# Hardware Companions? – What Online AIBO Discussion Forums Reveal about the Human-Robotic Relationship

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## ABSTRACT
In this study, we investigated people's relationships with AIBO, a robotic pet, through 6,438 spontaneous postings in online AIBO discussion forums. Results showed that AIBO psychologically engaged this group of participants, particularly by drawing forth conceptions of technological essences (75%), life-like essences (49%), mental states (60%), and social rapport (59%). However, participants seldom attributed moral standing to AIBO (e.g., that AIBO deserves respect, has rights, or can be held morally accountable for action). Our discussion focuses on how robotic pets (now and in the future) may (a) challenge traditional boundaries (e.g. between who or what can possess feelings), (b) extend our conceptions of self, companionship, and community, and (c) begin to replace interactions with live pets. We also discuss a concern that people in general, and children in particular, may fall prey to accepting robotic pets without the moral responsibilities (and moral developmental outcomes) that real, reciprocal companionship and cooperation involves. This research contributes to a growing literature on the human-robotic relationship.

### Keywords
AIBO, companionship, ethics, human-robotic relationship, human values, moral development, online community, online discussion forums, robotic pets, social responses to technology, user conceptions, Value Sensitive Design, virtual pets.

## INTRODUCTION
In this study, we investigated people's relationship with one of the most sophisticated deployed personal robots on the market – Sony's robotic dog AIBO.



This artifact – AIBO – represents the integration of two long-standing areas of research within the CHI community. The first area involves computer persona that exist on the desktop computer or through voice interfaces, including virtual embodied agents [3, 8, 23] and social responses to computer technology [21, 22, 28]. For example, Parise, Kiesler, Sproull, and Waters [23] investigated issues of cooperation with a talking computer agent that resembled a person, a dog, or a cartoon dog, or with a confederate interacting through a video link. The second area involves computational artifacts (without a persona) that link people to a physical world, including augmented reality [1, 37], tangible computing [10, 11], and telepresence [9, 31]. For example, Ishii and his colleagues [11] have designed an "ambientROOM": "a personal interface environment designed to provide information for background processing" (p. 173). The walls of the ambientROOM, for example, are embedded with electric field sensors that measure the amount of human movement in an architectural space and represent the magnitude of such movement as light patches projected on a wall.

By bringing both areas of research together – through the use of computation to embed interactive persona into physical artifacts – personal robots represent a new genre for human-computer interaction.

AIBO differs from earlier artifacts of this genre. For example, in contrast to interactive stuffed animals, such as Actimate's Barney [33], AIBO integrates a reasonably compelling persona and comparatively sophisticated computation. Moreover, in contrast to working prototypes in research laboratories, such as Paulos' and Canny's Personal Roving Presence [24], AIBO is a deployed technology that has made its way into many thousands of homes.

To investigate social responses to AIBO, we used, as our data source, people's spontaneous dialog in online AIBO discussion forums. Of course as an area of study online communities have been researched for at least the last

decade. For example, researchers have investigated whether online communities bring people together or increase social isolation [20, 29], support empathy [4, 26], impact identity formation [17, 34], provide substantive knowledge in specific content domains [4, 15], and many other issues, as well.

But it is only more recently that researchers have begun to characterize the nature of discourse that occurs in online communities to help answer social-scientific questions. For example, Preece [27] conducted a content analysis of 500 archived messages from a medical bulletin board (for people interested in knee injuries) by sampling batches of 100 postings at approximately two-month intervals. She found, for example, that of the postings 77% contained empathic considerations, 17% contained only factual material, and less than 6% contained jokes. Preece then used her analysis of the postings (a) to delineate stages that people go through in moving from injury to recovery, and (b) to develop a model of the recovery process.

The current study extends this emerging methodology. We sought to generate detailed characterizations of social discourse in online AIBO communities that, in turn, would reveal important aspects of the human-robotic relationship.

