Application

2015-03-31

2015-04378 **Castellano, Ginevra** **NT-2**

Information about applicant

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Project site: Inst för informationsteknologi

Information about application

Call name: Forskningsbidrag Stora utlysningen 2015 (Naturvetenskap och teknikvetenskap)

Type of grant: Projektbidrag

Focus: Unga forskare

Subject area:

Project title (english): Adaptive learning for personalised instructional robots

Project start: 2016-01-01

Project end: 2019-12-31

Review panel applied for: NT-2

Classification code: 10207. Datorseende och robotik (autonoma system), 10201. Datavetenskap (datalogi), 10204. Människa-datorinteraktion (interaktionsdesign) (Samhällsvetenskapliga aspekter under 50803)

Keywords: Instructional robots, Statistical learning, Social robotics

Funds applied for

Year:	2016	2017	2018	2019
Amount:	1,654,462	1,397,457	1,422,322	1,476,083

Descriptive data

Project info

Project title (Swedish)*

Adaptivt lärande för personifierade utbildningsrobotar

Project title (English)*

Adaptive learning for personalised instructional robots

Abstract (English)*

After the advent of industrial automation, we are now witnessing a second robotics revolution, but, as scientists strive to move the robots out of the factories and better integrate them into our daily lives to support and instruct humans to complete tasks, robot adaptation and personalisation abilities remain limited. A key requirement for an instructional robot is to adapt to its users by providing them with ad hoc support and instructions to maximise their performance during a given task and create an engaging user experience. To date most adaptive instructional robots rely on pre-scripted rules, but do not adaptively learn from the effects of such strategies, for example if they have been effective for a specific user in a specific context. This project will develop novel, ground-breaking adaptive learning algorithms for effective human-robot interaction in instructional settings that rely on robust real-time modelling and adaptation to human users and task performance, delivering highly personalised robots. To ground the research in a concrete instructional context the project will develop and evaluate new reinforcement learning approaches in the area of robot-supported learning, with a specific focus on social robots acting as educational agents. If successful, the project will open up new frontiers and opportunities, making a first step towards the development of robots that achieve long-term robot autonomy, prerequisite for a successful integration in our daily lives.

Popular scientific description (Swedish)*

Efter tillkomsten av industriell automation, bevittnar vi nu en andra robotrevolution, men även om forskare strävar efter att flytta robotarna ur fabrikerna och integrera dem bättre i vardagslivet för att stödja och instruera människor att utföra uppgifter, robotars anpassnings och personifieringsförmågor förblir begränsade. Ett viktigt krav för en utbildningsrobot är att anpassa sig till sina användare genom att ge dem ad hoc stöd och instruktioner för att höja sina prestationer när de jobbar med en given uppgift och skapa en engagerande användarupplevelse. Hittills de mest adaptiva utbildningsrobotar litar på på förhand skriptade regler, men kan inte lära och anpassa sig av de effekterna av sådana strategier, till exempel om de har varit effektiva för en specifik användare i ett specifikt sammanhang. Detta projekt kommer att utveckla nya, banbrytande adaptiva inlärningsalgoritmer för effektiv människa-robot interaktion i utbildningskontexter som är beroende av robust realtidsmodellering och anpassning till mänskliga användare för att leverera personifierade robotar. För att basera detta projekt på en konkret lärandesituation kommer vi att utveckla och utvärdera nya ansatser inom förstärkningslärande (Reinforcement Learning, RL) inom området robotstödd inlärning, med särskild inriktning på sociala robotar som fungerar som pedagogiska verktyg som underlättar inlärning av datorprogrammering för grundskolan årskurs 5-7. Projektet kommer att behandla flera viktiga vetenskapliga utmaningar för att uppnå robust robotpersonifiering till användare i ett utbildningssammanhang via adaptiv inlärning. Den första vetenskapliga utmaningen är hur man modellera användarnas lärandeframsteg och engagemang i uppgiften. Den andra vetenskapliga utmaningen handlar om hur man utvecklar RL algoritmer som lär de bästa kombinationerna av dialogstrategier och undervisningsverksamhet som levereras av roboten genom att använda belöningsmekanismer som tar hänsyn till tidigare inlärningsframsteg och användarnas engagemang. Den tredje vetenskapliga utmaningen tar ett steg längre och fokuserar på långsiktiga interaktioner med utbildningsrobotar. För att adressera de tre vetenskapliga utmaningar ovan kommer projektet att fokusera på tre specifika mål: (1) Utveckling av metoder för robust modellering av eleven och automatisk engagemangigenkännande i en utbildningsmiljö; (2) genomförandet av RL metoder baserade på dialogstrategier och undervisning för att låta robotar anpassa sig till användarnas lärandeframsteg och erfarenheter på ett naturligt sätt; (3) longitudinella studier för att utvärdera de utvecklade algoritmerna över olika undervisningssessioner. Om framgångsrikt kommer projektet att öppna upp nya möjligheter för att ta det första steget mot att utveckla robotar som uppnår långsiktig robotautonomi, vilket är en förutsättning för en framgångsrik integration av robotar i vardagslivet.

