SEMINARS IN ARTIFICIAL INTELLIGENCE

LONG-TERM INTERACTION

Marc Hanheide

LONG-TERM INTERACTION

13/05/16: Long-term Interaction

Long-term interaction poses a significant challenge for robots, not only in terms of robustness, but also in terms of habituation and adaptation effects. In this session we shall learn more about long-term challenges and applications for robots.

Paper	Presented by	Discussed by
6-1 Baxter, P. et al., 2011. Long-Term Human-Robot Interaction with Young Users. Memory, p.in press.	Sina Baharlou	Daniele Evangelista
6-2 Kanda, T. et al., 2007. A two-month field trial in an elementary school for long-term human-robot interaction. IEEE Transactions on Robotics, 23(5), pp.962–971.	Massimiliano Mancini	Paolo Russo & Ali Youssef
6-3 Sung, J., Christensen, H.I. & Grinter, R.E., 2009. Robots in the wild: Understanding long-term use. Human-Robot Interaction (HRI), 2009 4th ACM/IEEE International Conference on, pp.45–52.	Irvin Aloise	Mirco Colosi

WHY LONG-TERM INTERACTION?

WHY LONG-TERM INTERACTION?

- Purpose
  - To show trends across time (increase/decrease of measures of a whole cohort, comparing at milestones, comparing means)
  - To document change in individual behavior and/or attitudes across time (producing means of individual differences)
  - To compare individuals across time. (compare averaged differences)

WHY LONG-TERM INTERACTION?

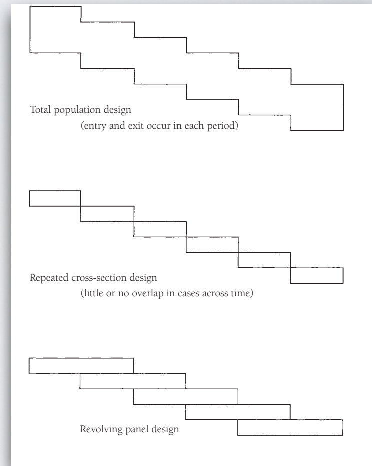
- In longitudinal data analysis:
  - Interest is on the behaviour of a response variable over time.
  - Assess how an **adaptive system** changes over time and how it is assessed by users
  - Assess how **users change their attitude** towards a system over time (static system), habituation effects
- Problem: Separating both effects is near impossible

WHY LONG-TERM INTERACTION?

- Strengths
  - Allows you to assess the **persistence of impacts** across time and place.
  - Allows you to assess how **time, maturation and other environmental factors** can influence impacts across time.
- Weaknesses
  - Time consuming
  - Expensive
  - **Attrition rates** over time can lead to small sample sizes

STUDY DESIGNS

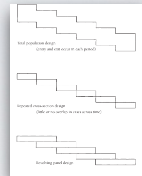
- longitudinal studies have periods
  - total population: full population is measured in each period of the design.
    - changes: birth, death, or dropout from the institution
  - repeated cross-sectional design
    - independent samples at each measurement period
  - revolving panel design
    - sample of cases for a specified measurement period, then drops some subjects, who are replaced with new subjects.



Bauer, K.W., 2004. Conducting longitudinal studies. New Directions for Institutional Research, 2004(121), pp.75–90.

STUDY DESIGNS

- longitudinal studies have periods
  - longitudinal panel is likely the most familiar design.



	Time 1	Time 2	Time 3	Time 4	Time 5	Time 6
Cohort 1						
Cohort 2						
Cohort 3						
Cohort 4						

Longitudinal panel design
(multiple cohort design)

Bauer, K.W., 2004. Conducting longitudinal studies. New Directions for Institutional Research, 2004(121), pp.75–90.

AN EXAMPLE

Personalization in HRI: A longitudinal field experiment

Min Kyung Lee[1], Jodi Forlizzi[1], Sara Kiesler[1], Paul Rybski[2], John Antanitis[1], Sarun Savetsila[2]
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5000 Forbes Ave
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Lee, M.K. et al., 2012. Personalization in HRI. In Proceedings of the seventh annual ACM/IEEE international conference on Human-Robot Interaction - HRI '12. New York, New York, USA: ACM Press, p. 319.

