ON ELECTRIC OWLS
Implicit life-stories of robots and their impact on human empathy

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B.S. in Computer Science, Stanford University, 2003

Submitted to the Program in Media Arts and Sciences, School of Architecture and Planning, in partial fulfillment of the requirements for the degree of Master of Science in Media Arts and Sciences at the Massachusetts Institute of Technology.

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ABSTRACT

Robots are moving from factories to people's homes taking on the roles of artificial pets, tutors and companions. If we are to have emotionally engaging robots, we must understand how we can design robots that people feel empathy towards. In this work, I explore one design criteria for such robots: implicit life stories or the ability for a robot to experience the world we share, be transformed by that experience and communicate that experience to us. Through the construction of novel robots that can have implicit life-stories, and through human subject studies I show that such robots can evoke empathy. I also show that empathy for robots can impact empathy for other human beings.

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1 INTRODUCTION

Figure 1: Death of a replicant in the movie *Blade Runner*

What makes us human? This question is explored in the science fiction movie *Blade Runner*. Set in a future-noir world against a backdrop of neon lit skyscrapers, we take on the persepctive of Deckard who is tasked with hunting down and killing replicants, an organic artificial humanoid. The replicants are assumed to be not human, a premise supported by their lack of moral rights. The movie suggests that what makes us human lies in the difference between the two.

However, from this beginning, the movie systematically eliminates possible candidate differences: physical form, intelligence, motivation to survive, emotional experiences, and so on. The last ontological distinction is lost at the death of the lead replicant. In one of cinema's most memorable scenes, just before his death, the replicant says:

> "I've seen things you people wouldn't believe. Attack ships on fire off the shoulder of Orion. I watched C-beams glitter in the dark near the Tannhäuser Gate. All those moments will be lost in time, like tears...in...rain. Time to die."

As he dies, in an allegorical reference to the ascension of a soul, a dove leaves his hands and flies up into the light. What was lost at death was, in his own words, his unique experiences that we could only glimpse but not fully know. At that moment, we cannot help but feel moved by the death of the replicant [49]. The movie merges the ontological categories by having Deckard, who we had identified with, realizing after this scene that he might be a replicant himself [41].

Relating to and being emotionally engaged by life-stories of machines is a recurring theme in many science fiction works: *2001: A*

Space Odyssey, *Ex Machina* and *Otherspace*, to name a few. This thesis is an exploration of this theme.

1.1 RESEARCH QUESTION

The main research question of this thesis is whether the implicit life-stories of a robot can invoke empathy for it. By implicit life-stories I mean the ability of the robot to experience the world we live in, to be transformed through that experience, and to communicate the experience to us. By empathy for a robot, I mean understanding and experiencing the robot's perceived emotions as if they are our own.

1.2 WHY EMPATHY FOR ROBOTS?

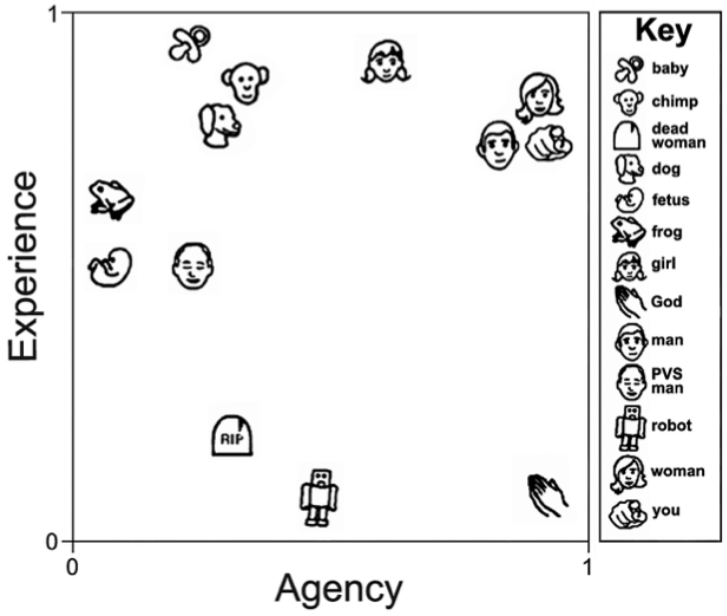

Figure 2: Gray et al.'s analysis of people's perception of minds of various character showed that robots are considered to be lacking in experience compared to other characters [27]