Project period

Number of project years*

4

Calculated project time*

2016-01-01 - 2019-12-31

Deductible time

Deductible time

Cause	Months

Career age: 83

Career age is a description of the time from your first doctoral degree until the last day of the call. Your career age change if you have deductible time. Your career age is shown in months. For some calls there are restrictions in the career age.

Classifications

Select a minimum of one and a maximum of three SCB-codes in order of priority.

Select the SCB-code in three levels and then click the lower plus-button to save your selection.

SCB-codes*

1. Naturvetenskap > 102. Data- och informationsvetenskap (Datateknik) > 10207. Datorseende och robotik (autonoma system)

1. Naturvetenskap > 102. Data- och informationsvetenskap (Datateknik) > 10201. Datavetenskap (datalogi)

1. Naturvetenskap > 102. Data- och informationsvetenskap (Datateknik) > 10204. Människa-datorinteraktion (interaktionsdesign) (Samhällsvetenskapliga aspekter under 50803)

Enter a minimum of three, and up to five, short keywords that describe your project.

Keyword 1*

Instructional robots

Keyword 2*

Statistical learning

Keyword 3*

Social robotics

Keyword 4

Keyword 5

Ethical considerations

Specify any ethical issues that the project (or equivalent) raises, and describe how they will be addressed in your research. Also indicate the specific considerations that might be relevant to your application.

Reporting of ethical considerations*

Research in this project will involve human participants (early secondary students) for data collection and for evaluation of the proposed approaches for robot personalisation in an instructional scenario. Interaction data will be collected, including, for example, video and audio recordings, data from other sensors (electrodermal activity measured via a simple non-invasive wrist sensor in the form of a bracelet), and data from the learning activity. The video recordings will be used for visual analysis and annotation to support the development of the project's technology. Students will also be asked to fill in some questionnaires to rate their overall experience of the interaction with the robot. No physical intervention on participants will take place.

All research activities will comply with the current legislation and regulations in Sweden. I will obtain approval of the relevant ethics committees (www.epn.se) prior to the start of the activities. The codes of the Swedish Research Council (Vetenskapsrådet) for research with children will be followed.

Specific issues:

Consent:
Children, parents/caretakers and teachers will be made fully aware of the research aims via participant information sheets before giving informed consent.

Withdrawal:
Participants will be able to withdraw from the research without penalty or judgment at any given time. This will be indicated at the very beginning of their participation in the study.

Confidentiality, storage, access to data:

Participants' data, such as video and audio recordings, as well as written assessments, will be collected during the project. Personal information will not be stored or combined with this data to ensure confidentiality. Participants will be assigned to an individual identification number. These numbers will be used for self-report and peer nomination. Data stored will not be shared with third parties. Parents and caretakers will be informed about the use and storage of the video and audio recordings. All data will be stored in accordance with national and EC legislation. All data collected from these studies will be treated as confidential and stored securely. Video recordings of these studies may be shown in scientific papers, conferences and events (but never made available to anyone outside of the project), but participants will be able to opt-out of this by ticking a checkbox on the consent form.

The project includes handling of personal data

Yes

The project includes animal experiments

No

Account of experiments on humans

Yes

Research plan

Attach a research plan in PDF-format, in accordance with the instructions in the call text.

You can only attach one file, with a maximum size of 10 MB. First click the folder-button to locate the file on your computer, then click the plus-button to upload the file to the application form.

Research Plan – Ginevra Castellano

Adaptive learning for personalised instructional robots

Purpose and aims

> This project will develop novel, ground-breaking adaptive learning algorithms for effective human-robot interaction in instructional settings that rely on robust real-time modelling and adaptation to human users and task performance, delivering highly personalised robots.

After the advent of industrial automation, we are now witnessing a second robotics revolution, but, as scientists strive to move the robots out of the factories and better integrate them into our daily lives to support humans in different ways, robot adaptation and personalisation abilities remain limited.

