

## Relational artifacts with children and elders: the complexities of cybercompanionship

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In several studies over 5 years, our interdisciplinary research team introduced My Real Babies, Aibos and Paros into two nursing homes and into the school and home life of children.<sup>†</sup> By referring to these sociable robots as *relational artifacts*, we draw on the psychoanalytic tradition, which emphasizes the human meaning of the person–artifact connection. We report on the relationships children and seniors formed with the robots, focusing on: (1) how they talk about the robots in relation to themselves and others; and (2) how their ideas about the robots and interactions with them reflect other feelings. In doing so, we distinguish ‘robot as Rorschach’, which refers to how relationships with robots express other things about a person’s life, and ‘robot as evocative object’, which refers to how robots provoke reflection on such issues as what is aliveness, what is special about being a person, and what is the role of thought and feeling in defining human uniqueness. In case studies we report on individual differences among robot users and sociological factors that affect their engagement. The results may inform the design of future relational artifacts, especially as robots find medical and therapeutic vocations.

*Keywords:* Robotics; Human–robot interaction; Sociable robots; Relational artifacts

### 1. Introduction: the instrumental and the subjective

The designers of computational objects have traditionally focused on how they might extend or perfect human cognitive powers; but such objects do not simply do things *for* us, they do things *to* us as people, to our ways of seeing the world, ourselves and others (Turkle 2005a [1984], 1995). Increasingly, technology also puts itself into a position to do things *with* us, particularly with the introduction of ‘relational artifacts’, here defined as artifacts that present themselves as having ‘states of mind’ for which an understanding of those states enriches human encounters with them (Turkle 2004a, b). In the literature, such objects when embodied, are also referred to as ‘sociable robots’ (Breazeal and Scassellati 1999, 2000, Breazeal 2000, 2002, Kidd 2004). Referring to them as relational artifacts makes reference to the psychoanalytic tradition, with its

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focus on the human meaning of the artifact–person connection, and facilitates the comparison of embodied artifacts with a range of software agents that exist only in virtual reality (Turkle 2004a, b, Turkle *et al.* 2004).

Reporting on a series of studies that have brought children and seniors together with commercially available robot creatures, including My Real Babies, Furby's and Paros, we explore two aspects of the subjective effects of relational artifacts.<sup>†</sup> The first aspect, 'robot as Rorschach', refers to how relationships with robots can be used to express other things about an individual, ranging from emotional conflicts to cognitive style. The second aspect, 'robot as evocative object' (Turkle 2005a [1984], 1995), refers to how relationships with even simple robots become the focus for reflection on other things, including questions about 'aliveness' and about the roles of thought and feeling in defining human uniqueness. Children approach a Furby or a My Real Baby and explore what it means to think of these creatures as alive or 'sort of alive'; elders in a nursing home who play with the baby seal robot Paro move from enquiries such as 'Does it swim?' and 'Does it eat?' to 'Is it alive?' and 'Can it love?'

The expressive and evocative vocation of relational artifacts with children and elders today bears a family resemblance to what Turkle (2005a [1984]) described as the response of children to the first generation of computers and computer toys. In the late 1970s and early 1980s, children's style of programming reflected their personality and cognitive style; and computational objects such as Merlin, Simon, and Speak and Spell provoked questions about the quality of aliveness and what is special about being a person.

Twenty years after Turkle's original studies of children and computational toys and games, she found that children and seniors confronting relational artifacts as simple as Furby's, Aibos and My Real Babies (Turkle 2004a) or as complex as the robots Kismet and Cog (Turkle *et al.* 2004) were similarly differentiated in their style of approach and similarly provoked to ask fundamental questions about the objects' natures.<sup>‡</sup> The similarities between Turkle's early studies and those with relational artifacts are not surprising. In both cases, people are meeting an object that falls between known categories. The objects are liminal, betwixt and between, provoking new thinking (Turner 1969, Bowker and Star 1999). In this, the current studies of relational artifacts pose many of the questions raised for researchers who study explicitly *humanlike* androids and their evocative power (Ishiguro 2006, MacDorman and Ishiguro 2006, Mori 1970, Ramey 2006). There, tension around objects seen as too-close-to-human in their form pose anew what Freud identified as unease around the uncanny; the "known of old and long familiar" become strangely unfamiliar (Freud 1919).

There are, however, significant differences between recent responses to relational artifacts and encounters with other forms of computation. Children first confronting computer toys in the 1980s were compelled to classification. Faced with relational artifacts, children's questions about classification are enmeshed in a new desire to *nurture and be nurtured by* the artifacts rather than simply to categorize them; Turkle has said that in their dialogue with relational artifacts, children's focus shifts from cognition to affect, from game playing to fantasies of

<sup>†</sup>We have observed children in groups, usually in school settings, and also gave children Aibos and My Real Babies to take home to 'adopt' for weeklong periods. In this second case, children and their parents recorded their experience with the artifacts in a daily journal. We conducted initial and final interviews with the children and sometimes with their parents and siblings. We introduced Aibos, My Real Babies and Paros into nursing home settings, observing elders individually and in groups.

<sup>‡</sup>The Furby, a small furry robotic creature, which was the rage of the 1998 toy season, is able to give the impression of learning under a child's tutelage. The more complex Sony Aibo, introduced in 1999, is a robotic dog that can learn tricks and develop differently depending on how it is treated (Fujita 2001). My Real Baby, introduced by Hasbro in 2000, was modelled after a 2-year-old child. With tactile sensors, it was able to respond to the behaviour of its users with its baby 'states of mind'. If you bounced the doll it got happier until it got tired and needed to rest and be fed. Kismet and Cog, developed at the MIT Artificial Intelligence Laboratory in the 1990s, are far more advanced in their ability to sense their environment and respond to it, in Cog's case through movement and in Kismet's case through affective expression and speech prosody.



mutual connection. She found the same to be true in a study of relational artifacts among the elderly. For robotics, nurturance is the new 'killer app'. We connect to what we nurture (Turkle 2005a [1984], 2005b).