Empathy for artificial agents has been proposed as a test of believability; that is to say, the greater the ability an agent has to invoke empathy, the more it is perceived to be life-like [44]. A common conception of robots is that they do not have the capacity for emotions. Gray et al. examined people's perception of minds by asking participants to rank characters on various mental capacities (for example, out of a robot and a baby, which has greater capacity for pride, for telling right from wrong, etc.) and personal judgements (for example, who should be more deserving of blame if they were to cause harm to others) [27]. Analysis of the responses showed that while robots were perceived to have agency that is comparable to other living enti-

ties, they were most lacking in affective experiences (See Figure 2). If we have empathy for robots, that is to say, we feel that we experience their emotions as if our own, then I argue that we implicitly believe that such robots have emotional experiences. Such capability could elevate the perception of robots to be closer to that of other living creatures. The process of bringing robots closer to us in our perception is, by construction, a pursuit of trying to understand who we are.

Figure 3: Residents at a retirement home find comfort in Paro, a therapeutic robotic seal[52]

A second case for empathy towards robots is to create robots that can have roles similar to companion animals. There is wide evidence that companion animals have a beneficial effect on our physiological and psychological health. Interaction with companion animals has been shown to reduce loneliness, blood pressure, cholestorol, depression, anxiety, and stress [55]. An important aspect of our relationship with animals is that we tend to feel empathy toward them. [45]. In addition, empathy toward companion animals can lead to greater empathy toward humans, which is a highly prosocial trait [53]. It is worth exploring how to design robots to elicit empathy which could bring some of the benefits of companion animals to those who are unable to have them.

1.3 IMPLICIT LIFE STORIES

Living entities grow and change from experience over the course of their lives. Dautenhahn and Nehaniv described life as a complex story embedded in biology [13]. Changes in morphology or behavior tell the story of the object. For example, consider encountering an one-

eyed orange cat sunning itself on a wall. From that brief encounter, one extrapolates a checkered past of scuffles in alleyways and summers enjoying warmth. While I leave more to the reader's imagination, the point here is that through morphology and behavior, living creatures implicitly tell the stories of their lives.

However, these stories are told imperfectly. They are not simple reproductions but rather underspecified ambiguous descriptions. Underspecificity, Gaver argued is a virtue, as it engages us as particpants [23]. We become particpants in constructing the story. Ackermann wrote that viewers engage with objects by "reconstructing them through the lens of their own interests and experiences." [1] We color in the details of the stories using our own life-stories. We wince at the pain of the imagined fight that cost our orange cat his eye from past experience of our own pain. Empathy is generally defined as the ability to understand and feel what another feels [17]. If, through our own experience, we understand and are engaged by the experiences of another, then it stands to reason we would feel empathy for them. I posit that if we can build robots with implicit life-stories, we will feel empathy towards them.

Based on the argument I outlined, I consider the following properties necessary for a robot to have an implicit life-story:

- Autonomous agent: Robot can mean different things. For the purpose of implicit life-stories, all that is required is the robot is perceived to be capable of sensing and acting on the world driven by an internal process. This is necessary to be able to attribute experience to it.

- Perceptible change: The robot must change from experience. Without change, experience wouldn't leave an imprint on the robot. The change needs to be human perceptible so we would know of its existence and of the experience that caused it.

