustration that working together to complete a task which requires human-robot collaboration is the most successful way to build a stronger relation between human and robot.

Recognising the otherness of robots

The relationship between human and robot in the film *Robot & Frank* only begins to develop more fully when it becomes clear that Robot's ethical programming won't interfere with its (or maybe more correctly, 'his', since this robot's voice is male) ability to help Frank return to his previous life stealing jewellery. Frank begins to teach Robot how to pick locks, chooses their first local target and 'cases the joint', observing the house he plans to rob from a vantage point in the woods with Robot at his side (shown in the Figure 2).

Figure 2: Robot and Frank 'casing the joint' (still from the film)

It is at this point that Frank becomes more animated, and begins to take some control over his life, although at times his memory still fails him when dealing with everyday tasks. Robot's communication remains precise and uniform in tone; instead, it is the specific abilities that he has that become more important in establishing his personality and position in the partnership. Of particular interest to Frank is Robot's ability to learn to pick locks quickly, which makes the robot a valuable team member in the context of planning a theft.

It takes Frank some time to find out that Robot could be the perfect partner in crime for a number of reasons. Robot is positioned as what might potentially be the ultimate ethical, reasonable and law-abiding 'person', particularly in relation to general demeanour, communication style and content conveyed. Robot's character is all about following the rules of healthy living, and abiding by the social norms around

maintaining a clean and tidy house. However, its ethical program has not been extended to cover crimes such as theft. The film highlights the difficulty Frank has in recognising the potential, but also the pitfalls, of employing Robot's particular skills and abilities as a partner in crime. Robot is designed to be humanoid, to perform tasks in humanlike ways, operating tools and moving in spaces just as a human would. However, Robot is able to learn to pick locks faster than Frank, and can also remember building plans more precisely. Unfortunately, it transpires that Robot's memory also contains a complete record of the pair's exploits, and at the end of the film Frank must erase Robot's memory, so that his involvement in the recent crime cannot be proved. Through this act of memory erasure Frank retains his freedom from prison, but is consigned to life in the hospital that he was so desperate to avoid at the start of the film. He has lost Robot as his companion, because, although many identical robots exist, the memories and experiences that supported this particular human-robot relation have been erased.

Designing robots as collaborative partners as opposed to human replacements

Setting aside the rather sad ending to the film (at least as I read the story), the course of the narrative raises the question of what potential there is for humans and robots to collaborate in real life, and how the recognition of each partner's different skills and abilities might more easily be acknowledged and valued. It might be that non-humanoid robots, even machine-like robots, whose difference from humans is overtly represented in their form, provide better partners with specific capabilities that are more easily kept in mind. This idea raises the question of whether it is possible for humans and robots of non-humanoid form to work together collaborative teams, interacting together even in the presence of marked differences in communication style.

Aside from care robotics, another area in which robots are being explored as helpers for humans is rescue and disaster response robotics. In general response robots are not humanoid, the main exception being the recently developed Atlas robot, which is designed specifically to replace human workers. In this case, the adoption of humanlike form makes sense when entry to a human tailored working environment is prohibitively dangerous, such as the Fukushima Daiichi nuclear power plant, but maintenance or disaster management is required. Although deployment into human-

tailored environments, and the need to operate controls designed for human workers, supports the design of humanoid response robots, in many other cases, such as jobs involving Explosive Ordnance Disposal (EOD) and surveillance of hostile territory, non-humanoid robots can be more useful. These robots have very different skills and abilities from their human counterparts. In particular, the addition of a robot such as a Packbot (see Figure 4) can extend a human team adding the ability to enter constrained spaces, see in low light situations and sense heat or chemical signatures (iRobot).

Figure 4: Soldier with Packbot

(US Navy image in the Public Domain on Wikimedia Commons)

Much of the communication between humans and robots like Packbots follows a command and response model, since these robots are almost always radio-controlled. Currently there are only a few autonomous actions that the robots perform, for example, they can right themselves if they are overturned on rough ground, and some models can now retrace their steps if radio contact with them is broken. It is likely

that more autonomy will be built into these robots over time, to help make them more flexible when working in teams with humans.

Even with their current low levels of autonomy, however, EOD robots are recognised as individuals by people that work with them. These robots are given names and genders, as might be expected given that people also name other machines such as boats and cars. Although this recognition of the machine as an other, or an individual, might simply be explained via media equation theory (as mentioned early on in this chapter), it is also worth analysing the development of human relations with EOD robots at a more detailed level by employing various communication theories.

