Social Robotics:
Crossovers between Science, Ethics and Design

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Structure

- Social Robotics and Animation
  - Introduce social robotics
  - Introduce animation
  - Applying Disney's Principles of Animation to Social Robotics
- Applications of Social Robotics
  - Social robots for education
  - Socially-assistive robots
  - Social robots for entertainment
- Robot Ethics
  - Could social robots threaten humans rights?
  - Should social robots have rights?

Slides have been inspired by Ana Paiva's Lecture Slides on Social Robotics and Human-Robot Interaction

Definition: Robot Centred

A social robot is an autonomous or semi-autonomous robot that interacts and communicates with humans by following the behavioral norms expected by the people with whom the robot is intended to interact (Bartneck & Forlizzi, 2004).

They are able to recognize each other and engage in social interactions, they possess histories (perceive and interpret the world in terms of their own experience), and they explicitly communicate with and learn from each other (Fong, Nourbakhsh, Dautenhahn, 2003) .

Definition: Human Centred

- We apply a social model to interact with robots and to understand them.
- We anthropomorphize social robots (i.e., attribute human or animal-like qualities to them; Breazeal, 2003).
- Breazeal (2002) envisioned that social robotics could befriend us.

Definition: Human Centred

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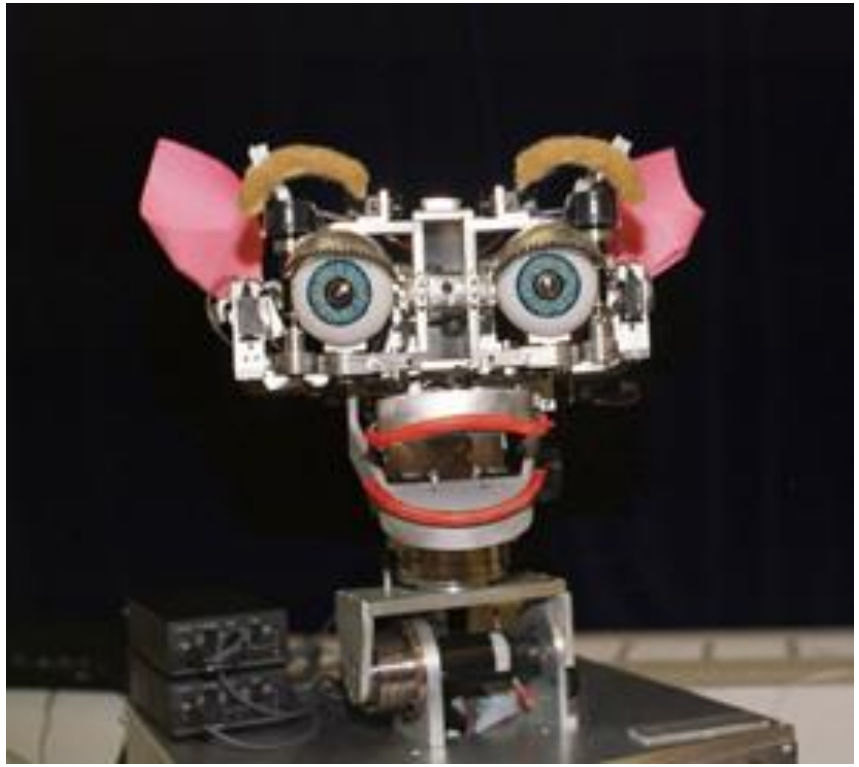
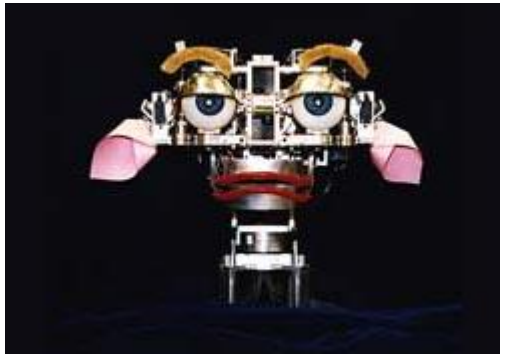
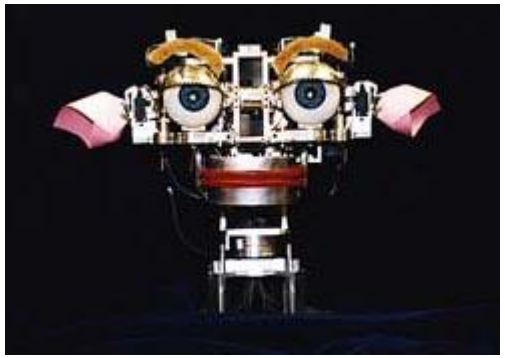
"Ideally, people will treat Kismet as if it were a socially aware creature with thoughts, intents, desires, and feelings. Believability is the goal. Realism is not necessary."
(Breazeal, 2002, pg 52).