CONTRIBUTION

- demonstrates the effects of personalization with memory in human-robot interaction.
- changes in people's experiences with the robot over time through a longitudinal study, adding to a small but growing literature that investigates social HRI over repeated interactions.

Lee, M.K. et al., 2012. Personalization in HRI. In Proceedings of the seventh annual ACM/IEEE international conference on Human-Robot Interaction - HRI '12. New York, New York, USA: ACM Press, p. 319.

PERSONALIZATION

- using the history of the robot's repeated interactions with users to personalize its social interactions
  - The system's memory of prior encounters with the user can be used to create or update each new interaction.
- Snackbot: deliver snacks ordered via website

Figure 1. Snackbot carrying snack (left panel) and with a participant doing a neck stretch with the robot (right panel)

Lee, M.K. et al., 2012. Personalization in HRI. In Proceedings of the seventh annual ACM/IEEE international conference on Human-Robot Interaction - HRI '12. New York, New York, USA: ACM Press, p. 319.

INTERACTIONS

Table 1. Social small talk topics

Categories	Topics	Examples
Temporal and seasonal	Days of the week, holidays (April Fool's Day, Memorial Day), seasons	"You've got something on your face! [pause] April Fool's!"
Organizational	Spring festival, mid-term and final exams, break	"Do you have any plans for carnival?"
Regional	Pittsburgh Pirates baseball team	"It is baseball season. Do you follow the Pirates?"
Task-oriented	Information or story related to snacks	"Bananas are a really good source of potassium and vitamin B6. Excellent choice."
Other	Joke, local weather	"It is a nice day today. I am glad to see you again and hope you are doing well."

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Table 2. Personalized topics

Categories	Topics	Examples
Snack choices	Users' favorite snacks; whether they stuck to healthy snacks; whether they seemed to like variety; group's snack consumption patterns	"By the way, it seems as though you really like [snack]. This is the [Nth] time you have ordered one. Are [snacks] your favorite snack?"
Service usage patterns	Whether they were regular weekly users; had they been in their office when the robot was there; times when they did not use the snack service	"I missed you during my snack deliveries [N] times so far. I am glad to finally see you again."
Robot's behaviors	Frequency of breakdowns and apology (no breakdowns to frequent breakdowns)	"I was thinking about my first month here. I realized that I broke down and made mistakes [N] times in front of you. Sorry for that, and thank you for being patient with me."

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2.3 Limited Capabilities of the Robot

Despite all our efforts, the robot had significant limitations that were evident to participants. It followed pre-set scripts. There were frequent delays in the dialogue. Sometimes the system froze when there were wireless network communication problems. However, there were not differences in breakdown frequencies in the conditions of the study.

HYPOTHESES

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- field experiment over 4 months to test the following hypotheses:
  - A **personalized** robot will **increase rapport** and cooperation with a robot as compared with a sociable robot lacking personalization.
  - A **personalized** robot will **increase engagement** during the service encounter as compared with a sociable robot lacking personalization.
  - A **personalized** robot will **increase satisfaction** with a snack service as compared with a sociable robot lacking personalization.

HYPOTHESES

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  - ...ase rapport ... compared ... onalization.
  - ...ase ... encounter as ... acking
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Why a long-term study?

Why a long-term study?

DESIGN

- Two (Personalization vs. No Personalization) x two (Pre-personalization [Period 1] vs. Post-personalization [Period 2]) mixed **factorial** design (Table 3).
- Interactions in Period 1 to collect **baseline attitude scores** and interaction behaviors.
- Baseline behaviors also were used to personalize the interactions in the Personalization condition.
- In general, Period 1 included each participant's first four interactions with the robot, and Period 2 included the rest of the interactions. However, for those who joined the service later (two in Personalization, three in No Personalization), we had to shorten their Period 1 as 2-3 interactions as we had to stop running the service at the end of June due to the scheduled office move.