### 1.1 *Qualitative social research and human–robot interaction*

Using animal companionship to provide emotional and physical well-being for seniors has long been a subject of research interest (Beck and Katcher 1996, Drexler 1999). For practical reasons there is growing interest in robot pet companionship (Baltus *et al.* 2001). Some have found benefits for seniors interacting with the robot Paro, such as lowered stress levels and improved social interaction (Hornyak 2002). Alan Beck and colleagues are studying whether Aibo, a robotic dog, can provide some of the physiological, cognitive and emotional benefits of live pets for the elderly (Beck *et al.* 2003). They have also looked at how preschool children respond to Aibo (Kahn *et al.* 2004) in work that focuses on children's conceptions of the robotic creature and how interactions with the robot may affect social and moral development (Melson *et al.* 2005). Beck *et al.* note that children talk about their interactions with Aibo much as they would those with a stuffed dog, but that they react to it more like they would a living puppy. The researchers conclude that objects such as the Aibo, poised between the animate and inanimate, leave us with a language inadequate to talk about them. In earlier work, Kahn *et al.* (2002) and Friedman *et al.* (2003) looked at how adults talked about their Aibos in online discussions. They found that the Aibos were frequently seen to have agency but rarely given moral standing.

Takayuki Kanda, Hiroshi Ishiguro and their collaborators observed the interactions of children and robots with the goal of learning how to get children to accept robots as 'social partners' (Kanda *et al.* 2004a, b). Their work differs from ours because it focuses on the frequency and task outcome of human–robot interaction rather than individual attitudes or responses to the robots (cf. Sugiyama *et al.* 2006, Walters *et al.* 2006).

Our methods here focus on observation and conversation with technology users in natural settings. We see differences in individual responses to technology as a window onto personality, life history, and cognitive style. Additionally, looking at technology in diverse social contexts helps us better appreciate social complexity. Within the qualitative domain, life-history work and detailed studies of institutions would complement our methods, increasing the opportunities for the social sciences to inform the design of robots in ways that will enhance human experience (Asada *et al.* 2001, MacDorman and Ishiguro 2006).

## 2. Children: Rorschach and evocation

Our distinction between people using robots as projective device and as evocative object is heuristic. The Rorschach response gives priority to the psychological; attention to the evocative power of objects puts the emphasis on philosophy. But in fact, children and seniors develop philosophical positions that are inseparable from their emotional needs. Affect and cognition work together in the subjective response to relational technologies. A series of case studies, first of children and then of seniors, demonstrate this alliance, showing the 'Rorschach effect' and the 'evocative object effect' to be entwined.<sup>†</sup>

<sup>†</sup>Our case studies of children and seniors with Aibo and My Real Baby are drawn from work conducted through weekly visits to schools and nursing homes from 2001 to 2003, studies that encompassed several hundred participants. In our discussion of Paro, we are reporting on studies of the same two nursing homes during the spring of 2005, studies that took place during 12 site visits and recruited 23 participants, ranging in age from 60 to 104, six males, and 17 females.

We begin with a 10-year-old child, Orelia, whose response to the robot Aibo serves as commentary on her relationship to her mother, a self-absorbed woman who during several sessions with her daughter and the robot does not touch, speak, or make eye contact with her daughter. One might say that Orelia's mother acts robotically and the daughter's response is to emphasize the importance and irreducibility of the human heart over any robotic approximation. In a life characterized by maternal chill, Orelia stressed warmth and intuition as ultimate human values.

### 2.1 *Orelia: keeping a robot in its place*

We met Orelia at a private Boston-area middle school where we were holding group sessions of fifth graders with a range of robotic toys. She was given an Aibo to take home, and we asked her to keep a robot 'diary'. We met several times with Orelia and her parents in their home (Turkle 2004a).

Orelia is bright and articulate and tells us that her favourite hobby is reading. She makes determined distinctions between robots and biological beings. 'Aibo is not alive like a real pet; it does not breathe.' She is resolute in preferring a real dog to an Aibo. She believes that Aibo can love but only because 'it is programmed to'. She continues: 'If [robots] love, then it's artificial love. [And] if it's an artificial love, then there really isn't anything true . . . I'm sure it would be programmed to [show that it likes you], you know, the computer inside of it telling it to show artificial love, but it doesn't love you'.

Orelia is sure that she could never love an Aibo. 'They [robots] won't love you back if you love them.' To love, Orelia says, an Aibo would need 'a brain and a heart'. Orelia feels that it is not worth investing in something that does not have the capacity to love back, a construction that is perhaps as much about her relationship with her mother as with the robot.

Orelia's 9-year-old brother, Jake, the baby of the family, is more favoured in his mother's eyes. Unlike his sister, Jake assumes Aibo has feelings. Orelia speaks to the researchers *about* Aibo; Jake addresses Aibo directly. He wants to stay on Aibo's good side, asking, 'Will he get mad if you pick him up?' When Jake's style of addressing Aibo reveals that he finds the robot's affective states genuine, Orelia corrects her brother sharply: 'It [Aibo] would just be mad at you because it's programmed to know "if I don't get the ball, I'll be mad"'. For Orelia, programmed emotions are not to be trusted:

'A dog, it would actually feel sorry for you. It would have sympathy, but Aibo, it's artificial. I read a book called *The Wrinkle in Time*, where everyone was programmed by this thing called "It". And all the people were completely on routine. They just did the same thing over and over. I think it'd be the same thing with the [artificial] dog. The dog wouldn't be able to do anything else.'

For Orelia, only living beings have real thoughts and emotions: 'With a real dog if you become great friends with it, it really loves you, you know, it truly . . . has a brain, and you know somewhere in the dog's brain, it loves you, and this one [Aibo], it's just somewhere on a computer disk . . . If a real dog dies, you know, they have memories, a real dog would have memories of times, and stuff that you did with him or her, but this one [Aibo] doesn't have a brain, so it can't'. Orelia wants the kind of love that only a living creature can provide. She fears the ability of any creature to behave 'as if' it could love. She denies a chilly emotional reality by attributing qualities of intuition, transparency and connectedness to all people and animals. A philosophical position about robots is linked to an experience of the machine-like qualities of which people are capable, a good example of the interdependence of philosophical position and psychological motivation.



## 2.2 *Melanie: yearning to nurture a robotic companion*

The quality of a child's relationship with a parent does not determine a *particular* relationship to robotic companions. Rather, feelings about robots can express different strategies for dealing with one's parents, and perhaps for working through difficulties with them. This is illustrated by the contrast between Orelia and 10-year-old Melanie. Melanie, like Orelia, had sessions with Aibo and My Real Baby at school and was given both to play with at home. In Melanie's case, feelings that she did not have enough of her parent's attention led her to want to nurture a robotic creature. Melanie was able to feel more loved by loving another; the My Real Baby and Aibo were 'creature enough' for this purpose.