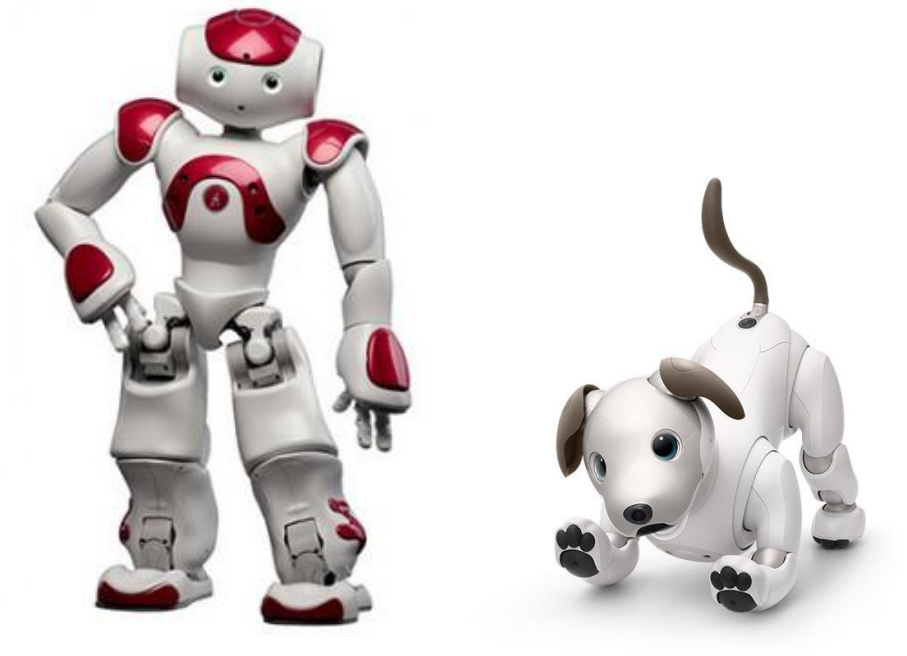
Animacy in Social Robotics

- Animacy is the state of being full of aliveness
- We naturally attend to objects that we have categorized as animate (New et al., 2007).
- Furthermore, animacy detection is a prerequisite to higher-level social understandings (Thalia Wheatley and Alex Martín, 2009).
- Consequently, creating the illusion of animacy is one of the most important features for a social robot.

Animacy in Social Robotics

Factors which influence perception of animacy:

- Size
- Appearance
- Responsiveness to stimuli
- Appropriateness of its responses
- Diversity of its behavioral repertoire
- Type of movement



Movement & Animacy

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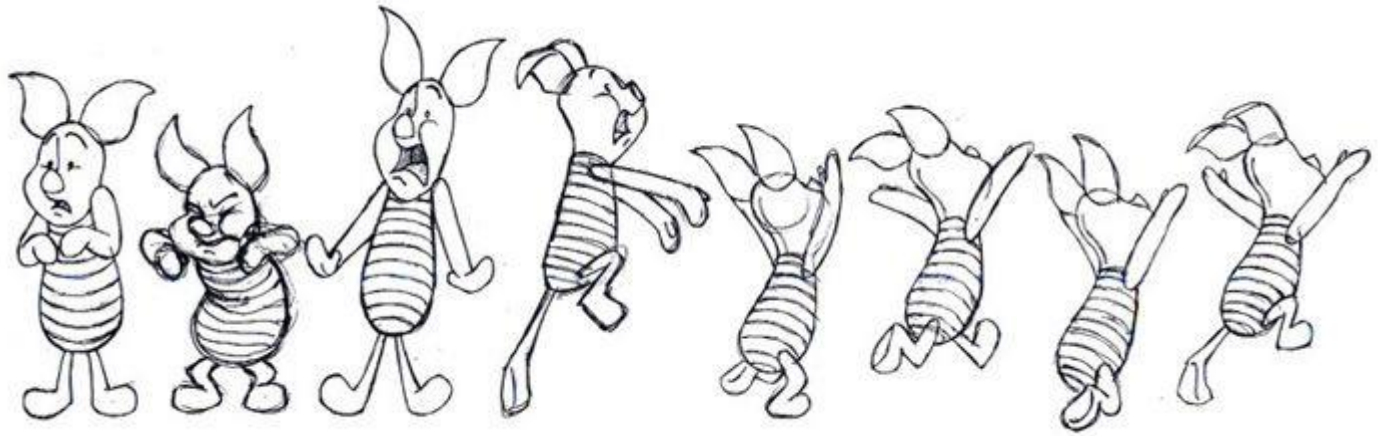
Heider & Simmel (1944)