Table 3. Experimental design

	Period 1	**Period 2**
Personalization	Social Interaction	Social Interaction + Personalized Interaction
No Personalization	Social Interaction	Social Interaction

SOME RESULTS

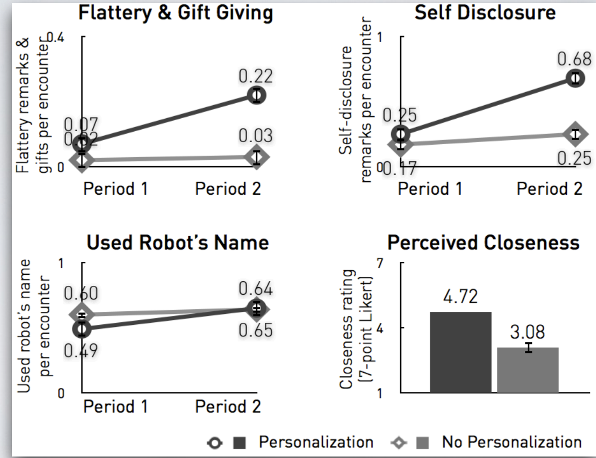
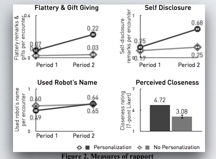


Figure 2. Measures of rapport

SOME RESULTS



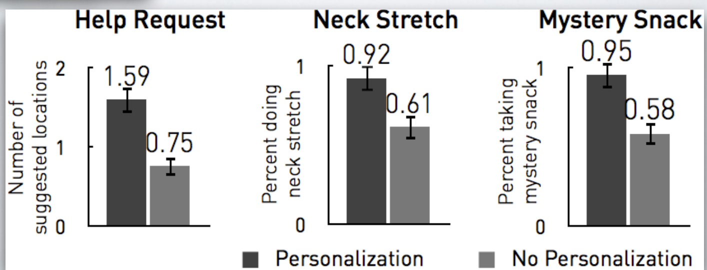
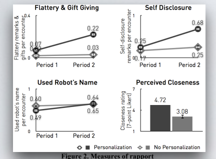
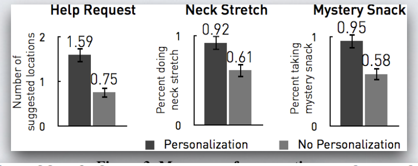


Figure 3. Measures of cooperation

SOME RESULTS





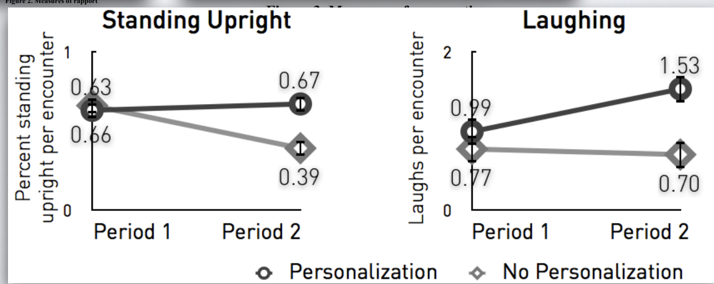


Figure 4. Measures of engagement

SURVEY

- While a lot of work has been done in studying how users interact with robots within a single interaction, only in the last decade the first long-term studies, in which the same user (or group of users) interacts with a robot several times, have started to appear.
- longitudinal studies are much more laborious and time-consuming than short-term studies, especially in naturalistic environments.
- only recently technology has been robust enough to allow for some degree of autonomy when users interact with robots for extended periods of time.

Social Robots for Long-Term Interaction: A Survey

Iolanda Leite, Carlos Martinho & Ana Paiva

International Journal of Social Robotics

ISSN 1875-4791

Int J of Soc Robotics
DOI 10.1007/s12369-013-0178-y

Springer

SURVEY

- Longitudinal studies are extremely useful to investigate **changes** in user behaviour and experiences over time.
- scope of this survey to robots designed to **socially interact** with people or to evoke **social responses** from them
- early long-term studies show that the **novelty effect** quickly wears off and, after that, people **lose interest** and **change their attitudes** towards the robots

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SURVEY: METHODOLOGY

- electronic searches using **digital libraries** such as Google Scholar, Microsoft Academic Search and CiteSeer
  - keywords used in the search included "**social robots**", "**long-term interaction**" and "**study**"
- manually searched the proceedings of the main HRI journals and conferences (e.g., HRI and RO-MAN).
  - 45 research papers
  - excluded studies that were not conducted in real-word environments such as offices, homes or schools, but rather in laboratory settings
- a total of **24 papers** were included in this survey.