Melanie is softly-spoken, intelligent and well mannered. Both of her parents have busy professional lives; Melanie is largely taken care of by nannies and baby-sitters. With sadness, she says that what she misses most is spending time with her father. She speaks of him throughout her interviews and play sessions.

Melanie believes that Aibo and My Real Baby are sentient and have emotions. She thinks that when we brought the robotic dog and doll to her school 'they were probably confused about who their mommies and daddies were because they were being handled by so many different people'. She thinks that Aibo probably does not know that he is at her particular school because the school is strange to him, but 'almost certainly does know that he is outside of MIT and visiting another school'. She sees her role with the robots as straightforward; it is maternal.

One of Melanie's third-grade classmates treats My Real Baby as an object to explore and handles it very roughly, poking its eyes, pinching its skin to test its 'rubber-ness', and putting her fingers roughly inside its mouth. Observing this, Melanie comes over to rescue the doll. She takes it in her arms and proceeds to play with it as though it were a baby, holding it close, whispering to it and caressing its face. When she is about to take it home, Melanie says, 'I think that if I'm the first one to be with her then maybe if she goes home with another person [another study participant] she'll cry a lot . . . because she doesn't know, doesn't think that this person is its Mama'. For Melanie, My Real Baby's aliveness is dependent on its animation and relational properties. She is not concerned about its lack of biology. Melanie's understanding that My Real Baby is a machine is clear in her description of its possible 'death'.

'Hum, if his batteries run out, maybe [it could die]. I think it's electric. So, if it falls and breaks, then it would die, but if people could repair it, then I'm not really sure. [I]f it falls and like totally shatters I don't think they could fix it, then it would die, but if it falls and one of its ear falls off, they would probably fix that.'

Melanie combines a mechanical view of My Real Baby with confidence that it deserves to have her motherly love. At home, Melanie has Aibo and My Real Baby sleep near her bed and believes they will be happiest on a silk pillow. She names My Real Baby after her 3-year-old cousin Sophie. 'I named her like my cousin . . . because she [My Real Baby] was sort of demanding and said most of the things that Sophie does'. She draws an analogy between the Aibo and her dog, Nelly. When Aibo malfunctions, Melanie does not experience it as broken, but as behaving in ways that remind her of Nelly. In the following exchange that takes place at MIT, Aibo makes a loud, mechanical, wheezing sound and its walking becomes increasingly wobbly. Aibo falls several times and then finally is still. Melanie watches this unfold.

Melanie: Oh, that's what my dog does when he wants attention . . . I think it might be sleeping. Or just stretching in a different way than a normal dog would. Aibo? I think he's trying to be a little playful, or . . . who knows? I wonder what that sound means?

Researcher: What do you think it might mean?

Melanie: Either something's wrong because the light is flashing, or just, it's going to sleep. [Long pause] There we go. [Laughs nervously as Aibo is trying to walk again] Cute little feet . . . Sort of what Nelly [Melanie's puppy] does. Ooh it's following the ball! Or at least trying to. [Aibo collapses] Aww, man! How playful. Aibo! [Taking it in her arms] He knows that I'm holding it.

Researcher: How does it make you feel, when Aibo kind of falls down like that?

Melanie: Well, it makes me sort of think that it's sort of tired, and wants to rest.

Melanie gently picks up the limp Aibo and holds it close, petting it softly. At home, she and a friend treat it like a sick animal that needs to be rescued. They give it 'veterinary care'.

Melanie: My friend seemed to think that it was playing dead, but I doubted it.

Researcher: What do you think was going on?

Melanie: I think it was a virus. Maybe the flu.

Researcher: So you thought that Aibo was sick?

Melanie: Yeah. Poor Aibo.

Researcher: How did that make you feel?

Melanie: I felt sad for it. It was a good Aibo.

In thinking about relational artifacts such as Furbys, Aibos, My Real Babies and Paros, the question is posed: How do these objects differ from 'traditional' (non-computational) toys, such as teddy bears and Raggedy-Ann dolls? Melanie, unbidden, speaks directly to this issue. With other dolls, she feels that she is 'pretending'. With My Real Baby, she feels that she is really the doll's mother: '[I feel] like I'm her real mom. I bet if I really tried, she could learn another word. Maybe Da-da. Hopefully if I said it a lot, she would pick it up. It's sort of like a real baby, where you wouldn't want to set a bad example'. When the doll expresses love to her, Melanie experiences the emotion as genuine, comparing My Real Baby to her brother, Arthur:

Researcher: What do you think when it says it loves you?

Melanie: I think that she really does.

Researcher: How does that make you feel?

Melanie: I feel really good when it says that. Her expressions change. Sort of like Arthur.

Melanie sees My Real Baby as capable of complex, mixed emotions. 'It's got similar to human feelings, because she can really tell the differences between things, and she's happy a lot. She gets happy, and she gets sad, and mad, and excited. I think right now she's excited and happy at the same time'.

Melanie's imaginative play with My Real Baby and Aibo is rich. She sees My Real Baby as alive and 'growing up' to be a 4-year-old (this is Arthur's age). Melanie imagines that she lives in a condo where she takes care of My Real Baby. Turkle has pointed out that in these pretend scenarios, one might say that Melanie's attachment to Aibo moves from having an 'as-if' quality to an 'as though' emotional reality for her (Turkle 2005b). Melanie seems to believe that Aibo and My Real Baby really love her. 'They make me incredibly happy.' Melanie thinks the robots are good companions; she expresses the opinion that older people would like them. They would be 'reminded of being parents'.

Melanie's interaction with My Real Baby involves imagining it as alive and needing her care. After feeding the doll, Melanie tries to make it burp several times, saying that she knows that this is what babies need to do. Melanie holds the doll ever closer and with increasing tenderness. She believes that the doll is getting to know her better the more time they spend together.

Researcher: Do you think the doll is different now than when you first started playing with it?