- Relatable experience: The change to the robot must come from an experience that we could imagine ourselves having. A machine learning algorithm, learning to classify a dataset, is changing from experience but an experience we cannot share. Such an agent wouldn't qualify as having an implicit life-story by my definition. Embodiment and/or having human-like perception would make it easier for an agent to have a shareable experience.

- Ambiguous Experience: As discussed earlier, the change to the robot must ambiguously reflect, or evoke, the experience it had. A video camera recording a movie is changing from a perceptual input that we could have. However, the perfect reproduction doesn't leave room for us to imagine a social model much less being able to put ourselves in its place. On the other hand

given an input, the resulting change cannot be incomprehensible as that would preclude us from reconstructing the experience.

Over the next few chapters, I share what I learned from building robots according to these ideas and testing my thesis with human subject studies.

1.4 THESIS OVERVIEW

Chapter **??**: I provide background for social robotics and empathy and describe the relationship of this work to these fields. I also note related work done on stories for artificial agents.

Chapter **??**: I describe a minimal robot that I construct as a preliminary exploration of implicit life-stories. Consider this as a thought experiment.

Chapter **??**: I test my thesis with a human robot interaction study where participants interact with a toy robot that has been given a fictional implicit life-story. After the interaction, the participants are asked to strike the robot. From measuring their hesitation to strike and through psychometric tests, I show that life-stories invoke empathy.

Chapter **??**: Based on the results from the initial human subject study, I build a sound robot that can have a life-story. In this chapter, I describe design considerations, the process of building the mechanical systems, and the architecture of the software necessary to animate the robot and to learn sounds.

Chapter **??**: I then conduct pilot studies with human subjects to understand perception of the robot and to refine validation study design. I describe my experience of iterating on the design.

Chapter **??**: I conduct controlled human subject study with both online and in person participants. I show that implicity life-stories create greater empathy for the new robot. I also find that empathy for robot can impact subsequent empathy for humans.

Chapter **??**: I summarize my findings from my studies and my contributions to the field. I discuss ideas for extending this work and possible applications for such robot.

1.5 CONTRIBUTION

As a preview of the final chapter, I submit these as my contributions:

- Proposed a new design element, implicit life-stories, for engendering empathy for social robots
- Demonstrated empathy for robots with implicit life-stories through human robot interaction experiments across two different platforms

- Designed and built a novel sound interaction social robot to embody and test these ideas
- Demonstrated that the implicit life-stories can improve perception of social robot on animacy, anthropomorphism, likeability and intelligence measures
- Showed that empathy for robot has an impact on subsequent empathy for humans. This is the first work to examine the connection between the two.
- Open-sourced design and code for the new robot

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APPENDIX: GODSPEED QUESTIONNAIRE SERIES

Adapted from: Bartneck, Christoph, E. Croft, and D. Kulic. (2009) "Measurement instruments for the anthropomorphism, animacy, likeability, perceived intelligence, and perceived safety of robots" In: *International journal of social robotic* (2009) pp. 71-81.

A.1 INSTRUCTION

Please rate your impression of the robot in the study on these scales:

(Answers given as 1-5 rating between each pair of terms in the subscales below. The names of the subscales were not shown. Perceived Safety subscale was not used)

A.2 ANTHROPOMORPHISM

- Fake/Natural
- Machinelike/humanlike
- Unconscious/Conscious
- Artificial/Lifelike
- Moving rigidly/Moving elegantly

A.3 ANIMACY

- Dead/Alive
- Stagnant/Lively
- Mechanical/Organic
- Artificial/Lifelike
- Inert/Interactive
- Apathetic/Responsive

A.4 LIKEABILITY

- Dislike/Like
- Unfriendly/Friendly

- Unkind/Kind
- Unpleasant/Pleasant
- Awful/Nice

A.5 PERCEIVED INTELLIGENCE

- Incompetent/Competent
- Ignorant/Knowledgeable
- Irresponsible/Responsible
- Unintelligent/Intelligent
- Foolish/Sensible

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