Of late, the use of robots to instruct humans to complete a physical or mental task has started to attract a lot of attention [1, 2] (Figure 1). A fundamental requirement for an instructional robot is to adapt to its users by providing them with *ad hoc* support and instructions to maximise their performance during a given task and create an engaging user experience. User engagement, in fact, has previously been proven to be linked with short and long-term learning performance [3].

Most approaches previously proposed in the literature for adaptive instructional robots rely on pre-scripted rules [2], often inspired by theories from psychology and social sciences or from observation of human behaviours. Though having been proven effective in short-term human-robot interactions, these approaches program the robot to display a number of different instructional strategies, but do not adaptively learn from the effects of such strategies, for example if they have been effective for a specific user in a specific context.

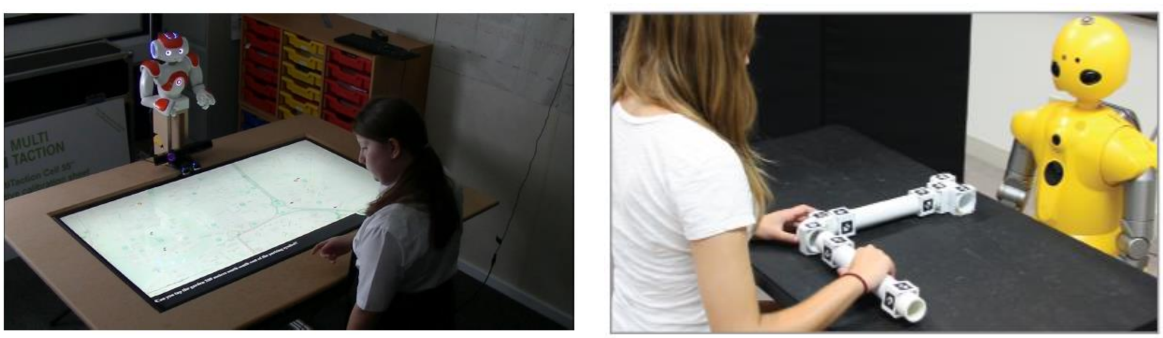

Figure 1. Instructional robots: student interacting with a robotic tutor (left) in one of my ongoing projects [1]; robot guiding a user in assembling pipes (right) [2].

A second strand of approaches leverages statistical learning to incrementally adapt robot behaviours and strategies to a specific user's situation. Examples include computational approaches that rely on Reinforcement Learning (RL) to incrementally adapt robot behaviours to maintain the user in a positive state [4], or adjust to a user's personality and progress with a task [5]. Moreover, outside of the robotics domain, previous work on intelligent tutoring systems used

RL techniques to adaptively personalise learning activities to each student in order to maximise their skills [6]. **However, nobody has yet proposed computational approaches based on RL in an instructional context to allow a robot to (1) learn how to change instructional activities to maintain the user engaged with the learning task and scaffold effective learning; and (2) learn how dialogue strategies contribute to individual learning performances.**

> This project aims to develop new RL-based approaches for personalised instructional robots that (1) model a user's state and learning progress over time; and (2) adapt to these in a natural way via personalised dialogue strategies and activities by learning the most appropriate intervention for a specific user.

To ground the research in a concrete instructional context, building on my experience of coordinator of the EMOTE project [7] on the topic of robotic tutors [1], the project will develop and evaluate new RL approaches in the area of robot-supported learning, with a specific focus on *social robots* acting as educational agents that facilitate learning of computer programming to early secondary students.

The project will address several important scientific challenges for achieving robust robot personalisation to users in an instructional context via adaptive learning. The **first scientific challenge** is how to model user learning progress and engagement with the task. The **second scientific challenge** involves how to develop RL algorithms that learn the best combinations of *dialogue strategies and teaching activities* delivered by the robot by employing reward mechanisms that appropriately account for the history of learning progress and user engagement. Finally, the **third scientific challenge** extends the challenges above to long-term interactions with instructional robots. In order to address the three scientific challenges above, the project will focus on three specific objectives:

> 1) Development of methods for robust learner modelling and automatic engagement recognition in an instructional setting
> 2) Implementation of RL methods based on dialogue and teaching strategies to allow robots to adapt in a natural way to users' learning progress and experiences
> 3) Longitudinal studies to evaluate the developed algorithms across different learning sessions

My research group and collaborators have experience with computational techniques for user modelling and statistical learning and experimental frameworks in instructional settings that include real robotic systems, which will be integrated in order to achieve the project's objectives. The starting point of the project is my work on adaptive and personalised robotic tutors conducted in the EMOTE project [1], as well as my previous work on RL-methods for robot learning of what support strategies are most preferred by a specific user [4]. I am therefore well positioned to address the project's challenges.