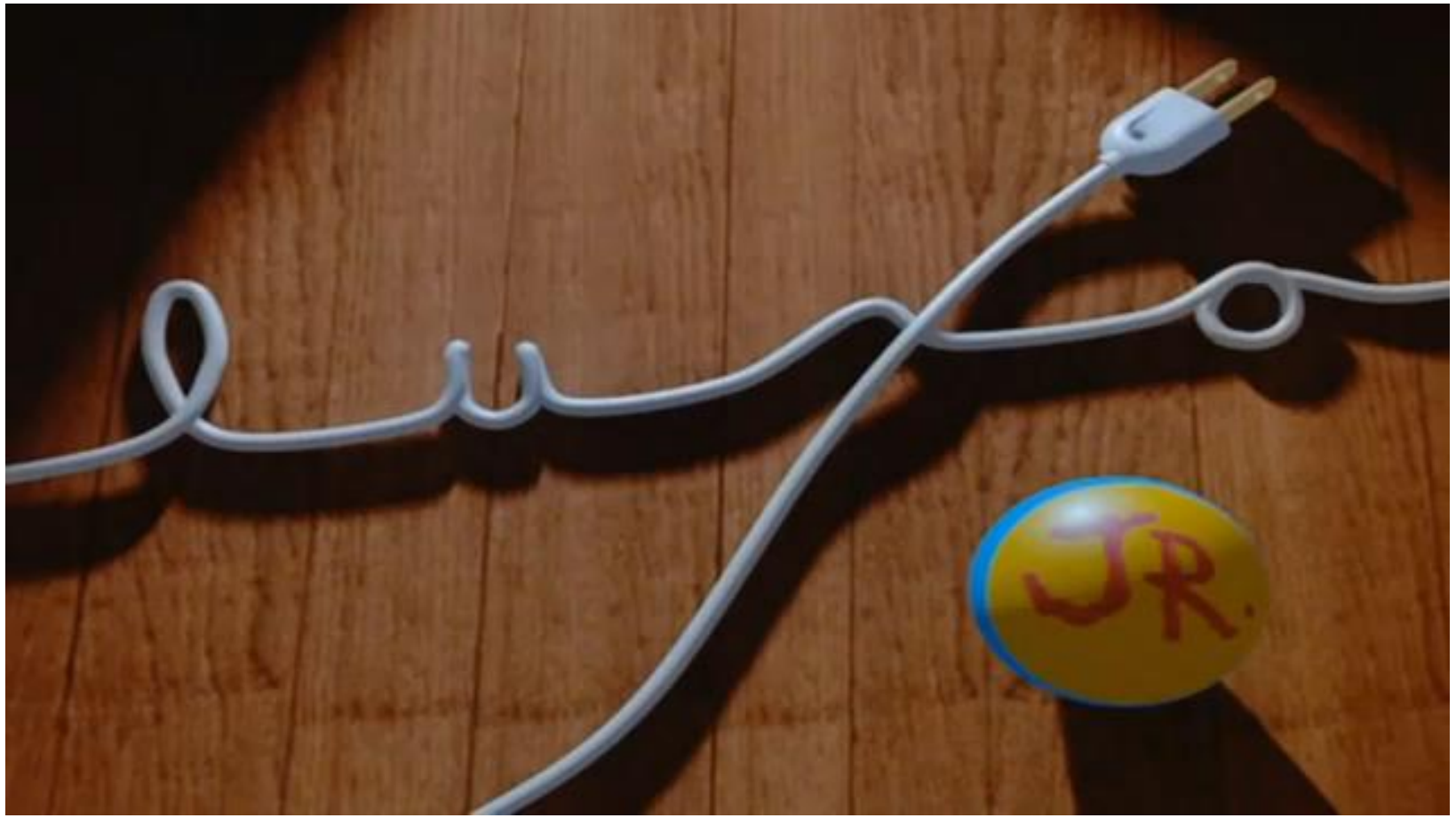
The Illusion of Life

"Disney animation makes audiences really believe in… characters, whose adventures and misfortunes make people laugh – and even cry. There is a special ingredient in our type of animation that produces drawings that appear to think and make decisions and act of their own volition; it is what creates the ILLUSION OF LIFE," (Thomas & Johnston, 1981, pg 1).



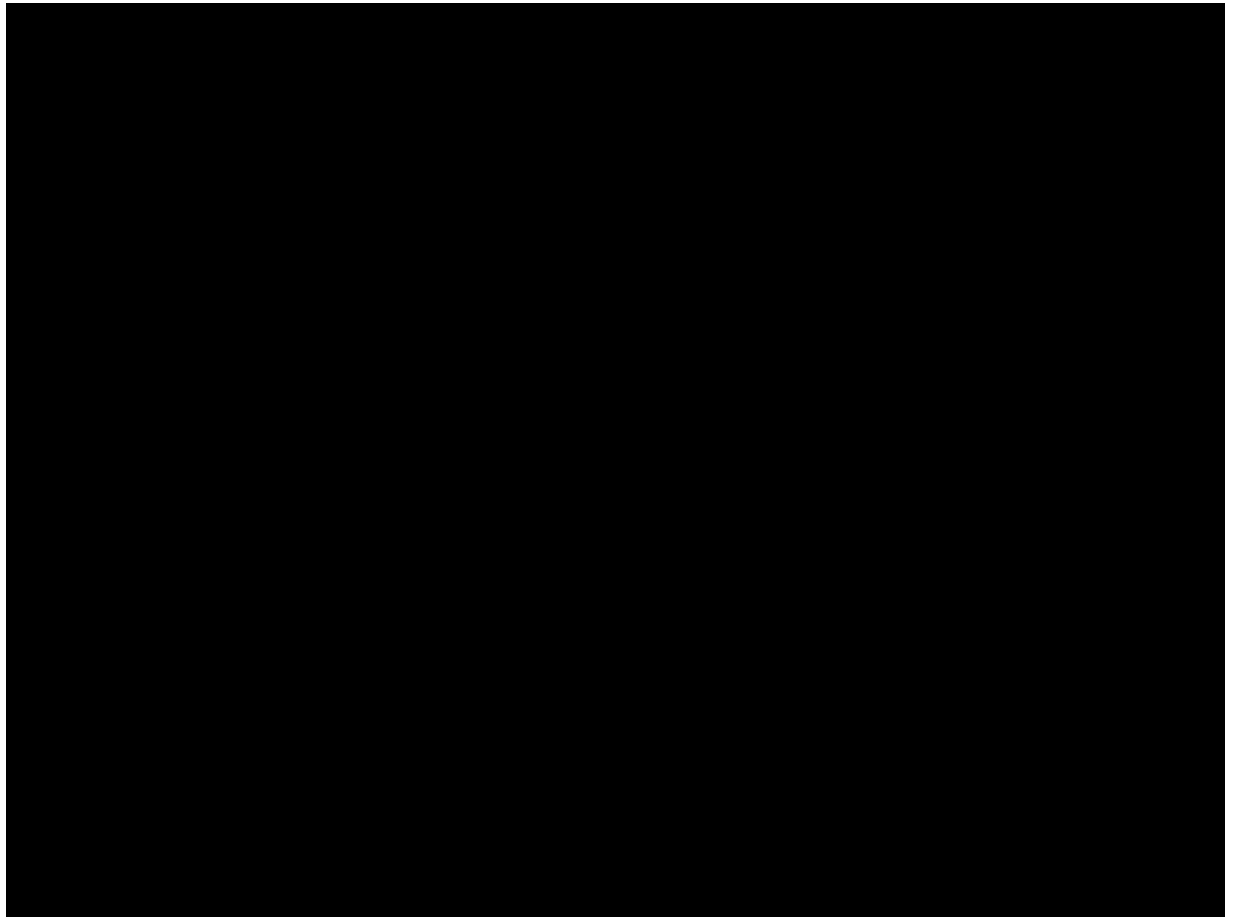
The Illusion of Life in Desklamps

Pixar Animation- Luxo Jr. (1986)



The Illusion of Life in Desklamps

Hoffman (2007)