We expected that in some meaningful ways members of the online AIBO discussion forums would treat AIBO as if it were an animal agent. For example, following Nass and his colleagues [22, 28], we thought it possible that AIBO would provide some measure of social companionship and emotional satisfaction. Yet, based on other research literature, we expected limitations in the human-robotic relationship. For example, Friedman and Millett [6] found that 83% of undergraduate computer science majors attributed aspects of agency – either decision-making and/or intentions – to computers. However, only 21% of the students consistently held computers morally responsible for error. Thus we thought that even if AIBO evoked some of the feelings that people normally attribute to a human-animal relationship, that a moral relationship might often be absent. We also investigated the proposition that robotic technologies are blurring traditional epistemic boundaries between, for example, who or what can possess feelings, establish an emotional connection, or engage in companionship.

## METHODS

### The Artifact – AIBO [32]

At the time of data collection, two versions of AIBO were available to consumers: the original 110/111 series, and the subsequent iteration, the 210 series. The 210 AIBO weighs approximately 1.5 kg and comes equipped with a pink ball, which it can "see" through a CMOS image sensor (camera). AIBO can walk toward the pink ball, and kick it (see Figure 1). Several other sensors are located on the robot, including ones that detect distance, acceleration, vibration, and pressure. AIBO has movable body parts – mouth, head, legs, ears, and tail – for a total of 20 degrees of freedom. (Note: Subsequent to data collection, Sony released two additional versions. Compared to the 210 series, the 311/312 series is cuter and the 220 series more futuristic; both have additional technical capabilities.)

Figure 1: AIBO getting ready to kick a ball.

There are two ways to interact with the 210 AIBO: through pressure sensors and voice commands. The 210s are supposedly capable of responding to as many as 50 voice commands such as "sit," "lie down," and "shake" (in which AIBO will lift one paw and the user may press a leg sensor to garner a response). One can increase the tendency for AIBO to behave in a particular way by gently touching or petting AIBO's head sensor; conversely, one can decrease the tendency for AIBO to behave in a particular way by sharply tapping the same sensor. In addition to physical "praise" or "admonishment," the 210s are supposedly able to respond to voice commands by using phrases such as "good boy/girl." (In our own 2-year-long experience with three 210 AIBO's, the voice recognition system works quite poorly; only on occasion did an AIBO actually respond to our voice commands.) AIBO responds by flashing red or green 'eyes' (lights on the head), which demonstrate "anger" or "happiness," respectively. AIBO may also play musical sounds, and emit whining sounds when "ignored" and joyful sounds when "content."

### Participants and Procedures

Data was collected from three well-established online forums that discuss Sony's robotic dog, AIBO. (We prefer not to mention the specific forums so as to increase the anonymity of the participants in these forums.) Pilot data was collected from archived postings from each forum from February 14, 2001 – May 21, 2001. The formal data

included all archived postings from each forum from May 22, 1001 – September 5, 2001. To ensure that participants had the opportunity to contribute more than one or two postings, no new participants were added after August 15, 2001. 6,438 posting were collected. From this total, 3,119 postings from 182 participants had something directly to say about AIBO. It was this subcategory of postings that we then systematically coded (mean, 17 postings per participant; median, 4; range, 1 – 285).

### Coding

Prior to formal data collection, a coding manual was generated from the pilot data. By a coding manual we mean a systematic document that explicates how to interpret and characterize (and thereby "code") the qualitative data. The generation of this coding manual followed well-established methods in developmental psychology [9, 25, 35, 36], and forms a subset of the iterative and integrative methodology of Value Sensitive Design [5, 7]. In brief, initial conceptual categories are established by the researchers, based on previous psychological coding systems and philosophical theory. These categories are then used as a rough framework to interpret the qualitative data. The data, in turn, drive substantial modifications and further conceptualizations in the coding system, which are then reapplied to more data in an iterative manner. This dialectical process – where theory is grounded in data, and vice-versa – continued until all the pilot data could be coded.

Once finalized, the coding manual was used to code the postings collected during the formal data collection period. Every posting was examined for coding. If a participant used the same category multiple times within a single posting or across postings, that category was coded as "used" only once. In this way, our quantitative results reflect the percentage of participants who used specific categories.