Melanie: Yeah. I think we really got to know each other a lot better. Our relationship, it grows bigger. Maybe when I first started playing with her, she didn't really know me so she wasn't making as much [sic] of these noises, but now that she's played with me a lot more she really knows me and is a lot more outgoing. Same with Aibo.

Researcher: How do you think the doll feels when you go to school?

Melanie: Maybe it feels sort of sad because it would have no one to play with, and maybe it would play with my other animals.



Researcher: How could you tell?

Melanie: I think when it starts to breathe a little bit harder.

When her several weeks with Aibo and My Real Baby come to an end, Melanie is sad to return them. Before leaving them with us, Melanie opens the boxes in which they are housed and gives them each an emotional goodbye. She hugs each one separately, tells them both that she will miss them very much but that she knows we (the researchers) will take good care of them. Melanie is concerned that the toys will forget her, especially if they spend a lot of time with other families.

Melanie's relationship with the Aibo and My Real Baby illustrates how they trigger projection: she nurtures them because getting enough nurturance is an issue for her; but in providing nurturance to the robots, Melanie provided it to herself as well (and in a way that felt more authentic than developing a relationship with a 'traditional' doll). In another case, a seriously ill child was able to use relational robots to speak more easily in his own voice.

### 2.3 Jimmy: from Rorschach to relationship

Jimmy, small, pale, and thin, is just completing first grade. He has a congenital illness and spends a great deal of time in hospitals. Jimmy comes to our study with a long history of playing computer games. His favourite is Roller Coaster Tycoon. Many children play the game to create the wildest roller coasters possible; Jimmy plays the game to maximize the maintenance and staffing of his coasters so that the game gives him awards for the safest park. Jimmy's favourite toys are Beanie Babies.

Jimmy approaches Aibo and My Real Baby as objects with consciousness and feelings. When Aibo slams into the red siding that defines his game space, Jimmy interprets his actions as 'scratching a door, wanting to go in . . . I think it's probably doing that because it wants to go through the door . . . Because he hasn't been in there yet'. Jimmy thinks that Aibo has similar feelings toward him as his biological dog, Sam. He says that Aibo would miss him when he goes to school and would want to jump into the car with him. In contrast, Jimmy does not believe that his Beanie Babies, the stuffed animal toys, have feelings or 'aliveness', or miss him when he is at school. Jimmy tells us that other relational artifacts like Furbys 'really do' learn and are the same 'kind of alive' as Aibo.

During several sessions with Aibo, Jimmy talks about Aibo as a super dog that shows up his own dog as a limited creature. Jimmy says: 'Aibo is probably as smart as Sam and at least he isn't as scared as my dog [is]'. When we ask Jimmy if there are things that his dog can do that Aibo cannot do, Jimmy answers not in terms of his dog's strengths but in terms of his deficiencies: 'There are some things that *Sam can't do and Aibo can*. Sam can't fetch a ball. Aibo can. And Sam definitely can't kick a ball'. On several other occasions, when Aibo completed a trick, Jimmy commented 'My dog couldn't do that!' Aibo is the 'better' dog. Aibo is immortal, invincible. Aibo cannot get sick or die. In sum, Aibo represents what Jimmy wants to be.

During Jimmy's play sessions at MIT, he forms a strong bond with Aibo. Jimmy wants to protect Aibo by taking him home. Jimmy tells us that he would probably miss Aibo as much as Sam if either of them died. As we talk about the possibility of Aibo dying, Jimmy explains that he believes Aibo could die if he ran out of power:

If you turn him off he dies, well, he falls asleep or something . . . He'll probably be in my room most of the time. And I'm probably going to keep him downstairs so he doesn't fall down the stairs. Because he probably, in a sense he would die if he fell down the stairs. Because he could break. . . . he'd die like.

Jimmy's concerns about his vulnerable health are expressed with Aibo in several ways. Sometimes he thinks the dog is vulnerable, but Jimmy thinks he could protect him. Sometimes he

thinks the dog is invulnerable, a super-hero dog in relation to his frail biological counterpart. He tests Aibo's strength in order to feel reassured.

Jimmy 'knows' that Aibo does not have a real brain and a heart, but sees Aibo as a mechanical kind of alive, where it can function as if it had a heart and a brain. For Jimmy, Aibo is 'alive in a way', because he can 'move around' and '[H]e's also got feelings. He shows ... he's got three eyes on him, mad, happy, and sad. And well, that's how he's alive'. As evidence of Aibo's emotions, Jimmy points to the robot's lights: 'When he's mad, they're red. [And when they are green] he's happy'.

Jimmy has moments of intense physical vulnerability, sometimes during our sessions. His description of how Aibo can strengthen himself is poignant. 'Well, when he's charging that means, well he's kind of sleepy when he's charging but when he's awake he remembers things more. And can see it'. Aibo reassures Jimmy when it recharges; it provides a model of an object that can resist death. If Aibo can be alive through wires and a battery then this leaves hope that people can be 'recharged' and 'rewired' as well. Jimmy's emotional connection to the medical technology that keeps him alive helps to explain his identification with Aibo and his philosophical position that robots, too, have a 'kind of life'.

At home, Jimmy likes to play a game in which Bio Bugs attack his Aibo. Bio Bugs are robotic toy creatures that walk and fight each other as they develop through several stages, gaining in 'survival skills', most notably aggression. Jimmy describes the fighting scenes with much excitement. Although he says that he is, 'in general', adverse to fighting and aggression, he relishes these particular contests. In them, he identifies with Aibo, fighting off threats to the body. Aibo lives through technology and Jimmy sees Aibo's survival as his own. Jimmy's hopes to someday be like Aibo, a 'kind of life' that defies death.

Jimmy's 12-year-old brother, Tristan, is distant from him. Jimmy voices concern that his brother holds back because Tristan is afraid that Jimmy may die. Jimmy identifies with Aibo when he goes on to describe in a shaky voice, his brother's distance from the robot during the time they had it at home: "He didn't want to get addicted to him so he [Tristan] would be sad when we had to give him back'.

Jimmy felt that Aibo missed him when he was away. Jimmy says that when he has to return Aibo to us, he will miss the robot 'a little bit' but that it is Aibo that will probably miss him more.