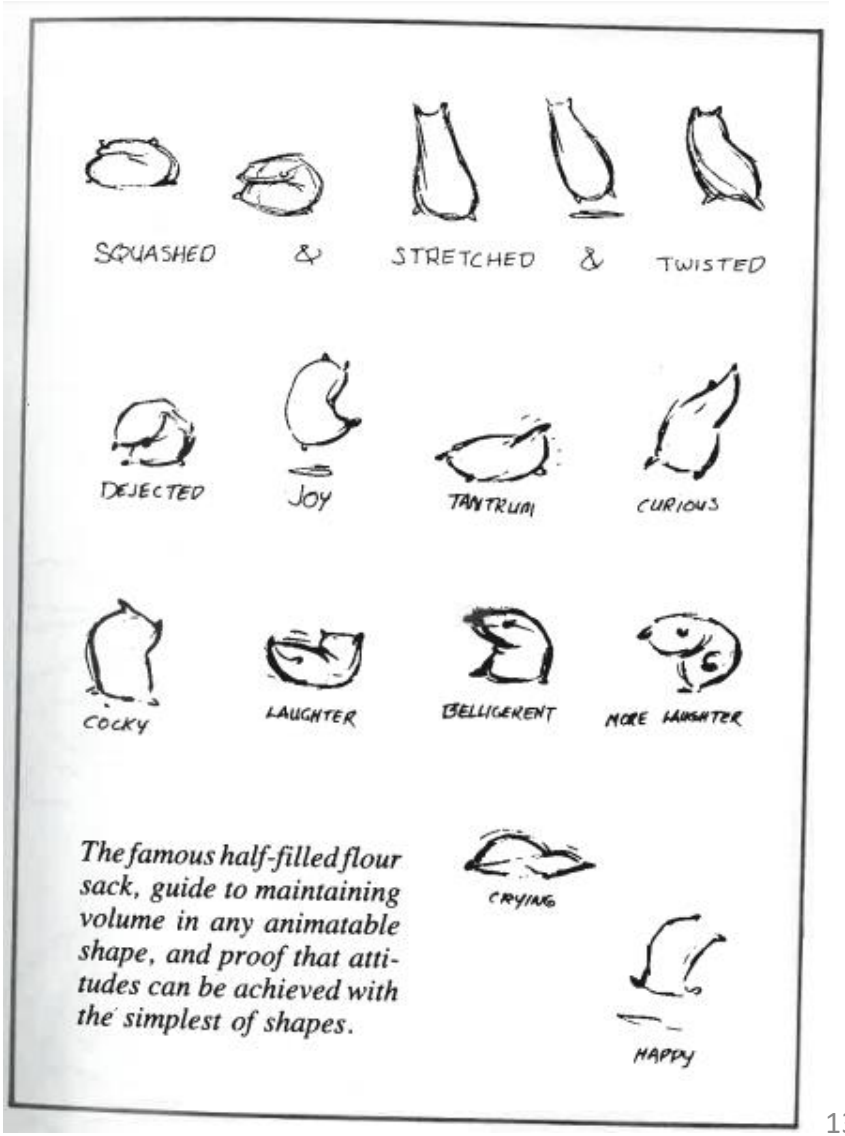


Disney's Principles of Animation

- Squash and Stretch
- Anticipation
- Staging
- Straight Ahead and Pose-to-Pose
- Follow-Through and Overlapping Animation
- Slow In and Slow Out
- Arcs
- Secondary Action
- Timing
- Exaggeration
- Solid Drawing
- Appeal

Animation: Squash & Stretch

- Anything living will move in a variety of ways while it completes an action. Movement without ‘squash or stretch’ appears rigid.
- To ensure believability during squash and stretch, the drawings should always maintain volume as they’re distended.
- This principle is hard to apply to robots, because robots are generally composed of rigid parts.



Social Robotics: Squash & Stretch

Kory Westlund et al., 2016

Animation: Anticipation

- The audience should be led sequentially through the action to anticipate each successive action.

- That anticipation helps the user to interpret the character or robot in a more natural way.

Animation: Anticipation

Big Hero 6 (2014)

Animation: Anticipation

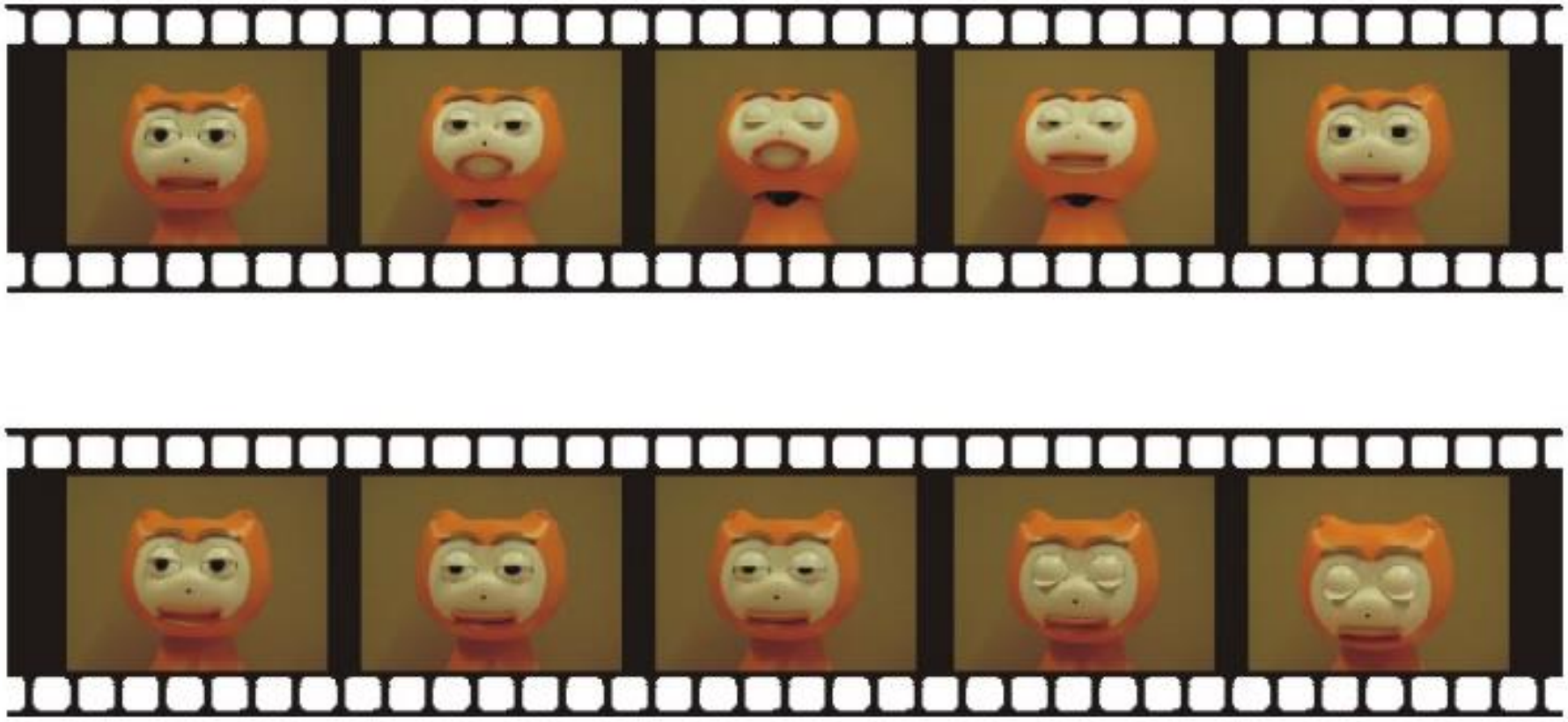
Big Hero 6 (2014)