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SURVEY: APPLICATIONS

- Health Care and Therapy
- Education
- Work Environments and Public Spaces
- At Home

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SURVEY: APPLICATIONS

- **Health Care and Therapy**
- Education
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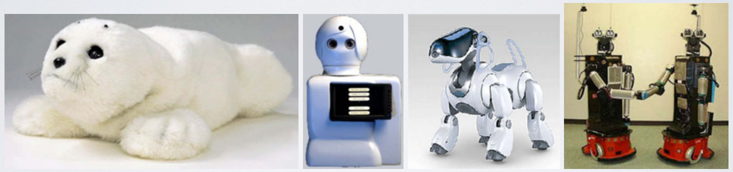
SURVEY: HEALTH CARE AND THERAPY



(a) Paro (AIST, Japan)[74,75,76] (b) Autom [39] (c) AIBO[19] ©Sony (d) Robovie [61,35]

Fig. 1 Robots used in the health care and therapy related long-term studies (images used with permission of the authors)

SURVEY: HEALTH CARE AND THERAPY

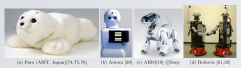
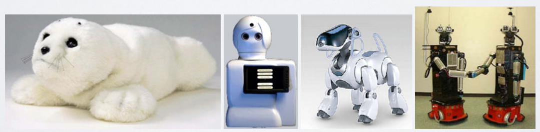


Table 1 Summary of the long-term studies in the health care and therapy domains

References	Agent/Robot	Capabilities	Exp. design	Nr. sessions	Main results
Wada & Shibata (2006, 2007)	Paro	Animal-like behaviour; responds to touch, sound and lights; limited-keyword recognition	Subjects: 12 Measures: degree of social interaction, stress levels Methods: video, interviews, urine tests	30 (9 hours a day)	Increased social interaction between participants, stress levels reduced
Kidd & Breazeal (2008)	Autom	Eye contact and small talk depending on time of day, state of the relationship with the user, etc.	Subjects: 45; 17–72 years old (3 conditions) Measures: weight loss, WAI, usage of the system Methods: questionnaire	50 (average)	Participants interacting with the robot reported their weight for more days and expressed more willing to continue interacting with the system
Francois et al. (2009)	AIBO	Dog-like behaviour (e.g., wag the tail); responds to touch	Subjects: 6 (autistic children) Measures: children's progress during interaction Methods: video observation	10 (40 minutes each)	Children tended to express more interest towards the robot over time, with occasional displays of affect
Sabelli et al. (2011)	Robovie	Remotely operated dialogues and child-like behaviours (e.g. "what is this?")	Subjects: 55 Measures: interaction patterns during interaction Methods: interviews, direct observations	15 to 35 (10 to 20 minutes each)	Robot was well accepted due to role as "child" and behaviours such as greetings and calling users by their names

SURVEY: HEALTH CARE AND THERAPY

- Take Home Messages
  - design varies a lot (from a few spread-out sessions to long interaction every day)
  - often also WoZ design (a lot effort!)



(a) Paro (AIST, Japan)[74,75,76] (b) Autom [39] (c) AIBO[19] ©Sony (d) Robovie [61,35]

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ADDITIONAL: ROBOTS IN SPACE

- Long-term HRI studies with robots to keep astronauts fit
  - isolation study (3 weeks like on the way to Mars!)
  - results are a secret :-(

ADDITIONAL: ROBOTS IN SPACE

- related separate study about a fitness robot

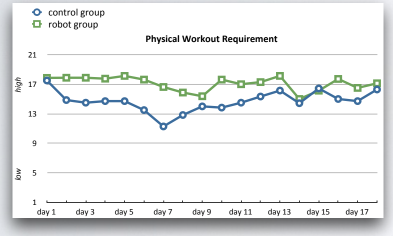


Fig. 6. Physical Workout Requirement

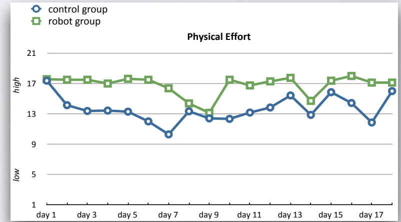
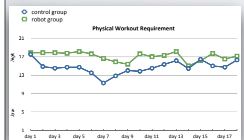


Fig. 7. Physical Effort

Sussenbach, L. et al., 2014. A robot as fitness companion: Towards an interactive action-based motivation model. Proceedings - IEEE International Workshop on Robot and Human Interactive Communication, 2014-October(October), pp.286–293.