If successful, the project will open up new frontiers and opportunities, making a first step towards the development of robots that achieve long-term robot autonomy, prerequisite for a successful integration in our daily lives.

Survey of the field

While many robotic systems described in the literature are capable of adapting to their users, only a few of them automatically learn user preferences using RL methods, which has become a popular approach to develop robots that learn from users in an intuitive, natural way [8]. While RL usually involves learning using explicit evaluative feedback, for example, in the form of a reward from the user, researchers have extended RL to enable learning in more natural, straightforward ways, such as using users' affective states and task performance as reward signals to measure the effects of different selected robot actions.

RL for robot adaptation to user states: I have shown in previous work that real-time robot adaptation to children's affective states in an educational chess game scenario by means of support strategies leads to children perceiving the robot as more helpful, engaging and friendly [9]. Our work, based on a RL algorithm (*EXP3*) that solves the Multi-Armed Bandit (MAB) problem [10], proposed an approach that allows an iCat robot to learn by trial and error the best support strategies for a particular user by monitoring transitions in the children's affective states and adapting its supportive behaviour accordingly (Figure 2). To classify the success (or failure) of a certain strategy, the reward function captures the improvement in the user's positive feelings after the robot employed such strategy. The algorithm, therefore, attempts to select the strategies that maximise users' positive feelings. Related work presented in [11] proposed an RL-based method for learning and adapting to users' affective states using *QV*-learning, a variant of the standard RL algorithm *Q*-learning. The advantage of the EXP3 algorithm over the one employed by [11] is that it focuses on maximising performance during learning, which translates in a more effective adaptation as perceived by the user. In a multi-party human-robot interaction context, Markov Decision Processes (MDPs) have been employed to generate socially appropriate behaviour by a bartender robot based on each individual user's engagement [12] . No previous work, however, has explored RL for personalising activities proposed by an instructional robot in order to maximize user engagement.

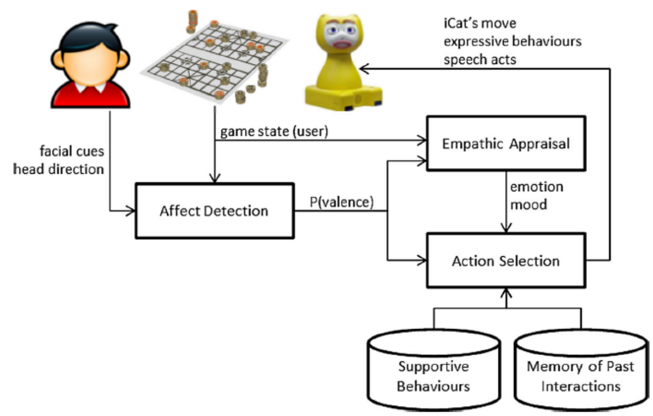

Figure 2: Architecture of the model applied to an iCat robot [4].

RL for robot adaptation to user task performance: Related work [5] presented in the context of post-stroke rehabilitation therapy proposed a method based on Policy Gradient Reinforcement Learning (PGRL) that adapts the robot's behaviour as a function of the user's personality and their progress in the rehabilitation exercises, while trying to maximize the latter. Outside of the robotics domain, Clement et al. proposed an approach for intelligent tutoring systems that uses MAB techniques to adaptively personalise sequences of learning activities by maximising the skills acquired by each student [6] Their work leverages expert knowledge to constrain initial exploration of the MAB, and requires only coarse guidance information of the expert. In other works in the intelligent tutoring system domain, Partially Observable Markov Decision Processes (POMDPs) have been used to compute individualised teaching policies where the learner's knowledge is the hidden variable [13]. In recent years RL approaches such as POMDPs and MDPs have been shown to provide an effective statistical model of the structure of a dialogue and Natural Language Generation (NLG) [14]. With this approach, decisions about what the system should say are all learned automatically. While RL has been used in initial studies for learning pedagogical policies and advantages of the MDPs and POMDPs have been shown, they have not been used for instructional robots and explored in detail in a real learning environment with real complex learning tasks.