Social Robotics: Anticipation

- In 2001 Philips Research was researching the usage of user-interface robots for home automation (van Breeman, 2004).
- Developed iCAT to be connected to the home network to control devices.
- Investigated the application of Disney principles to iCAT's expression.

Social Robotics: Anticipation

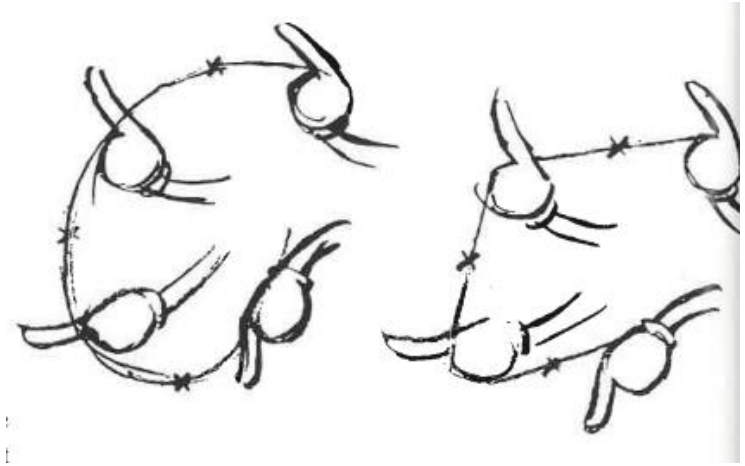
van Breeman (2004)



Animation: Arcs

- The movement of living creatures follow a circular trajectory, not a mechanical or disjointed one.

- When animating characters their movement should follow an arc to create the perception of biological movement.



Social Robotics: Arcs

Castro-González, Admoni and Scassellati (2016)

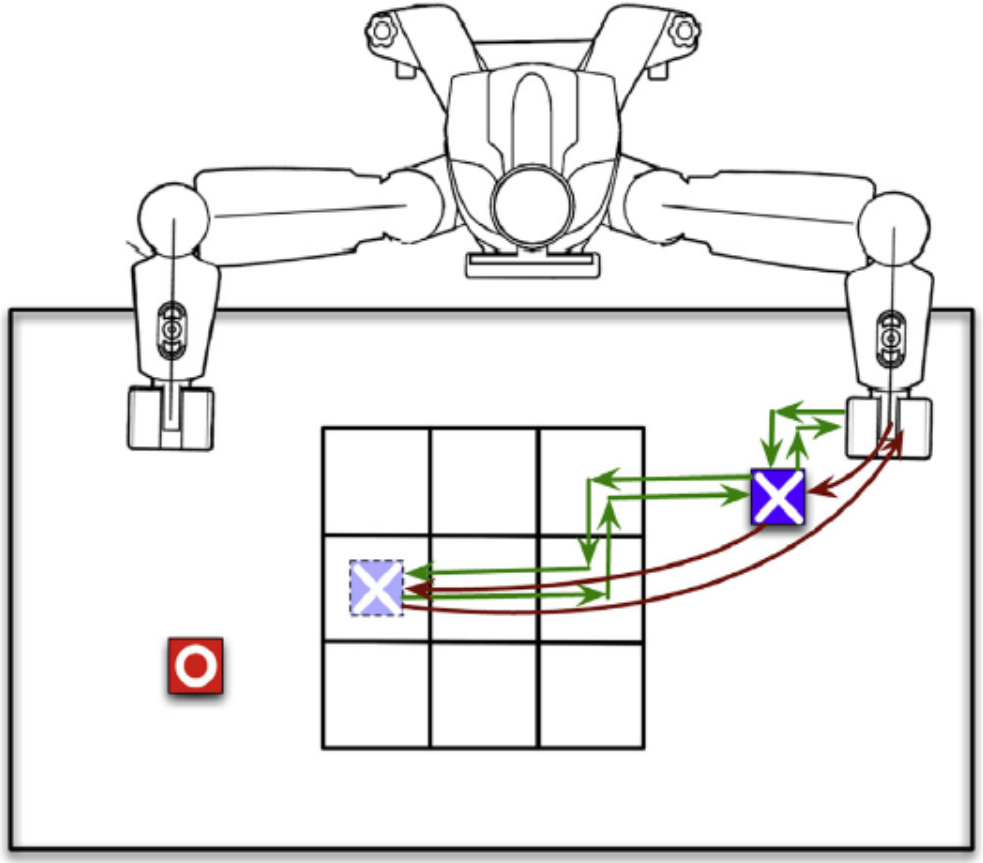


Table 2
Size of the condition groups.