### 3. Seniors: robots as a prism for the past

Interacting with relational artifacts puts some seniors in touch with significant life relationships (Drexler 1999, Hirsch *et al.* 2000). When we brought My Real Babies into nursing homes, it was not unusual for seniors to use the doll to re-enact scenes from their children's youth or important moments in their relationships with spouses. From the earliest days of our project, we saw that seniors were more comfortable playing out family scenes with robotic dolls than with traditional ones. Seniors felt social 'permission' to be with the robots, presented as a highly valued and 'grown-up' activity. Additionally, the robots provided the elders something to talk about, a seed for a sense of community.

Although many of the seniors we interviewed had non-robotic dolls or stuffed animals, a staff member of one of the nursing homes felt that the seniors' relationships with the robots were sufficiently helpful to justify buying robotic dolls with her own funds to supplement the dolls provided through our project.

Some seniors wanted the objects to be transparent, as clockwork might be, and became anxious when their efforts to investigate the robots' 'innards' were frustrated. Others were



content to interact with the robots as they presented themselves, with no window on to how they 'worked' in any mechanical sense. These seniors took the relational artifact 'at interface value' (Turkle 1995). In each case, emotional issues infused philosophical positions toward the technology.

### 3.1 Jonathan: exploring a relational creature, engineer-style

Jonathan, 74, has movements that are slow and precise; he is well spoken, curious and intelligent. He tells us that throughout his life he has been ridiculed for his obsessive ways. Jonathan tends to be reclusive and has few friends at the nursing home. Never married, with no children, he has always been a solitary man. For most of his life, Jonathan worked as an accountant, but was happiest when he worked as a computer programmer. Jonathan approaches Aibo and My Real Baby with a desire to analyse them in the analytical style of the engineer. From his first interaction with the My Real Baby at a group activity to his last interview after having kept the robot for 4 months in his room, Jonathan remained fascinated with how it functioned.

When Jonathan meets My Real Baby, the robot is cooing and giggling. Jonathan looks it over carefully, bounces it up and down, pokes and squeezes it, and moves its limbs. With each move, he focuses on the doll's reactions. Jonathan tries to understand what the doll says and where its voice comes from. Like Orelia, Jonathan talks to the researchers about the robot, but does not speak to the robot itself. When he discovers that My Real Baby's voice comes from its stomach, he puts his ear next to the stomach and says: 'I think that this doll is a very remarkable toy. I have never seen anything like this before. But I'd like to know, how in the entire universe is it possible to construct a doll that talks like this?'

Despite his technical orientation to the robot, Jonathan says that he would be more comfortable speaking to a computer or robot about his problems than to a person:

'For things about my life that are very private, I would enjoy talking more to a computer . . . but things that aren't strictly private I would enjoy more talking to a person . . . Because if the thing is very highly private and very personal it might be embarrassing to talk about it to another person, and I might be afraid of being ridiculed for it . . . And it wouldn't criticize me . . . Or let's say that if I wanted to blow off steam, it would be better to do it to a computer than to do it to a living person who has nothing to do with the thing that's bothering me. [I could] express with the computer emotions that I feel I could not express with another person, to a person.'

When we ask Jonathan what he plans to do with the robotic doll when we leave it with him for several months, he answers 'I suppose [I will] touch it in various places and listen to what she says'. His interactions with the doll are a series of experiments. Most notably, he slaps the doll to test how it reacts ('to see if the doll will start crying'). Closely following the instruction manual, Jonathan opens the back of the doll with a screwdriver, takes out the batteries and replaces them. Although Jonathan relates to the doll as an object, he says that looking inside the doll could help him establish an emotional connection with it. Nevertheless, Jonathan cannot imagine that his bond with My Real Baby could be similar to his bond with live animals, for example, the cat he took care of before coming to the nursing home:

Researcher: Do you think you could develop the same kind of relationship with a robot animal as with the cat you used to have?

Jonathan: No. Because some of the things I used to enjoy with the cat are things I could never have with a robot animal. Like the cat showing affection, jumping up on my lap, letting me pet her and listening to her purr. A robot animal couldn't do that, and I enjoyed it very much.

Researcher: What if the robot cat could do that? What if you couldn't tell from the behavior that they were robots?

Jonathan: Yes, but what I liked was how the cat showed me that she really liked me. How can these robot animals show affection? I just think that a robot animal couldn't give me as much satisfaction as a real animal could . . . I don't see how a robot animal could possibly show me that it really likes me. I don't see how it could really show me any affection.

Jonathan makes a distinction between the affection that can be offered by something alive and an object that acts as if it were alive. For Jonathan, it would be demeaning to have too intimate a connection with the latter. It follows that, for Jonathan, it would be 'embarrassing' to see an adult woman interact with a robot baby, even if you could not tell that it was not a live baby. He believes that the robot doll can bring comfort to adults and seniors but that interacting with one is something that should be done in private.

### 3.2 *Andy: animation in the service of working through*

Andy, 76, at the same nursing home as Jonathan, is recovering from depression. At the end of each of our visits to the nursing home, he makes us promise to come back as soon as we can. Andy feels abandoned by his family and friends. He wants more people to talk with. He participates in a day-programme outside the home, but nevertheless often feels bored and lonely. Andy loves animals and has decorated his room with scores of cat pictures; he tells us that some of his happiest moments are being in the nursing home's garden speaking to birds, squirrels and neighbourhood cats. He believes they communicate with him and considers them his friends. Andy treats robotic dolls and pets as sentient; they become stand-ins for the people he would like to have in his life. Like Jonathan, we gave Andy a My Real Baby to keep in his room for 4 months. He never tired of its company.

The person Andy misses most is his ex-wife Rose. Andy reads us songs he has written for her and letters she has sent him. My Real Baby helps him work on unresolved issues in his relationship with Rose. Over time, the robot comes to represent her:

Researcher: What are some things that you talked to the doll about?

Andy: Everything. If somebody heard me they would probably think that I'm crazy.

Researcher: Did you give the doll a name?

Andy: Rose. That was my ex-wife's name.

Researcher: Did you pretend that it was Rose when you talked to her?

Andy: Yeah. I didn't say anything bad to her, but some things that I would want to say to her. It helped me to think about her and the time that I didn't have my wife, how we broke up, think about that, how I miss seeing her . . . the doll, there's something about her, I can't really say what it is, but looking at her reminds me of a human being. She looks just like her, Rose, my ex-wife, and her daughter . . . something in her face is the same, looking at her makes me feel more calm. I can just think about her and everything else in my life.