Project description

Theory

The project aims to develop RL-based approaches for personalised instructional robots that learn which dialogues strategies and teaching activities delivered by the robot maximise learning performance and user engagement. This is a problem of *policy learning*, which in a RL framework means optimising action selection policies to maximise a reward. The general idea here is for the robot to learn a policy of optimal strategies that maximise a user's learning performance and engagement with the learning task. Building on my previous work on affect co-adaptation mechanisms for a social robot [4,9], this project will explore MAB techniques for the purpose of creating personalisation mechanisms that allow a robot to learn how to change instructional activities to maintain the user engaged with the learning task and maximise their learning and learn what dialogue strategies maximise learning performances.

One well-known algorithm designed to tackle the MAB problem is *EXP3* [10]. Consider the problem of a gambler facing a set of N slot-machines (also known as armed bandits). At each step, the gambler must select the machine that will maximize the expected payoff. As the gambler continues to play, estimates are built $\hat{x}_i,\ i = 1, \dots, N$, on the expected payoff from the machine i. The gambler must decide whether to invest in the machine with the seemingly best average payoff or to invest in other less explored machines, for which the estimate may still be crude. The EXP3 algorithm prescribes a policy for the gambler ensuring that in the long run, the gambler will do almost as well as if he had played consistently on the most rewarding machine. At time-step t, the gambler should play each machine $i,\ i = 1, \dots, N$ with a probability:

$$p_i(t) = (1 - \gamma) \frac{e^{\gamma \hat{x}_i(t)/N}}{\sum_{j=1}^{N} e^{\gamma \hat{x}_j(t)}} + \frac{\gamma}{N}, \qquad (1)$$

where γ is a positive parameter. As seen from equation (1), the probability of playing any machine $i, i = 1, \dots, N$ is always at least γ/N. Additionally, if $\hat{x}_j < \hat{x}_i$, then machine i will be selected more often than machine j. The difference in probability is controlled by parameter γ; if $\gamma = 0$ the gambler will make his selection uniformly and at random. On the other hand, as γ increases, the gambler will focus more on the (seemingly) most rewarding machines. With an adequate selection of γ, the resulting policy provides a theoretically satisfactory balance between exploration and exploitation [10]. In our case, the robot would play the role of the gambler that needs to select at each step a dialogue strategy or teaching activity (or combination of both) that will maximise the expected payoff or reward (for example, in terms of learning performance or user engagement).

Method

To ground the research in a concrete instructional context, the project will develop a test-bed scenario in the area of computer programming, in which a robot acts as a tutor that teaches students programming skills. The learning scenario (Figure 3) will be designed in collaboration with teachers in secondary schools in the Göteborg area, with whom my collaborator Associate Professor Wolmet Barendregt has established ongoing collaborations. Table 1 summarises the main features of the test-bed scenario. The proposed research will use an iterative technology development approach. This iterative approach will focus on identifying how to optimise learning performances and student engagement. The methodology therefore examines and develops robot behaviours and instructional strategies as a result of careful analysis of human-robot interactions. Wizard-of-Oz (WoZ) experiments (in which a robot is remotely operated by a human wizard in a controllable environment) will be iteratively performed in the test-bed scenario for initial testing of the RL-based robot personalisation approaches. These will be followed by an evaluation of robot prototypes exhibiting autonomous behaviour in a classroom environment in order to understand their impact on children's learning processes.

Figure 3. User interacting with a robotic tutor.

The project's activities are structured around three main subprojects: **(1) learner modelling; (2) RL approaches for robot personalisation; and (3) scenarios, learning platform, and evaluation**.

Subproject 1: Learner modelling

This subproject aims to develop prototype systems for learner modelling. These will follow an iterative design process and will be tested in the scenario developed in Subproject 3. Learner behaviour is analysed at the low level (e.g., non-verbal social signals from videos and/or data from other sensors) and at the high level (by inferring learner needs, preference and affective states) over time throughout the learning process.

Data collection and framework for learner modelling: A corpus of learner-robot interactions will be collected in the initial stages of the project via a WoZ study. This will include video recordings of students' behavioural expressions, contextual information relating to the learning task defined in Subproject 3, and data from other sensors (e.g., physiological data).

Development of prototypes for learner modelling: Indicators conveying information about learner needs, preferences and affective states (e.g., user engagement) from the corpus collected in the previous task will be developed. These may include non-verbal social signals such as smiles and eye gaze and other contextual features. Indicators of learner progress in the learning task will also be implemented. Machine learning methods to automatically model and recognise learner needs, preferences and engagement will be designed, developed and evaluated.