Condition	Sample size
Control	8
One-arm-mechanistic	7
One-arm-smooth	9
Full-body-mechanistic	9
Full-body-smooth	9

Social Robotics: Arcs

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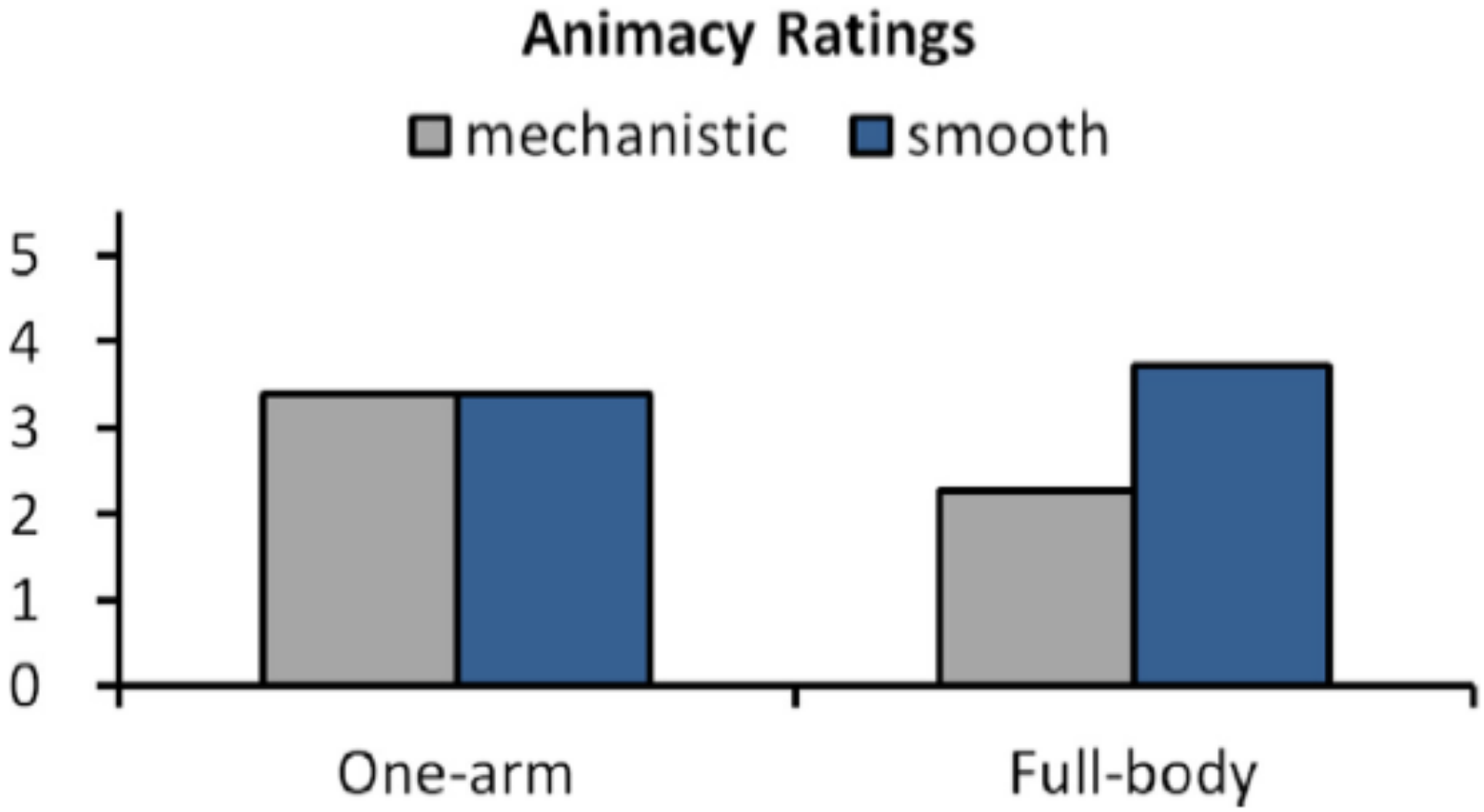
Results



Animation: Timing

- The speed of the movement helps display the characters emotions, and the sense of a scene.
- For example, fast movement could indicate fear or excitability, whereas slow movement could indicate tiredness.
- This can be achieved by altering how many frames are shot per second.

Animation: Timing

Big Hero 6 (2014)






Social Robotics: Arcs & Timing

Saerbeck & Bartneck (2010)

- Conducted a study to assess whether curvature (arcs) and acceleration (timing) could effect whether participants perceived robots as having an affective state.
- They varied the curvature and acceleration of two robots: iCat and Roomba.
- They found a strong relation between motion parameters and attribution of affect, while the type of embodiment had no effect.

Sample interaction in the iCat condition

Sample interaction in the Roomba condition

Types of Social Robots

- Social Robots for Education
- Social Robots for Entertainment
- Socially Assistive Robots

Kory Westlund et al., 2016

Nourbakhsh, Kunz & Willeke, 2003

Shibata, 1993

Kory Westlund et al., (2016)

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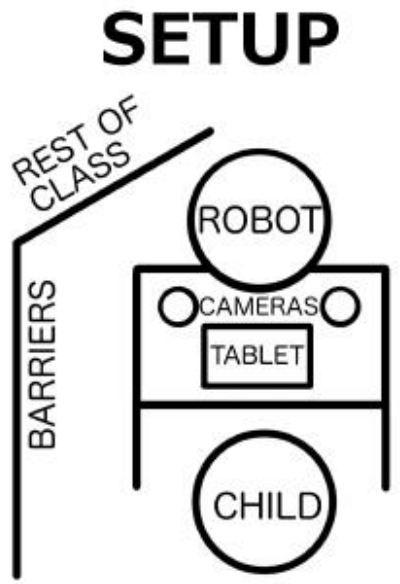
Study Design

- Preliminary study into teachers opinions of using a robot in class
- Introduced Tega into a classroom for two months
- 34 children aged between 3 – 5 with 15 classified as special needs and 19 as typically developing
- Tega and a tablet were used to teach the children Spanish
- Mixed method qualitative and quantitative study



Kory Westlund et al., (2016)

Quantitative Results

- Teachers weren't afraid of robots in class
- Teachers thought robots could help children learn
- Teachers thought robots might be unnecessary, tablet could do the same thing
- Robot could be used to monitor the child's learning progress
- Excitement about having a social robot in the classroom decreased
- Perceptions that the robot in the classroom would be beneficial decreased

Kory Westlund et al., (2016)