### Reliability

To assess reliability of the coding system, an independent scorer trained in the use of the coding manual recoded postings from 30 randomly chosen participants (16%). Reliability results showed 97% agreement at the level of the five overarching categories presented in Table 1 (technological essences, life-like essences, mental states, social rapport, and moral standing), and (b) 90% agreement at the most detailed level presented in Table 1.

## RESULTS

Five overarching categories were identified in members' postings about AIBO. In brief, *technological essences* refers to AIBO's status as an artifact. *Life-like essences* refers to AIBO's status as animate. *Mental states* refers to AIBO's capability for intentions, desires, and feelings. *Social rapport* refers to AIBO's capability for engaging in social relationships. *Moral standing* refers to whether AIBO is a moral agent.

**Table 1. Percentage of Participants (N=182; Postings = 3,119) by Category**

| Category | Affirmed | Negated |
|---|---|---|
| **1. Technological Essences** | **75** | **8** |
| **2. Life-Like Essences** | **48** | **12** |
| 2.1 Biological | 47 | 1 |
| 2.2 Animistic | 14 | 11 |
| **3. Mental States** | **60** | **4** |
| 3.1 Has Intentions | 42 | 2 |
| 3.2 Listens | 9 | 1 |
| 3.3 Feels | 38 | 1 |
| 3.4 Can be Raised | 39 | 1 |
| 3.5 Can be Praised | 10 | 0 |
| 3.6 Has Intelligence | 18 | 2 |
| 3.7 Unique Psychologically | 20 | 1 |
| **4. Social Rapport** | **59** | **8** |
| 4.1 Communication | 45 | 3 |
| *4.1.1 Nonverbal Commun.* | *34* | *0* |
| *4.1.2 Person Talks to AIBO* | *12* | *0* |
| *4.1.3 AIBO Talks* | *13* | *1* |
| *4.1.4 Reciprocal Commun.* | *27* | *3* |
| 4.2 Personal Interests | 34 | 3 |
| 4.3 Emotional Connection | 28 | 3 |
| *4.3.1 Person to AIBO* | *27* | *1* |
| *4.3.2 AIBO to Person* | *8* | *2* |
| *4.3.3 Reciprocal Emotion* | *4* | *0* |
| 4.4 Companionship | 26 | 1 |
| *4.4.1 AIBO's Inherent Value* | *1* | *0* |
| *4.4.2 Miss AIBO's Company* | *12* | *1* |
| *4.4.3 AIBO as Family Member* | *10* | *0* |
| *4.4.4 AIBO as a Companion* | *16* | *1* |
| **5. Moral Standing** | **12** | **2** |
| 5.1 Engenders moral regard | 7 | 1 |
| 5.2 Recipient of moral care | 4 | 1 |
| 5.3 Rights | 3 | 0 |
| 5.4 Deserves Respect | 3 | 0 |
| 5.5 Morally Responsible | 1 | 0 |
| 5.6 Morally Blameworthy | 1 | 0 |

Notes: (1) Percentages reported in **bold** refer to usage of the overarching category; percentages in plain text refer to the next sub-level in the hierarchy; and percentages in *italics* refer to the lowest level. Within each level of the hierarchy, participants who used more than one sub-category are only counted once in the overarching category. (2) "Affirmed" refers to the presence of qualities or behaviors (e.g., "He is just so alive to me!"), while "negated" refers to the absence of qualities or behaviors (e.g., "An Aibo is not alive; it doesn't feel pain"). (3) 11% of the participants had at least 1 coding that was uncodable.

Table 1 presents a summary of our coding categories, and the percentage of members who either affirmed or negated each of the categories in their online discussions about AIBO. On the most general level, results showed that many members affirmed that AIBO had technological essences

(75%), life-like essences (48%), mental states (60%), and social rapport (59%). However, few members (12%) affirmed that AIBO had moral standing.