ADDITIONAL: ROBOTS IN SPACE

- related separate study about a fitness robot



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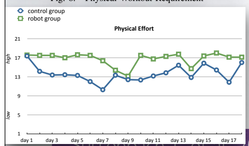

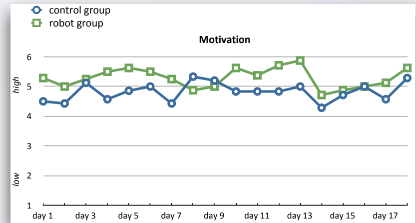

Fig. 8. Subjective Feeling of Motivation

Sussenbach, L. et al., 2014. A robot as fitness companion: Towards an interactive action-based motivation model. Proceedings - IEEE International Workshop on Robot and Human Interactive Communication, 2014-October(October), pp.286–293.

ADDITIONAL: ROBOTS IN SPACE

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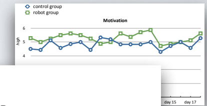


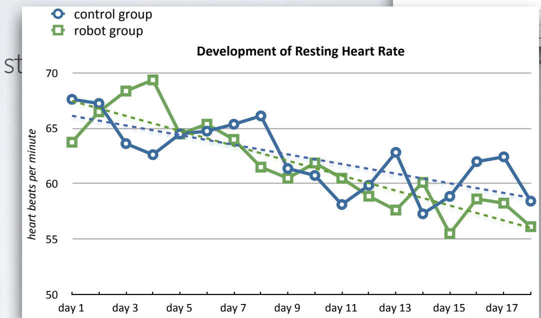
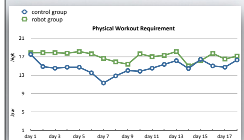


Fig. 5. Development Resting Heart Rate



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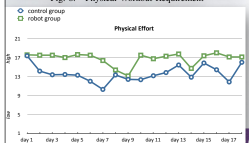

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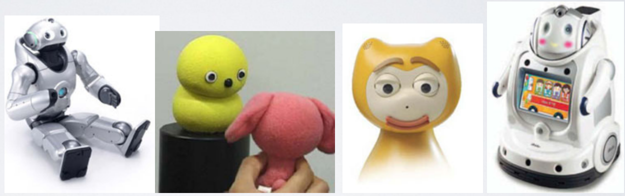
SURVEY: APPLICATIONS

- Health Care and Therapy
- **Education**
- Work Environments and Public Spaces
- At Home

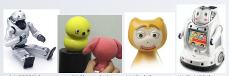
SURVEY: EDUCATION

Fig. 2 Some of the robots used in the long-term studies in the education domain (images used with permission of the authors)



(a) QRIO[71] ©Sony (b) Keepon [44] (c) iCat[47] ©Philips Research (d) iRobiQ[30] ©iRobiQ Co.,Ltd.

SURVEY: EDU-CATION



(a) QRIO[71] ©Sony (b) Keepon [44] (c) iCat[47] ©Philips Research (d) iRobiQ[30] ©iRobiQ Co.,Ltd.

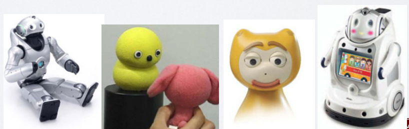
Table 2 Summary of the long-term studies in the domain of education