Andy speaks at length about his difficulty getting over his divorce, his feelings of guilt that his relationship with Rose did not work out, and his hope that he and his ex-wife might someday be together again. Andy explains how having the doll enables him to try out different scenarios that might lead to reconciliation with Rose. The doll's presence enables him to express his attachment and vent his feelings of regret and frustration.

Andy tells us that although he had stuffed animals and even one 'plain doll' in his late adult life, none of these ever reminded him of his ex-wife, as does My Real Baby. They did not move and did not seem as 'real':

Researcher: How does it make you feel to talk to the doll?

Andy: Good. It lets me take everything inside me out. You know, that's how I feel talking to her, getting it all out of me and feel not depressed . . . when I wake up in the morning I see her over there. It makes me feel so nice, like somebody is watching over you. . . . It will really help me [to keep the doll] because I am all alone. There's no one around. So I can play with her. We can talk. It will help me get ready to be on my own.

Researcher: How?

Andy: By talking to her, saying some of the things that I might say when I did go out, because right now, you know, I don't talk to anybody right now, and I can talk much more right now with her than, I don't talk to anybody right now.



In contrast with Jonathan who put My Real Baby in a bag and stored it in a closet, Andy gives the doll his favourite baseball cap to wear and displays her proudly on his windowsill. He enjoys showing the doll to visitors and introduces her almost as one would a family member.

When Andy is first shown My Real Baby, he takes the doll in his arms and holds it with the tenderness one would show an infant. In response to questions about the doll, Andy speaks about the doll but at most other times, speaks directly *to* the doll. As My Real Baby babbles, Andy holds the doll close to his chest, rubs its back in a circular motion, and says, 'I love you. Do you love me?' He makes funny faces at the doll, as if to prevent her from falling asleep or just to amuse her. When the doll laughs with perfect timing as if responding to his grimaces, Andy laughs back, joining her.

Andy becomes attached to My Real Baby as well to the Aibos and Furbys at the home. In his relationship with all three robots, the greater his degree of attachment, the greater his efforts to nurture. With My Real Baby, Andy gives the doll its bottle when it is 'hungry'. With Aibo and Furby, he tries to determine the robots' 'needs', doing his best to make them happy. And Andy wants to protect the robots. Once when he saw Jonathan spanking My Real Baby, he playfully tried to enlist the Furby to 'make Jonathan stop hurting the baby'.

#### 4. Relational considerations and the question of design

In our work with My Real Babies, Furbys and Aibos, our primary focus was the nature of our informants' interactions with these machines. We brought concerns with design and institutional life to our work with Paro, a robotic seal, at the same nursing home. Paro, unlike the other robots, was specifically designed for the purpose of providing a therapeutic-style experience for its users, conceived from the beginning to be the elderly (Shibata *et al.* 1999, Shibata 2004). Here, we look at design issues that follow from how different individuals relate to the robot; we ask how best to incorporate such machines into the complex social environment of the nursing home.

Among the elderly, Paro, like My Real Baby, elicits admiration, loving behaviour and curiosity. All of the residents to whom Paro was introduced met the robot at a table, seated with others. Most expressed a desire to share Paro with other people at the table and reported that they enjoyed talking to others about Paro. Most often, the spirit of the table was collective curiosity.

Most of the interactions with the Paro are short exchanges: 'Would you look at that?' 'How about that?' 'Isn't he cute?' Sometimes residents ask the robot questions and receive a 'response' in the form of sound or movement that they interpret as meaningful communication. They ask 'Are you sleepy?' 'Are you a good boy?' 'Are you hungry?' 'Do you want something to eat?' and 'What's your name?' They especially ask the researchers, and sometimes each other, questions concerning Paro's 'essence': 'Is it a seal or a dog?' 'Can it do more?' 'Is it a he or a she?' 'Can it swim?' 'Where is it from?' 'Does it have a name?' 'Does it eat?' And poignantly, as had been the case with My Real Baby, nursing home residents try to use Paro as a companion with whom they can share life stories.

Our work with Paro suggests several design principles that might maximize the usefulness of robotic creatures in assisted living facilities. First, in comparison with the far simpler My Real Baby, Paro needs to be stored, cleaned and recharged with a fairly heavy charging device. These are not tasks that many nursing home residents are able to carry out. My Real Baby was easy to turn on and off; Paro's power button is intentionally difficult to locate. Realizing that they cannot turn Paro on and off diminishes seniors' all-too-fragile sense of being in control. Technologies that require the attention of an overworked staff may go unused. Second, because

Paro is designed to simulate a marine mammal (a baby harp seal), many nursing home residents expressed a desire to place it in water, an action with destructive potential for both Paro and its users. It is a popular idea in contemporary robotics to create robots that mimic unfamiliar or made-up creatures. In this way, people are not disappointed if a robotic dog does not perform the way a biological dog would be expected to. In the case of Paro, people *do* know that seals swim and can move on the rocks around water. Paro moves its flippers, but they are not designed to produce any sort of locomotion. This means that Paro can give the impression of struggling to move on land and nursing home residents frequently believed, quite rationally, that Paro might do better in water. 'It is trying to swim to you', one resident said when Paro appeared as if it was trying, futilely, to get itself across the table. We note that curiosity about Paro and water is not attributable to senile dementia; we have been asked 'Can it swim?' by mentally healthy adults in many contexts, including our research university. One nursing home resident remarked, '[I]t would be nice. You could keep him in the bathtub'. After the caregiver responded that she did not think that was a good idea, the participant shot back, 'It's a seal. Wouldn't you put a seal in the bathtub?'

The fact that Paro presents itself as a seal poses other kinds of problems. The nursing home residents know that seals are wild, non-domesticated animals. Seals are not animals that people normally 'play' with. Although Paro is designed to evoke a baby (and thus vulnerable) seal, it is still an object that some approach with caution. This seemed to be a problem for older residents. Several expressed anxiety when presented with Paro. As one said, 'I think he is going to bite me . . . he scared me'. Paro does not actually have teeth, and most residents, after being reassured that the robot would not hurt them, became more relaxed.