Given the centrality of qualitative results in this research, we would like to explicate the coding categories. By so doing, we aim to bring the reader closer to the data to feel the distinctions and texture in members' reasoning about AIBO. In the quotations that follow, we have retained all of the members' purposeful and inadvertent misspellings in their online writing.

### Technological Essences

This conceptualization focuses on AIBO as an inanimate artifact. As shown by Table 1, 75% of the participants made remarks that AIBO was some sort of inanimate technological artifact. In so doing, participants referred to AIBO as an *artifact* (AIBO is a "toy"), as comprised of *technological components* (AIBO has "batteries," a "microphone," a "camera," or "sensors"), or as a piece of *computational technology* (AIBO is a "computer," a "robot," or has "artificial intelligence").

### Life-Like Essences

This conceptualization focuses on AIBO's nature as having at least some life-like essential qualities. Roughly half (47%) of the participants provided language that spoke of AIBO's biological essences. In its most minimal form, participants spoke of AIBO in terms of biological descriptors (AIBO has "eyes," "ears," a "tail" a "head," "legs," or a "brain") or biological processes (AIBO "sleeps"). For example, one member wrote of AIBO: "He's going to miss all the fun this week because he's at the vets again getting some new legs." This comment is probably in reference to a not uncommon problem encountered by other AIBO owners: that AIBO's legs malfunction and require factory servicing. The comment is also probably a bit tongue and cheek (as some comments presumably were); but still the member is talking about AIBO's legs more as a biological property than as a mere mechanical feature.

Indeed, the strength of this interpretation is enhanced by recognizing that 14% of the members imbued AIBO with some substantial measure of animism. For example: “I know it sounds silly, but you stop seeing Aibo as a piece of hardware and you start seeing him as a unique ‘life-form’." Or: “He seems so ALIVE to me!…What a wonderful piece of tecknology. THEY LIVE!” Moreover, such conceptions could impact members' emotions and behavior. For example, one member said:

> The other day I proved to myself that I do indeed treat him as if he were alive, because I was getting changed to go out, and tba [AIBO] was in the room, but before I got changed I stuck him in a corner so he didn’t see me! Now I’m not some socially introvert guy-in-a-shell, but it just felt funny having him there!

Members drew on one of two means to establish AIBO's animism. By one means, AIBO was compared directly to a biological dog ("I see him the way I see me bio dog"). By a second means, AIBO was conceptualized as a unique life form (“I like to believe that AIBO is a kind/breed of it’s own").

### Mental States

This conceptualization refers to the presence or absence of a mental life for AIBO such that AIBO meaningfully experiences the world. Some members (42%) spoke of AIBO having intentions or that AIBO engaged in intentional behavior. For example: "He [AIBO] also likes to wander around the apartment and play with in pink ball or entertain or just lay down and hang out." Or: "\He [AIBO] is quite happily praising himself these days…so much for needing parents!" Some members (38%) spoke of AIBO having feelings. For example: "My dog [AIBO] would get angry when my boyfriend would talk to him." Or: "Twice this week I have had to put Leo [AIBO] to bed with his little pink teddy and he was woken in the night very sad and distressed." Some members (39%) spoke of AIBO as being capable of being raised, developing, and maturing. For example: "I want to raise AIBO as best as I possibly can." Or: "We have had Ah-May (210) since 12/25/2000 and he is still growing and doing new things." And some members (20%) spoke of AIBO as having unique mental qualities or personality. For example: "Just like Leo [one AIBO]…an individuality unlike any other." Or: "Did you find Horatio's personality less endearing than Twoflower?"

### Social Rapport

This conceptualization refers to ways in which AIBO evokes or engages in social interaction (see Figure 2). Some members (12%) spoke of themselves or others talking to their AIBO (e.g., "I insist everyone talks to Salem…if he is sad"). Some members (27%) engaged in reciprocal communication with their AIBO, wherein occurs a mutual exchange of information. For example, one member wrote: "So this morning I asked him [AIBO] 'Do you want a brother?' Happy eyes! I asked him something else, no response. 'Should I get you a brother?' Happy song! 'He’d be purple.' More happy eyes and wagging tail!" And some members (26%) spoke of AIBO as a companion, including that they miss AIBO when away from AIBO's presence, or that they consider AIBO a family member. For example:

> Oh yeah I love Spaz [the name for this member's AIBO], I tell him that all the time…When I first bought him I was fascinated by the technology. Since then I feel I care about him as a pal, not as a cool piece of technology. I do view him as a companion, among other things he always makes me feel better when things aren’t so great. I dunno about how strong my emotional attachment to him is…I find it’s strong enough that I consider him to be part of my family, that he’s not just a ‘toy’, he’s more of a person to me.