Target users	Secondary school students
Teaching topic	Computer programming
Learning platform	Instructional robot (e.g. NAO robot; Zeno R25) acting as a tutor; computer programming exercises on a desktop computer
Language	Swedish
Interaction modalities	User: text and basic verbal commands; robot sensitive to user via cameras and other sensors. Robot: dialogue, non-verbal behaviour

Table 1. Design space in the test-bed scenario.

Subproject 2: RL approaches for robot personalisation

The core technical aim of this subproject is to develop RL-based approaches for personalised instructional robots. These will follow an iterative design process and will be tested in the scenario developed in Subproject 3. Learner models produced in the previous subproject will be used to develop mechanisms for reward estimation for learning optimal robot strategies.
<u>Data collection and framework for robot personalisation</u>: Analysis of a corpus of learner-robot interactions (collected in Subproject 1) to derive a framework for robot personalisation will be performed. This task will identify what set of robot dialogue strategies and teaching activities the RL-based approaches for robot personalisation developed in this subproject will be tested with. This work will build on the results of my previous research in collaboration with Prof. Barendregt in the EMOTE project [7], where a rigorous experimental design including *ad hoc* studies with real teachers led to the identification of *support strategies* (e.g., pump and prompt, feedback, small talk) to inspire robot behaviours generation.
<u>Development of RL-based prototypes for robot personalisation</u>: RL-based approaches based on the MAB techniques discussed in the *Theory* section will be developed that enable a robot to personalise its dialogue strategies and proposed teaching activities in ways that are customised to a learner's needs, preferences and affective states emerging during the learning experience. The focus will be on developing RL-based approaches that employ mechanisms for reward estimation that maximise learning performance and user engagement and that appropriately account for the history of the latter.

Subproject 3: Scenario, learning platform and evaluation

The objective of this subproject is to design a test-best scenarios and learning platform, and conduct evaluation of the developed approaches for personalised instructional robots first in controlled and then in real world classroom environments.
<u>Learning platform and test-bed scenario:</u> User-centred studies will be conducted in schools. These will include focus groups and participatory design workshops with teachers to design a test-bed learning scenario based on computer programming. The learning platform (e.g., a set of computer programming exercises running on a desktop computer) will be designed and developed. This will be fully integrated with the prototypes developed in subprojects 1 and 2.
<u>Evaluation in controlled environments and schools:</u> Robot prototypes integrating the learner models and RL-based approaches for robot personalisation components developed in Subproject

1 and Subproject 2 will be evaluated. The first evaluation with students will take place in a controlled laboratory environment and will provide feedback for additional iterations of the implementation of the prototypes. This will be followed by a long-term evaluation (i.e., across several teaching sessions) in real world classroom environments. Qualitative and quantitative analysis (e.g, video observations, questionnaires, and simple learning metrics) will be performed to assess, together with more traditional RL metrics, the effectiveness of the proposed RL-based approaches for robot personalisation and compare an instructional robot that adapts to each specific user over different interactions versus a robot that does not.

Timeline

Key milestones of the project are:

Year 1: Development of test-bed scenario and learning platform *(milestone 1)*
Year 2: Corpus of human-robot data collected and framework for learner modelling and robot personalisation developed *(milestone 2)*
Year 3: Development of prototype systems for learner modelling and implementation of RL methods for robot personalisation based on dialogue and teaching strategies. WoZ studies for initial testing of robot personalisation conducted *(milestone 3)*
Year 4: Integration of learner modelling and RL-based robot personalisation approaches and evaluation in controlled environment and schools *(milestone 4)*

Implementation

In addition to me, the research group working in this project will include one PhD student employed for the whole project's duration, and collaborator Prof. Wolmet Barendregt from the Divison of Learning Communication and ICT, Department of Applied IT, Göteborg Universitet.

I will be responsible for the daily scientific and administrative management of the project and for providing short and long-term planning of publications and demonstrators. My background in automatic affect recognition and socially adaptive robots is necessary for supervising the PhD student, of which I will be the main supervisor. I will also dedicate time to the dissemination of the project's results and organise workshops and tutorials at major conferences in the areas of social robotics, human-robot interaction and affective computing. This is an interdisciplinary project which will conduct ground-breaking research at the interface of social robotics, affective computing, and machine learning. As such, I am in a unique position to carry out successful research in this project. I am an internationally recognised expert in the fields of social robotics and affective computing. Moreover, I have a long-standing experience in conducting research in schools and, as coordinator of the EU FP7 EMOTE [7] project on robotic tutors, has led research in collaboration with teachers, students, and education experts.