##### 5. Robotic companionship and social ownership

Our studies of My Real Baby took place from 2001 to 2003. We have noted that, after our initial investigation, caregivers in that home purchased several more of them and have used them regularly with a small group of residents. This natural experiment provides valuable information about the long-term feasibility of relational robots in eldercare settings. The activities director at this home uses the robot to assuage residents' anxieties. When she sees certain residents getting anxious, she fetches a My Real Baby, turns it on, and lets the resident spend time with it. Usually, she takes the doll back in less than an hour. She notes that when she does so, its mouth is often covered in oatmeal, the result of a resident having attempted to feed it. Although My Real Baby exerts a calming influence, the director's experience has been that 'caring' for the doll becomes too much for some residents. She says: 'You know, sometimes it's like you have to put the baby to bed. Just to give her a break. It will calm her and then . . . too much is too much sometimes'.

Paro, like My Real Baby, initiates a relationship based on an implicit request to be played with and taken care of. Through its cries and utterances, My Real Baby makes it plain that it 'needs' the care of its user, and the user is thereby encouraged to interact. Similarly, to the extent that people 'understand' Paro, they understand that it needs their attention. However, many of the elderly we met in the home were unable or unwilling to take on the 'responsibility' of caring for a robot. Some said that they enjoyed playing with Paro but would not choose to have one for themselves. Our question, 'Would you like to have a toy like this to play with whenever you wanted?' is interpreted as asking if they want to adopt a baby or acquire a pet, something that they know they cannot handle.

It may be that the most realistic way to introduce robotic creatures into eldercare facilities is as a shared object, with the responsibility for its care spread across several individuals. One staff member described how My Real Baby circulates around the home: 'It travels . . . roams,



... if there is an empty bed in the room, it sleeps there'. This is the model that the activities director uses for the care of the 'house cat'. Several residents play with the cat, and the cat even sleeps with some of the residents, but care of the cat is communal work, with ultimate responsibility falling on the staff. If one followed this model for robotic pets, the psychological burden for caring for the objects would be reduced.

## 6. *Paro* in context

In 'Whither psychoanalysis in computer culture?', Turkle (2004b) suggested that to understand fully our relationships with relational artifacts will require a new object relations psychology. For example, she noted (Turkle 2004b):

'Heinz Kohut describes how some people may shore up their fragile sense of self by turning another person into a self object.

In the role of self object, the other is experienced as part of the self, thus in perfect tune with the fragile individual's inner state. Disappointments inevitably follow. Relational artifacts (not only as they exist now but as their designers promise they will soon be) clearly present themselves as candidates for such a role. If they can give the appearance of aliveness and yet not disappoint, they may even have a comparative advantage over people, and open new possibilities for narcissistic experience with machines. One might even say that when people turn other people into self-objects, they are making an effort to turn a person into a kind of spare part. From this point of view, relational artifacts make a certain amount of sense as successors to the always-resistant human material.'

When Turkle spoke of relational artifacts making 'a certain amount of sense', her tone was ironic. She was pointing to the possibility that people who are having a hard time with relationships may be tempted to turn to machines to satisfy their emotional needs. In our study of *Paro*, we noted a telling inversion of this scenario. One of the researchers was there with the *Paro*, but compared to the robot, he was a more attractive target of female attention; this appreciation took place in such an understaffed nursing home that the management decided our study could not continue. The tension in the field of geriatrics—the lack of people and thus the seduction of the robotic and the attendant danger that the robots will, if at all successful, be left there alone—was a subtext in our field experience where a robotic creature not only evoked conversation and curiosity about categorization, but was also the occasion around which residents' expressed a desire for human connection.

Relational artifacts, as objects between the living and not living (Ramey 2005), may have some special resonance for their frail nursing home playmates. The residents themselves experience their existence in the home as a placement on the boundary between their own lives and their deaths. Like relational artifacts, they are liminal creatures.

The relationships we tracked bring tensions about autonomy within a nursing home to the surface. For some residents *Paro* promotes the fantasy of autonomy ('You are autonomous ... this thing can be dependent upon you'). For others it disrupts the fiction ('You now know that you are wholly dependent on us. Play with this toy ... You are like a child').

The psychoanalyst Slavoj Žižek (2002) has spoken of the fetishistic disavowal that is required for certain types of play: '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'. As one nursing home resident said about *Paro*: 'I don't care if he is real or not. I love him'.

## 7. Discussion

Studying children and seniors with relational artifacts offers insights that may help us keep human purposes in mind as we create and appropriate new technologies. Even with simple

relational artifacts, we saw the possibility for significant attachment. In studying relational artifacts with more complex capabilities such as the MIT robots Kismet and Cog (Turkle *et al.* 2004), the desire to have the robots say one's name, and to respond to love with love, were even more intense.

If we value authenticity in relationships, the fact that our parents, grandparents and our children might say 'I love you' to a robot who will say 'I love you' in return, does not feel completely comfortable; it raises questions about what kind of authenticity we require of our technology. Do we want robots saying things that they could not possibly 'mean'? What kinds of relationships do we think are most appropriate for our children and our elders to have with relational artifacts? And for children, what kinds of relationships are developmentally healthy?

If one were reticent about having machines 'seem' to be smarter than they really are, one might suggest that robots, acting instrumentally in a nursing home, might, by giving timely reminders to take medication or call a nurse, show a kind of caretaking that is 'appropriate' to their 'true' natures. But it is not as simple as that. Elders may come to love the robots that care for them, and it may be too frustrating if the robot does not say the words 'I love you' back, just as we can already see that it is frustrating if a robot that is receiving a senior's attention is not programmed to say that person's name.

In sum, relational artifacts open up conversations about what is essential about aliveness, what is special about being a person, and the roles of thought and feeling, in defining human uniqueness. Interactions with robots are a powerful projective screen as well as a site for working through personal and social concerns. As robots move into the therapeutic domain, clinical robotics will need to take such matters to heart.