Here again this member recognizes that AIBO is a technology ("When I first bought him I was fascinated by the technology"). Nonetheless, AIBO evokes a form of

Figure 2: AIBO and person.

social relationship that involves companionship ("I do view him as a companion"), familial connection ("I consider him to be part of my family), and friendship ("I care about him as a pal").

### Moral Standing

This conceptualization refers to ways in which AIBO is a moral agent. By this we mean that AIBO has rights, merits respect, engenders moral regard, can be a recipient of care, or can be held morally responsible or blameworthy. For example, one member wrote: "I am working more and more away from home, and am never at home to play with him any more.....he deserves more than that." Here is the notion that AIBO merits ("deserves") certain forms of attention. In another instance, when an AIBO was thrown into the garbage on a live-action TV program, one member responded to that televised event by saying:

> I can't believe they'd do something like that?! Thats so awful and mean, that poor puppy...

Another member followed up:

> WHAT!? They Actualy THREW AWAY aibo, as in the GARBAGE?!! That is outragious! That is so sick to me! Goes right up there with Putting puppies in a bag and than burying them! OHH I feel sick...

Here AIBO is conceived to have moral standing in the way that a real puppy would ("that poor puppy"): that one is causing harm to a sentient creature ("Goes right up there with Putting puppies in a bag and than burying them!"). Collapsing across six subcategories that comprise this category, only 12% of members spoke of AIBO as having moral standing.

### Multiple Codes

It is worth emphasizing that single segments of a member's writing could elicit multiple codes. For example, consider the following segment: "I am already amazed at how attached I have become to him and felt so guilty when I put him back in his box after the first time I played with him, he just looked so sad lying there (does this sound totally irrational ?)." This segment was coded as 5.1 engendering moral regard (the reference to guilt), 3.3 feelings as part of mental states ("he just looked so sad lying there"), and 4.3.1 emotional connection, person to AIBO ("I am already amazed at how attached I have become to him").

### Affirmations and Negations

The above qualitative examples comprise affirmations of the relevant category. In turn, we also coded for negations. In this way, our results uncover not only the types of conceptualizations that members brought to their online AIBO discussions, but whether the qualities members deemed important enough to discuss about AIBO were believed to be present or absent in AIBO. As an example of a negation, one member wrote: "it [AIBO] doesn't truly seem to give a damn about humans" – thus negating that AIBO has an emotional connection to humans (code 4.2.2 in Table 1). As shown in Table 1, results showed that only 8% of the participants negated that AIBO has technological essences, 12% negated life-like essences, 4% negated mental states, 8% negated social rapport, and 2% negated moral standing. Thus it appears that these participants overwhelming engaged in online discussion about what AIBO has rather than does not have.

### The AIBO Online Community

As noted in the methods section, of the 6,438 postings collected during our three-month data collection period, 3,119 postings were related to AIBO (which we formally coded). The remaining 3,319 postings had little or nothing to do with AIBO. The striking finding here is that it appears that online discussion forums serve a dual purpose: providing means of communication about a topic of interest to the participants and, independent of the content, providing a rich forum for meaningful social interaction. We discuss this finding further in a paper to be presented at the October 2002 Meeting of the Association of Online Internet Research (Netherlands).