References	Robot	Capabilities	Exp. design	Nr. sessions	Main results
Kanda et al. (2004)	Robovie	Identify users, recognising and speaking English	Subjects: 228 Measures: length of interaction, English skills Methods: video observation, English tests	9 school days	Interaction after 1th week declined; improvement of English skills in children who kept interacting with the robot
Kanda et al. (2007)	Robovie	Identify users, pseudo-development mechanism, confiding personal information	Subjects: 37 (10–11 years) Measures: length of interaction Methods: questionnaire, video observation	32 school days	Children kept interacting with the robot after the 2nd week
Salter et al. (2004)	Wany	Obstacle avoidance, move in the environment	Subjects: 8 (5–8 years, male) Measures: activity around the robot Methods: video observation, analysis of interaction data	5	Children lost interest in the interaction from the third session
Tanaka et al. (2007)	QRIO	Choreographed dance sequences and mimicking children's movements	Subjects: 11 (10–24 months) Measures: quality of interaction, haptic behaviour towards the robot Methods: video observation	15 (45–50 min. each)	Toddlers progressively started treating QRIO as a peer and exhibited several care-taking behaviours towards the robot
Kozima et al. (2009) (study 1)	Keepon	Display non-verbal behaviours (gaze, emotions, ...)	Subjects: 27 (3–4 years) Measures: children's responses Methods: video observation	20 (90 minutes each)	Robot played the role of social mediator; children maintained interest over the sessions
Kozima et al. (2009) (study 2)	Keepon	Display non-verbal behaviours (gaze, emotions, ...)	Subjects: 30 (2–4 years, autistic) Measures: children's responses towards the robot Methods: video observation	15	Although eye contact decreased, children gradually approached the robot more and established physical contact
Leite et al. (2008)	iCat	Feedback on children's moves through facial expressions	Subjects: 5 (5–15 years) Measures: social presence, eye contact with the robot Methods: questionnaire, video observation	5 (aprox. 1 hour)	Some dimensions of social presence decreased; eye contact with the robot decreased after the 2nd week
Hyun et al. (2010)	iRobiQ	Move head and arms, navigate in the environment, express emotions	Subjects: 111 (5 years) Measures: children's perception of the robot Methods: interviews	10 (approx. 1 hour)	Robots are well accepted by children in educational settings

SURVEY: EDUCATION

- Take Home Messages
  - robots appear to be effective tools
  - novelty effects wears off quickly

Fig. 2 Some of the robots used in the long-term studies in the education domain (images used with permission of the authors)



(a) QRIO[71] ©Sony (b) Keepon [44] (c) iCat[47] ©Philips Research (d) iRobiQ[30] ©iRobiQ Co.,Ltd.

SURVEY: APPLICATIONS

- Health Care and Therapy
- Education
- **Work Environments and Public Spaces**
- At Home

SURVEY: WORK ENVIRONMENTS AND PUBLIC SPACES

(a) Cero [64] (b) Valerie [22, 41] (c) PER [67]

Fig. 3 Robots used in the long-term studies in work environments and public spaces (images used with permission of the authors)

SURVEY: WORK ENVIRONMENTS AND PUBLIC SPACES

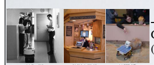


Table 3 Summary of the long-term studies in work environments and public spaces

References	Robot	Capabilities	Exp. design	Nr. sessions	Main results
Severinson-Eklundh et al. (2003)	Cero	Fetch-and-carry objects such as books or coffee cups	Subjects: 1 target user in a work group of 30 Measures: long-term effects of a service robot Methods: video and direct observation, system logs, pos-trial interviews	66	Social robots in public spaces should be able to interact with everyone, not just the main users
Stubbs et al. (2004)	PER	Simulated scientific testing	Subjects: 11 Measures: people's cognitive model of the robot Methods: interviews	3 months	Regular interactions influence people's cognitive model of the robot
Gockley et al. (2005)	Valerie	Reveal back-story, recognise people around the booth, limited natural language user interaction through text input	Subjects: 233 Measures: length of interactions Methods: analysis of interaction data	180	Many users kept interacting daily with the robot, but after a certain period only a few interacted for more than 30 seconds
Kirby et al. (2007)	Valerie	Additional mood displays while telling stories	Subjects: 62 Measures: length of interactions Methods: analysis of interaction data, questionnaire	45 (8 hours a day)	Interaction patterns change according to the robot's mood and level of familiarity with the robot
Kanda et al. (2010)	Robovie	Guiding, rapport building, identify repeated users, advertisement	Subjects: 162 Measures: intention of use, interest, perceived familiarity, intelligence and adequacy of route guidance Methods: questionnaire	2.1 (average); from 2 to 18 sessions	Perception of the robot was positive; shopping suggestions of the robot were accepted by visitors