Many EOD robots of the same make and model are deployed at any one time; however, each of these robots develops individual quirks in the field. These odd movements, turning in one direction more quickly than the other, moving erratically in certain situations, are not intentionally programmed; instead, they emerge as the process of wear and tear on the robot takes its toll in what is often a difficult physical environment. At this level, EOD robots communicate in ways that bring Erving Goffman's conception of "small behaviours" to mind (1969: 1). The somewhat random movements of the robots are difficult to interpret as transmissions of information in the sense described by the cybernetic tradition. However, the quirks of the robots are read as nonverbal communications that feed unintentionally into the interaction with a human team member (Goffman, 1969: 1). The 'gaze' of the camera often attached to the robot's arm, the gestures of that arm and the whole body movement of the robot all come into play and are read as "external signs of orientation and involvement" (Goffman, 1969: 1).

Human communication with EOD robots, beyond the use of radio controllers, is clearly somewhat limited, but supports the development of trust in the team, such that operators will ask that a damaged robot be repaired if at all possible, as opposed to being replaced with a new robot. The sense that the robots are individuals, and that one may work better in the team than another, is a strong factor in this choice. Relations between humans and robots in EOD teams operates at a fairly low level of interaction and relation, but the teamwork between humans and EOD robots nonetheless bears some resemblance to that which occurs between human handlers

and bomb disposal dogs. The communication between humans and dogs is more dynamic, involving voice, as well as gesture and whole body language, with meaning emerging as the team interacts as opposed to following a rigid command-response or turn-taking structure. This flowing communication, and deep trust relation, is in part built on the long history of human-dog working teams in general, but is also dependent on the level of continuous training that human and dog take part in together.

In both human-robot and human-dog teams the ability of the team is enhanced by the wide range of capabilities introduced by combining disparate partners. Dogs provide far greater scent recognition and tracking abilities than humans, along with better hearing and the ability to enter small spaces. EOD robots can also enter restricted spaces, and there are many different sensors that can be fitted to the machine, such that it can perceive heat and various chemical signatures, for example, as mentioned above. The connections made between humans and dogs, and humans and robots, are also somewhat similar because of the sociocultural setting in which they are embedded. Bonds between humans and dogs working in teams are strong, and when a dog is retired it will often continue to live with its handler or their familiar. This relates to the intense training that they experience together as a team, as well as their deployment and reliance on each other in dangerous, often life threatening, situations. In terms of robots, Ian Roderick has noted that when the machine is positioned as a life saver, sometimes on repeated occasions, this goes a long way to reinforce a team's desire to keep that particular robot, as opposed to accepting any EOD robot as a replacement if theirs is damaged (2010).

The potential in developing non-humanoid care robots

Returning to the subject of care robots, it is notable that while many of the robot designs in this area of development are only partly humanoid, because of the need to adhere to safety regulations they almost always have heavy wheeled bases for example, they are nonetheless focused on providing human-like care, in particular through the use of well-developed speech interfaces. Non-humanoid carers more often take the form of dogs than robots, with assistance dogs working not only to guide blind and partially blind people, but also helping people with a variety of tasks such as opening doors, putting laundry into washing machines and operating buttons on

lifts, intercoms and road crossings. In performing these jobs human and dog are most often required to work together to complete the task effectively and, instead of the animal providing complete care, it is more that they increase the potential for a person to live a life that is independent from human carers through collaborative action. The relation that develops between human and dog also relies on mutual care, so while a dog may act as the human's eyes in new spaces, for example, it is then reliant on the human for its food, water and other aspects of care while at home. It is very likely that relations between assistance dogs and people are about far more than providing physical assistance to human partner, and more about a collaborative working and living relationship, with dog and human acting as mutual life companions.

However, there are some situations for which the introduction of animals may be very difficult, and a person might even simply not be able, or wish, to live with and care for an animal. In these cases, where animals cannot be introduced on a long-term basis, there may be potential for non-humanoid robots to enter into some type of collaborative care relation with a human. The skill-set of the robot working with a human could be tailored to suit that person's situation, and the resulting relation could be flexible and altered as necessary as needs change. The introduction of this type of robot, as opposed to the care robots discussed at the beginning of this chapter, might well be more about enabling people to live on their own, as opposed to offering complete care. However, the potential for a robot that operates as a collaborative partner, as seen in EOD robots that have very restricted autonomy, is that it would become a companion of a clearly non-humanlike or animal-like form, designed to help people to do things for themselves. This new relation therefore provides support and independence, without being mistaken as a replacement for human contact, for example.

This chapter has tried to break down the assumption that humanlike form and interaction style are the only way to support effective relations between humans and robots, with the result of rethinking the possibilities of communication with non-human others. By doing this it has stressed the possibilities for the development of multi-skilled teams, within which communication, in particular nonverbal communication, operates to support collaboration. Communication in these teams can be read as produced by both humans and robots, even when the robot in question is

only partially autonomous. However, communication also emerges as the interaction between human and robot develops over time, from continuous practice in collaboration, and through an arrangement that is not about the robot caring for the human in any complete way, but is rather about the robot being able to offer assistance as a partner, to work in a team that can carry out tasks that cannot be completed by the person alone.

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