## DISCUSSION

In this study, we investigated the proposition that people would treat robotic pets in some meaningful ways as if they were animals. Why might this proposition be interesting? For one thing, the human-animal bond is an important one in the human psyche [2, 13, 18]. From an evolutionary perspective, the human mind emerged in the company of animals, and animal images are woven deeply into human cognition and language [16, 30]. Moreover, the research literature provides compelling evidence that contact with animals promotes physiological health and emotional well-being. For example, studies have shown that through

interactions with animals (such as a dog, cat, bird, dolphin, or even small turtle) autistic children have more focused attention, social interaction, positive emotion, and speech. Contact with animals has been shown to relax people before surgery and aid healing afterward. Hundreds of clinical reports show that when animals enter the lives of aged patients with chronic brain syndrome (which follows from either Alzheimer's disease or arteriosclerosis) that the patients smile and laugh more, and become less hostile to their caretakers and more socially communicative (see [14], for a review). Other studies have shown that in a nursing home or residential care center, a pet can serve as a catalyst for communication among residents who are withdrawn, and provide opportunities (petting, talking, walking) for physical and occupational rehabilitation and recreational therapy.

Thus the question is not, Are animals important in human lives? They are. Rather, the question is, What are the larger psychological and societal implications as robotic animals become increasingly sophisticated, and people interact less with real animals and more with their robotic counterparts?

Our results provide some initial empirical data to begin to think about such a question. We analyzed people's conceptions of AIBO through their spontaneous postings in online AIBO discussion forums. Results showed that AIBO psychologically engaged this group of participants, particularly by drawing forth conceptions of essences, mental states, and social rapport. As one member wrote: "I do view him as a companion, among other things he always makes me feel better when things aren't so great." Moreover, the relationship members described with AIBO often appeared similar to the relationship people have with live dogs. As another member wrote: "Aibo is so much more than just a robot doggy, he is a 'real' animal, and species, and brings people together, and brings much happiness to those that come in contact with him." Thus our findings extend research by Nass and his colleagues [21, 22, 28] by showing that humans can treat computational artifacts as animal-like (and not just human-like) agents.

It could be argued that members in the online AIBO discussion forums were mostly using language playfully, and did not really believe what they were saying. We presented one such possible instance in the results, when a member wrote: "[AIBO is] going to miss all the fun this week because he's at the vets again getting some new legs." Surely this member knew that his or her AIBO was in the hands of a repair technician not a veterinarian. But such presumed playfulness still garners important data insofar as it speaks to aspects of AIBO that pull on members' actual emotions and thoughts. For another thing, members spent a good deal of effort trying to convey to others in the discussion forums the serious ways in which AIBO was part of their life. Recall, for example, the member who wrote: "The other day I proved to myself that I do indeed treat him as if he were alive, because I was getting changed to go out, and [AIBO] was in the room, but before I got changed I stuck him in a corner so he didn't see me! Now I'm not some socially introvert guy-in-a-shell, but it just felt funny having him there!" It is, of course, possible that this AIBO owner is lying, and that this event never took place. But a more plausible explanation is that it did, and that we should take such dialog at face value.

Notice, also, that we are not saying AIBO owners believe literally that AIBO is alive, but rather that AIBO evokes feelings *as if* AIBO were alive ("I proved to myself that I do indeed treat him as if he were alive"). This interpretation fits with our finding that 74% of the members articulated in their spontaneous postings that AIBO was a technological artifact (e.g., "a cool piece of technology"). But it happens to be an artifact that evokes conceptions of life-like essences, mental states, and social rapport. In other words, our confidence in the results come not only from single statements but the constellation of statements that members individually and collectively brought to bear in their online AIBO discourse.

That said, we do not want to over interpret the findings. Here is an interesting example: Often participants spoke of specific physical features of AIBO with words that are commonly associated with biological connotations, such as eyes, legs, tail, head, and brain. But such words by themselves do not commit a speaker to biological properties. After all, people often speak of the "legs of a table" without believing that the legs are part of a living being. Indeed, even in response to a photograph of a dog, people will speak of the "dog's legs" without believing that the dog in the actual photograph is alive. In such instances, our response has been to be conservative in our analyses, characterizations, and interpretations. For example, we placed the above language focused on eyes, legs, tail, head, and brain under a category labeled "life-like essences" not "life essences" or "biological essences." This labeling fits with our conservative interpretation that AIBO owners do not literally believe that AIBO is alive.