SURVEY: WORK ENVIRONMENTS AND PUBLIC SPACES

- Take Home Messages
  - interaction time decreases over time
  - people "integrate" the robot into the environment

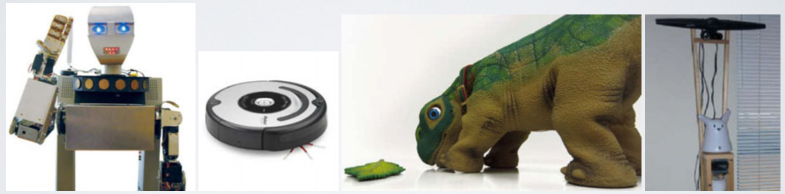
(a) Cero [64] (b) Valerie [22, 41] (c) PER [67]

Fig. 3 Robots used in the long-term studies in work environments and public spaces (images used with permission of the authors)

SURVEY: APPLICATIONS

- Health Care and Therapy
- Education
- Work Environments and Public Spaces
- **At Home**

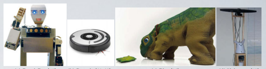
SURVEY: AT HOME



(a) PeopleBot [43] (b) Roomba[68, 69] ©iRobot (c) Pleo [16] (d) Nabaztag [42]

Fig. 4 Robots used in the long-term studies in home environments (images used with permission of the authors)

SURVEY: AT HOME



(a) PeopleBot [43] (b) Roomba[68, 69] ©iRobot (c) Pleo [16] (d) Nabaztag [42]

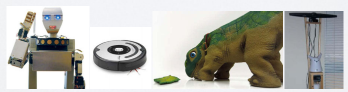
Fig. 4 Robots used in the long-term studies in home environments (images used with permission of the authors)

Table 4 Summary of the long-term studies in home environments

References	Robot	Capabilities	Exp. design	Nr. sessions	Main results
Koay et al. (2003)	PeopleBot	Approach the user in several ways	Subjects: 12 (8 male and 4 female) Measures: proxemic preferences Methods: questionnaire, comfort level device	8 (aprox. 1 hour each)	People's preferences in terms of promixity change over time
Sung et al. (2009, 2010)	Roomba	Vacuum cleaning, move around the house	Subjects: 48 (across 30 households) Measures: acceptance of robot Methods: observation, interviews, probing techniques, activity cards, small questionnaires	6 months	Two months is the time required for observing stable interactions between robots and households. Several techniques should be complemented to really capture people's routines at home
Fernaeus et al. (2010)	Pleo	Animal-like behaviour	Subjects: 6 families Measures: exploratory study Methods: interviews, video recordings and pictures	2–10 months	Initial expectations about Pleo were not met. After the novelty effect, participants played with the robot only occasionally
Klamer et al. (2011)	Nabaztag	Personalised health conversations; users interact using yes- and no-buttons	Subjects: 3 (50–65 years old, females) Measures: usage and acceptance of social robots Methods: interviews	10 days	Utilitarian and social factors seem important reasons for participants to accept social robots in domestic environments

SURVEY: AT HOME

- Take Home Messages
  - very strong novelty effect => strong loss of interest if entertainment
  - it needs to actually fulfil a purpose



(a) PeopleBot [43] (b) Roomba[68, 69] ©iRobot (c) Pleo [16] (d) Nabaztag [42]

Fig. 4 Robots used in the long-term studies in home environments (images used with permission of the authors)

RECOMMENDATION

Table 5 Summary of the guidelines for future design of social robots for long-term interaction

Guideline	Recommendations
Appearance	– Select embodiment according to the robot's purpose and capabilities – Functional embodiments well suited for home or office environments – Animal-like embodiments create less expectations of robot's social capabilities
Continuity and incremental behaviours	– Routine behaviours (e.g., greetings and farewells) – Strategic behaviours (e.g., recalling previous activities and self-disclosure) – Incremental addition of novel behaviours over time
Affective interactions and empathy	– Understand the user's affective state (and react accordingly) – Display contextualised affective reactions
Memory and adaptation	– Identify new and repeated users – Remember aspects of past interactions and recall them appropriately – Use information about the user to personalise the interaction