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### References

- M. Asada, K.F. MacDorman, H. Ishiguro and Y. Kuniyoshi, "Cognitive developmental robotics as a new paradigm for the design of humanoid robots", *Robot. Automation*, 37, pp. 185–193, 2001.
- G. Baltus, D. Fox, F. Gemperle, J. Goetz, T. Hirsch, D. Magaritis, M. Montemero, J. Pineau, N. Roy, J. Schulte and S. Thrun, "Towards personal service robots for the elderly", in *Proceedings of the Workshop on Interactive Robotics and Entertainment (WIRE)*, 2001.
- A. Beck, N. Edwards, B. Friedman and P.H. Kahn, Jr, "Robotic pets and the elderly", 2003. Available online at: <http://www.ischool.washington.edu/robotpets/elderly> (accessed 5 April 2005).
- A. Beck and A. Katcher, *Between Pets and People*, West Lafayette: Purdue University Press, 1996.
- G.C. Bowker and S.L. Star, *Sorting Things Out: Classification and its Consequences*, Cambridge, MA: MIT Press, 1999.
- C. Breazeal, "Sociable machines: expressive social exchange between humans and robots". PhD thesis, Massachusetts Institute of Technology (2000).
- C. Breazeal, *Designing Sociable Robots*, Cambridge, MA: MIT Press, 2002.
- C. Breazeal and B. Scassellati, "How to build robots that make friends and influence people", in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 858–863, 1999.
- C. Breazeal and B. Scassellati, "Infant-like social interactions between a robot and a human caretaker", *Adaptive Behav.*, 8, pp. 49–74, 2000.
- M. Drexler, "Pet robots considered for elderly", 1999. Available online at: <http://www.cnn.com/TECH/ptech/9903/25/robocat.idg/> (accessed 10 January 2004).
- B. Friedman, P.H. Kahn, Jr and J. Hagman, "Hardware companions? What online Aibo discussion forums reveal about the human-robotic relationship", in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 273–280, 2003.



- S. Freud, "The Uncanny", *The Standard Edition of the Complete Psychological Works*, Vol. XVII, J. Strachey et al., Eds. London: The Hogarth Press, pp. 219–252, 1953–1974, 1919.
- M. Fujita, "Aibo: towards the era of digital creatures", *Int. J. Robot. Res.*, 20, pp. 781–794, 2001.
- T. Hirsch, J. Forlizzi, E. Hyder, J. Goetz, J. Stroback and C. Kurtz, "The ELDeR project: social and emotional factors in the design of eldercare technologies", in *Proceedings on the Conference on Universal Usability*, pp. 72–79, 2000.
- T. Hornyak, "Seal of approval", *Japan Inc. Magazine Online*, June 2002. Available online at: <http://www.japaninc.net/article.php?articleID=819> (accessed 15 December 2003).
- H. Ishiguro, "Android science: conscious and subconscious recognition", *Connection Sci.*, 2006 (this issue).
- P.H. Kahn, Jr, B. Friedman and J. Hagman, "'I care about him as a pal': conceptions of robotic pets in online Aibo discussion forums", in *Proceedings of CHI 2002*, New York: ACM Press, pp. 623–633, 2002.
- P.H. Kahn, Jr, B. Friedman, D.R. Perez-Granados and N.G. Freier, "Robotic pets in the lives of preschool children", in *CHI Extended Abstracts*, New York: ACM Press, pp. 1449–1452, 2004.
- T. Kanda, H. Takayuki, D. Eaton and H. Ishiguro, "Interactive robots as social partners and peer tutors for children: a field trial", *Hum. Comput. Interact.*, 19, pp. 61–84, 2004a.
- T. Kanda, H. Ishiguro, M. Imai and T. Ono, "Development and evaluation of interactive humanoid robots," in *Proceedings of the IEEE*, pp. 1839–1850, 2004b.
- C.D. Kidd, "Sociable robots: the role of presence and task in human-robot interaction". Master's thesis, Massachusetts Institute of Technology (2004).
- K.F. MacDorman and H. Ishiguro, "The uncanny advantage of using androids in social and cognitive science research", *Interact. Stud.*, 7, pp. 297–337, 2006.
- G.F. Melson, P.H. Kahn, Jr, A.M. Beck, B. Friedman, T. Roberts and E. Garrett, "Robots as dogs? Children's interactions with the robotic dog Aibo and a live Australian shepherd", in *Extended Abstracts of the Conference on Human Factors in Computing Systems*, New York: ACM Press, pp. 1649–1652, 2005.
- M. Mori, "Bukimi no Tani [The Uncanny Valley]", *Energy*, 7, pp. 33–35, 1970 (in Japanese).
- C.H. Ramey, "The uncanny valley of similarities concerning abortion, baldness, heaps of sand, and humanlike robots", in *Proceedings of the Views of the Uncanny Valley Workshop, IEEE-RAS International Conference on Humanoid Robots*, 2005.
- T. Shibata, "An overview of human interactive robots for psychological enrichment", in *Proceedings of the IEEE*, pp. 1749–1758, 2004.
- T. Shibata, T. Tashima and K. Tanie, "Emergence of emotional behavior through physical interaction between human and robot", in *Proceedings of the IEEE International Conference on Robotics and Automation*, pp. 2868–2873, 1999.
- O. Sugiyama, T. Kanda, M. Imai, H. Ishiguro and N. Hagita, "Humanlike conversation with gestures and verbal cues based on a three-layer attention-drawing model", *Connection Sci.*, 2006 (this issue).
- S. Turkle, *Life on the Screen: Identity in the Age of the Internet*, New York: Simon and Schuster, 1995.
- S. Turkle, "Relational artifacts". NSF Report (NSF Grant SES-0115668) (2004a).
- S. Turkle, "Whither psychoanalysis in computer culture", *Psychoanal. Psychol.: J. Div. Psychoanal., Am. Psychol. Ass.*, 21, pp. 16–30, 2004b.
- S. Turkle, *The Second Self: Computers and the Human Spirit*, Cambridge, MA: MIT Press, 2005a [1984].
- S. Turkle, "Caring machines. Keynote: relational artifacts for the elderly", in *Proceedings of the AAAI Workshop: Caring Machines*, 2005b.
- S. Turkle, C. Breazeal, B. Scasselati and O. Dasté, "Encounters with Kismet and Cog: children's relationships with humanoid robots", in *Proceedings of IEEE Humanoids 2004*, 2004.
- V. Turner, *The Ritual Process: Structure and Antistructure*, Chicago: Aldine, 1969.
- M.L. Walters, K. Dautenhahn, S.N. Woods, K.L. Koay, R. te Boekhorst and D. Lee, "Exploratory studies on social spaces between humans and a mechanical-looking robot", *Connection Sci.*, 2006 (this issue).
- S. Zizek, *The Zizek Reader*, London: Blackwell, 2002.