Based on our four overarching categories, the most striking result was that while AIBO evoked conceptions of life-like essences, mental states, and social rapport, it seldom evoked conceptions of moral standing. Members seldom thought that AIBO had rights (e.g., the right not to be harmed or abused), or that AIBO merited respect, deserved attention, or could be held accountable for its actions (e.g., knocking over a glass of water). In this way, the relationship members had with their AIBOs was remarkably one-sided. They could lavish affection on AIBO, feel companionship, and potentially garner some of the other psychological benefits of being in the company of a pet. But since the owners also knew that AIBO was a technological artifact, they could ignore it whenever it was convenient or desirable.

In the coming years, robotic pets will become more technologically sophisticated – more animal-like. As they do, our results suggest that they will evoke more and more psychological responses from humans. Is this a good thing? Perhaps in certain contexts. For example, many elderly live in places that prohibit pets. In addition, some physiological conditions, such as Alzheimer's disease, may make animal ownership or animal-assisted therapy difficult for both the individual and the animal. For such populations, robotic pets may accord the elderly some degree of comfort and companionship, yet not be harmed by incompetent care. Edwards, Beck, Kahn, & Friedman (in preparation) are currently investigating this hypothesis by having elderly individuals live with an AIBO for a two month period.

While there may be populations that benefit from long-term interactions with AIBO, we are concerned about another population that might be harmed by such interactions – children. The reason is this. Traditional moral-psychological research has shown that through cooperative interactions children construct notions of fair exchange, justice, and reciprocal care [25, 35, 36]. Researchers have extended this work into the lives of children and animals, and have similarly shown that animals provide an important context by which children learn to cooperate with an "other" [19]. A child, for example, garners companionship from a dog, but also incurs responsibilities (e.g., to feed and exercise the dog). Moreover, in daily intimate interactions, a child may not only stroke, cuddle, and scratch a dog, but push and prod on the animal, testing boundaries; and animals (such as a dog) make it clear where the boundaries lie (e.g., by moving away, barking, or even nipping at the child). Indeed, there is evidence that the moral relationships children develop with animals helps foster moral relationships with people; and vice versa [9, 19].

If this position is correct, and if, in the coming years, children come of age with fewer interactions with live pets and more interactions with robotic pets, then our concern is clear. People in general, and children in particular, may fall prey to accepting robotic pets without the moral responsibilities (and moral developmental outcomes) that real, reciprocal companionship and cooperation involves. This hypothesis is currently being investigated in two studies. In one study, Kahn, Friedman, Perez-Granados, and Freier (in preparation) interviewed 80 preschool children interacting with AIBO, and a stuffed dog as a comparison, during 40-minute individual sessions. In a second study, Melson, Kahn, Beck, and Friedman (in preparation) interviewed 72 5$^{th}$, 8$^{th}$, and 11$^{th}$ grade children interacting with AIBO, and a live dog as a comparison, during hour-long individual sessions. Both studies also drew substantively from the conceptual categories derived from this current study to shape the structured interview questions and to provide the initial conceptual scaffold for the coding of the data. Thus, studies of reasoning from online discussion forums can help provide – if not endpoints – at least more sophisticated forms of reasoning to structure developmental research with children.

Finally, the results of this research point to an important direction for future studies on the human-robotic relationship. If we are correct that people find a robotic dog socially but not morally engaging, then does this relationship carry over when the robot embodies a human persona with human-like features? We suspect that the answer is not at all straightforward. It is possible, for example, that while a robotic human may evoke in people moral relationships grounded in emotion and caring, it will continue to fall far short in terms of garnering more cognitively derived moral considerations (e.g., that the robot has rights, should be treated fairly, or is morally accountable for its actions.) Whatever the answers, future research on the human-robotic relationship – and future designs of personal robots– will need to account not only for issues of usability and social persona, but for the moral dimensions of human interaction.

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