RECOMMENDATION APPEARANCE

– Select embodiment according to the robot's purpose and capabilities

– Functional embodiments well suited for home or office environments

– Animal-like embodiments create less expectations of robot's social capabilities

- important role in the **first impressions** and future **expectations**
- participants consider the robot's appearance more relevant than functionality, especially in domestic robots.
- facial features of several robotic heads influenced significantly the perception of humanness in those robots
- human appearance is not always desirable as suggested in Mori's theory of the uncanny valley
- "**anthropomorphism** might raise **false expectations** regarding the cognitive and social abilities that the robot cannot fulfil"

RECOMMENDATION APPEARANCE

– Select embodiment according to the robot's purpose and capabilities

– Functional embodiments well suited for home or office environments

– Animal-like embodiments create less expectations of robot's social capabilities

- robot's appearance must take into account not only its behavioural and social capabilities, but also the application domain where the robot will operate and its function
- While **animal-inspired embodiments** are well suited for health and therapy related scenarios, as they elicit care-taking behaviours from humans, **functional embodiments** are more appropriate for **work environments or domestic settings**, where the ways in which the robot can assist users are a major determinant

RECOMMENDATION CONTINUITY AND BEHAVIOUR

– Routine behaviours (e.g., greetings and farewells)

– Strategic behaviours (e.g., recalling previous activities and self-disclosure)

– Incremental addition of novel behaviours over time

- difficult trade-off:
  - **coherent and consistent behaviour** (not erratic over time) on the one hand,
  - **changing** and **adaptive** to keep interest on the other
- also: behaviour changes are difficult for studies when you want to study the human

RECOMMENDATION AFFECTIVE INTERACTION

– Understand the user's affective state (and react accordingly)
– Display contextualised affective reactions

- empathy as "an affective response more appropriate to someone else's situation than to one's own" => difficult for a robot?
- empathy facilitates the creation and development of human social relationships
- some researchers even consider the awareness of the user's affective state more important than the actual display of emotions by the robot.

RECOMMENDATION MEMORY AND ADAPTATION

– Identify new and repeated users
– Remember aspects of past interactions and recall them appropriately
– Use information about the user to personalise the interaction

- Though, it has been shown that an all-remembering robot is not as accepted as a "forgetful" one
- Individualised adaptation is useful
- Memory is almost always present in robotic systems but often the interaction itself does not exploit ut.

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STUDY CONSIDERATIONS (ECONOMICS IN HRI)

- Sample size:
  - the number of participants should be reasonable considering the number of interaction sessions, the data collection methods and the number of people allocated to analyse the data.
- Number of interaction sessions:
  - the number of interactions should take into account the factors mentioned above.
  - It often is enough to capture the changes on people's perception of the robot after the "novelty effect".
- Control conditions:
  - the use of one (or more) control conditions should be done only if extremely necessary.
  - most of the long-term studies do not have a control condition.
  - user's experience over time can already be considered a strong independent variable.

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LONG-TERM INTERACTION

6-1 Baxter, P. et al., 2011. Long-Term Human-Robot Interaction with Young Users. Memory, p.in press.	Sina Baharlou	Daniele Evangelista

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LONG-TERM INTERACTION

6-2 Kanda, T. et al., 2007. A two-month field trial in an elementary school for long-term human-robot interaction. IEEE Transactions on Robotics, 23(5), pp.962–971.	Massimiliano Mancini	Paolo Russo & Ali Youssef

LONG-TERM INTERACTION

6-3 Sung, J., Christensen, H.I. & Grinter, R.E., 2009. Robots in the wild: Understanding long-term use. Human-Robot Interaction (HRI), 2009 4th ACM/IEEE International Conference on, pp.45–52.	Irvin Aloise	Mirco Colosi

WRAP-UP

01/04/16: Studying and Measuring in HRI

13/05/16: Long-term Interaction

29/04/16: Social Signals

15/04/16: Human-Robot Spatial Interaction

22/04/16: Human-Robot Collaboration

Why do we want to study HRI?

What are the big *technical* challenges?

Where is HRI different to HCI?

What are challenges in *studying* HRI?

Will we ever have a robot to pass the Turing test? When?

https://lcas.lincoln.ac.uk/qv/LAS/