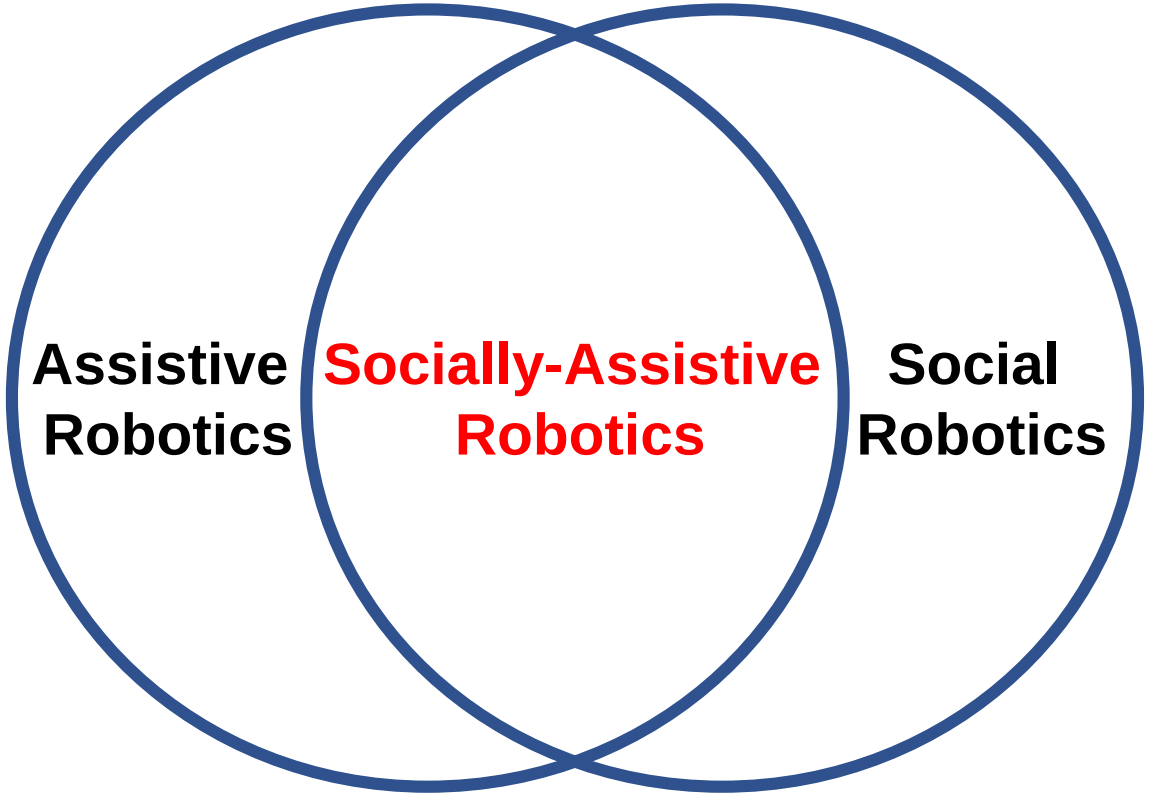
Qualitative Results

Teachers:

- Were surprised the robot wasn’t disruptive
- Were surprised with the child's positive engagement
- Loved seeing the child’s enthusiasm
- Thought the robot could be useful if its designed to the curriculum
- Thought robots could be useful in the classroom

Socially-Assistive Robots

Socially-assistive robotics, focuses on helping human users through social rather than physical interaction.



Socially-Assistive Robots for Autism

- Individuals with autism spectrum conditions have difficulties with social interaction and communication (American Psychiatric Association, 2013).

- They often struggle with social behaviours such as eye-contact, imitating behaviour, taking turns and understanding facial expressions.

- Individuals on the spectrum are known to prefer technology. It's thought to be because its safe, predictable and controlled.

Robins, Dautenhahn & Dickerson (2009)

Robot Design

- KASPAR uses body expressions (movements of the head, hand and arms), facial expressions and gestures to interact.
- KASPAR was designed to imitate facial features of humans, but not to appear too realistic, to try to avoid overwhelmed.

Robins, Dautenhahn & Dickerson (2009)

Study Design

- Robins, Dautenhahn and Dickerson (2009) analysed cases of individuals with autism interacting with KASPAR.
- Robins et al., did trials with the robot present, a therapist and an individual with autism. The sessions were ‘free play’ sessions without structure.
- Used qualitative method to look for patterns in videos of interactions.
- Does KASPAR elicit basic communication and interaction skills?

Robins, Dautenhahn & Dickerson (2009)

Results: Kelly

Figure 3: Left – Kelly indicating her wish to come closer to KASPAR; Right – Kelly exploring KASPAR and imitating its drumming action.

Figure 4: Left - Kelly is exploring KASPAR's eyes; Right – Kelly is reaching for the experimenter's hand.

Socially-Assistive Robots for Elderly

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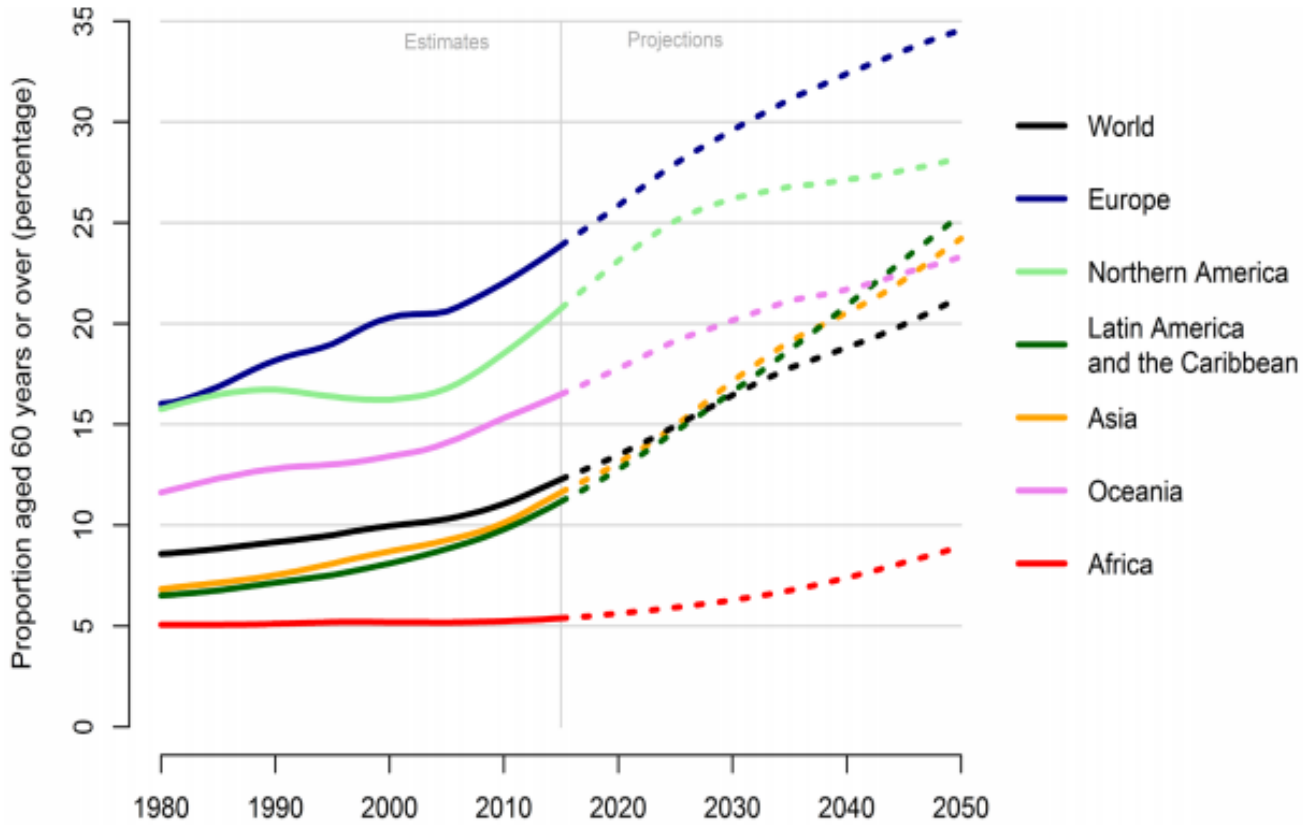
Figure 4.

Percentage of population aged 60 years or over by region, from 1980 to 2050



Data source: United Nations (2017). World Population Prospects: the 2017 Revision.

Paro

Posture Sensor

Artificial Fur

Actuators:

- Eyelids
- Neck
- Front flipper
- Rear flipper

Tactile Sensors:

- Head
- Under jaw
- Back and side
- Front flipper
- Rear flipper

Microphones

Light Sensors

Speaker

Review: Kachouie, Sedighadeli, Khosla & Chu (2014)

- Positive social and psychological effects (reduced depression, increase in laughing, better able to cope with stress)
- Decrease in nursing staff's mental poverty; decrease in stress
- Increase in social interaction with each other, experimenters and nursing staff, even without Paro
- Patients did not loose interest long term- but more interesting when turned on
- Paro is safe and durable but doesn't swim!

Social Robots for Entertainment: Museum Guide

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Nourbakhsh, Kunz & Willeke (2003)

Figure 1: *Chips the Dinosaur Hall Robot*

Figure 2: *The Sweetlips robot near a diorama*

Figure 3: *Joe Historybot in the Heinz History Center*

Nourbakhsh, Kunz, Willeke (2003)

Lessons Learned

- Conservative museums don't favour unnecessary technological advances.
- Only a handful of museums are large enough to purchase the hardware and audiovisual content for a $200,000 robot system.
- The novelty wore off and the museum staff became accustomed to the robots "without an active champion, there is really no reason for a piece of high technology to stay in a staid museum, and so the decision will eventually be made: remove the robot and thereby cut superfluous costs."

Robot Ethics

- Robot ethics is a subfield within ethics, which is interested in how the world ought (or ought not) to be, as opposed to how the world is.

- Consequently, ethics typically involves establishing, recommending and defending approaches to ensure right behaviour and how one "ought" to live to have a good life.

- Robot ethics aims to create greater discussions about what the function of a robot "ought" to be.

A (Human) Rights-Based Approach

- Rights-based ethics is an approach to ethical theory, which is based on the notion of rights.
- A right is an entitlement to something, such as legal rights or human rights proposed by the United Nations.
- Rights imply correlative duties. If I have a right to freedom from physical harm, others have a duty not to physically harm me.

Right to Privacy

Sharkey and Sharkey (2012)

Article 12 of the Universal Declaration of Human Rights:

“ No one shall be subjected to arbitrary interference with his privacy, family, home, or correspondence, nor to attacks upon his honor and reputation. Everyone has the right to the protection of the law against such interference or attacks. ”

Right to Privacy vs. Safety

- Improving an individuals safety must be traded off against an individuals rights to privacy

- For example, a robot could be used to monitor health 24/7 however this might not be appropriate if the child or elderly is taking a shower.

Right to Personal Liberty

Article 3 of the Universal Declaration of Human Rights:

“Everyone has the right to life, liberty and security of person.”

Right to Personal Liberty vs. Safety

- How could a robot know how to draw the line between ensuring safety for someone without encroaching on their personal liberty?
- For example, what if a child is going towards a stove with a match, should the robot intervene and remove the matches?
- What if an elderly person with dementia is going towards a stove with a match, should the robot intervene and remove the matches?

The Right to Social Contact

This is not a right in the Universal Declaration of Human Rights

The Right to Social Contact

- People could be left in the near-exclusive company of robots.
- This could effect typical development of children if they learn social behaviours from a robot
- Using robots to care for the elderly could reduce the number of opportunities they have to interact with other human beings

Should we give robots rights?

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Pleo vs.ComBot

Should we give robots rights?

Darling & Gassert (2013)

- Participants were given Pleos and asked to tie up, strike and “kill” their Pleos.
- Many participants refused, even physically protecting them from being struck by other teammates.
- One participant removed her Pleos battery, wanting to spare it the pain..
- Only one Pleo was sacrificed in the end.

Should we give robots rights?

Darling (2014) argues that we should because:

- Robot rights would discourage harmful behaviour, especially in children. Given the lifelike behaviour of a robot, a child could equate kicking a robotic dog to kicking a ‘real’ dog
- If we don’t we might become desensitized to this behaviour
- It causes us pain to see violence

“He who is cruel to animals becomes hard also in his dealings with men.”

- Kant

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Big Hero 6 (2014)

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