The PhD student will be responsible for the development of methods for automatic user modelling, RL-based approaches for robot personalisation, design and implementation of the test-bed scenario and for conducting evaluation of the proposed approaches.

Barendregt, who will act as co-supervisor for the PhD student, is an internationally recognised expert in children's educational technology and will provide the guidance on educational methods necessary to assess the proposed robot personalisation approaches in real instructional settings. Barendregt has solid established collaborations with secondary schools in the Göteborg area, which will facilitate the implementation of the project's activities in real world classroom environments. Barendregt and I have a well-established ongoing collaboration, working together in the EMOTE project, of which I am coordinator and Barendregt the PI responsible for evaluation [1,7].

Existing resources: I have just recruited a PhD student in social robotics. This means that their expertise will be available for most of the duration of the project. Moreover, some parts of the planned research may require additional expertise in terms of image analysis and human-computer interaction. The expertise is available at the Division of Visual Information and Interaction and Centre for Image Analysis of the Department of Information Technology, with which I am affiliated.

Significance

The proposed work will provide important fundamental advances scientifically and technologically. Scientifically, the project advocates a *breath-first*, holistic approach to the development of technology for personalised instructional robots. The approach is possible only by bringing together areas that traditionally are either considered in isolation or whose challenges require a diverse range of expertise. Technologically, the project will provide methods for robust user modelling, affect recognition and robot adaptation via statistical learning, thus advancing the state of the art in both the affective computing and social robotics domain. The proposed methodology provides the unique opportunity to produce a new standard of robot personalisation methods transferable across different robotic platforms and interaction contexts. If successful, the project will open up new frontiers and opportunities, making a first step towards the development of robots that achieve long-term robot autonomy, prerequisite for a successful integration in our daily lives.

Preliminary results

The starting point of the project is my previous work on robot personalisation based on RL for robot learning by trial and error the best strategies to keep a particular user in a positive affective state an educational scenario. The approach, based on a RL algorithm that solves the multi-armed bandit problem, allows a robot to monitor transitions in the children's affective states and adapt its behaviour accordingly [4, 9, 15]. Moreover, the project builds on my work in collaboration with Prof. Barendregt ongoing work on adaptive and personalised robotic tutors for early secondary students conducted in the EMOTE project [1, 7, 16]. They are also both part of the working group of a VINNOVA-funded project on producing a strategic roadmap on social robotics research.

Independent line of research

As a new associate senior lecturer at the Department of Information Technology of Uppsala University I am leading a strategic initiative towards building a new research strand concerned with the study of intelligent interactive systems, with a specific focus on natural interaction with social artefacts such as embodied virtual agents and, especially, robots. This is a novel research area, not previously represented at Uppsala University. In addition to remotely supervising two PhD students and one postdoctoral researcher at the University of Birmingham, I am focusing on establishing a new research group. I have just recruited a PhD student who will join my team. Therefore, I now have the relevant pieces in place to build and lead an internationally competitive research group. My ambition is to develop Uppsala University as an internationally recognised research centre that operates across social robotics and affective computing, building on my experience as leader of the Affective Computing and Social Robotics Lab at the University of Birmingham and as coordinator of EMOTE [7], the first European-funded project on empathic robotic tutors to support learning of STEM-related topics for school children, leading a consortium of six partners. If awarded, the VR Project Research Grant for Junior Researchers will facilitate this by providing me with the necessary resources to build the infrastructure (e.g., state-of-the-art robotic platforms) and make the strategic recruitments of another talented doctoral student necessary to launch my research group.

Form of employment

In October 2014 I joined the Division of Visual Information and Interaction of the Department of Information Technology of Uppsala University as an associate senior lecturer in intelligent interactive systems. This is a tenure track position.

International and national collaboration

I have a large international network in the field of social robotics and affective computing. In concrete projects, in addition to Prof. Barendregt, I collaborate with Prof. Christopher Peters (KTH, intelligent virtual agents), Prof. Ana Paiva (Technical University of Lisbon – agents, social robots and synthetic characters), Prof. Ruth Aylett (Heriot-Watt University – intelligent graphical characters, affective agent models), Prof. Arvid Kappas (Jacobs University Bremen – psychology of emotion and expressive behaviours), and Dr. Susan Bull (University of Birmingham, learning technology). Internationally, I have close collaborations and connections with world leading scientists in the areas of social robotics and affective computing that work in this project will benefit from. Here are examples of potential research visits and exchanges:

- Prof. Kerstin Dautenhanh, University of Hertfordshire (human-robot interaction and social robotics; Adaptive Systems Research Group, http://adapsys.stca.herts.ac.uk/);
- Prof. Adriana Tapus, ENSTA ParisTech (intelligent and adaptive social robotics, user personalisation; Robotics and Computer Vision Lab, http://perso.ensta-paristech.fr/~tapus/eng/index.html);
- Dr. Louis-Philippe Morency, Carnegie Mellon University (automatic analysis of non-verbal behaviour; Language Technology Institute, http://www.cs.cmu.edu/~morency/)
- Prof. Bjoern Schuller, University of Passau and Imperial College (automatic affect recognition and affective computing; http://www.schuller.it/)

Besides the contact mentioned previously, Barendregt also has strong connections with world leading scientists in the areas of Child-Computer Interaction and Educational Technology: Prof. Panos Markopoulos and Assoc. Prof. Tilde Bekker, Eindhoven University of Technology (Child-Computer Interaction); Prof. Janet Read, University of Lancashire, Preston (Child Computer Interaction, Director of the Child Computer Interaction (ChiCI) research group); Dr. Mina Vasalou, London Knowledge Lab (Technology Enhanced Learning), Prof. B. Lindström, The Linnaeus Centre for Research on Learning (Interaction and Mediated Communication in Contemporary Society).

I plan to build on the project's results to start new research initiatives with our existing collaborators and to establish new, relevant research partnerships to develop future research project proposals at the European (e.g., H2020) and national level.

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[16] Jones, A., Castellano, G., and Bull, S. (2014). Investigating the Effect of a Robotic Tutor on Learner Perception of Skill Based Feedback. *In Proceedings of the 6th International Conference on Social Robotics*, Sydney, Australia, 27-29 October 2014.

Interdisciplinarity

My application is interdisciplinary

☐

An interdisciplinary research project is defined in this call for proposals as a project that can not be completed without knowledge, methods, terminology, data and researchers from more than one of the Swedish Research Councils subject areas; Medicine and health, Natural and engineering sciences, Humanities and social sciences and Educational sciences. If your research project is interdisciplinary according to this definition, you indicate and explain this here.

Click here for more information

Scientific report

Scientific report/Account for scientific activities of previous project

Budget and research resources

Project staff

Describe the staff that will be working in the project and the salary that is applied for in the project budget. Enter the full amount, not in thousands SEK.

Participating researchers that accept an invitation to participate in the application will be displayed automatically under Dedicated time for this project. Note that it will take a few minutes before the information is updated, and that it might be necessary for the project leader to close and reopen the form.

Dedicated time for this project*

	Role in the project	Name	Percent of full time
1	Applicant	Ginevra Castellano	40
2	Other personnel without doctoral degree	PhD student	100
3	Other personnel with doctoral degree	Wolmet Barendregt	20

Salaries including social fees

	Role in the project	Name	Percent of salary	2016	2017	2018	2019	Total
1	Applicant	Ginevra Castellano	40	299,578	307,067	314,744	322,612	1,244,001
2	Other personnel without doctoral degree	PhD student	100	478,878	493,501	500,812	530,056	2,003,247
3	Other personnel with doctoral degree	Wolmet Barendregt	20	161,515	165,553	169,692	173,934	670,694
	Total			939,971	966,121	985,248	1,026,602	3,917,942

Other costs

Describe the other project costs for which you apply from the Swedish Research Council. Enter the full amount, not in thousands SEK.

Premises

	Type of premises	2016	2017	2018	2019	Total
1	Offices rooms	57,000	57,000	57,000	57,000	228,000
	Total	57,000	57,000	57,000	57,000	228,000

Running Costs

	Running Cost	Description	2016	2017	2018	2019	Total
1	Travel costs	Attendance to conferences for dissemination of project's resutts	45,000	45,000	45,000	45,000	180,000
2	Consumables	Software licenses, cameras, desktop and laptop computers, open access publications	90,000	20,000	20,000	20,000	150,000
3	Equipment	Robotic platforms	200,000	0	0	0	200,000
	Total		335,000	65,000	65,000	65,000	530,000

Depreciation costs

Depreciation cost	Description	2016	2017	2018	2019

Total project cost

Below you can see a summary of the costs in your budget, which are the costs that you apply for from the Swedish Research Council. Indirect costs are entered separately into the table.

Under Other costs you can enter which costs, aside from the ones you apply for from the Swedish Research Council, that the project includes. Add the full amounts, not in thousands of SEK.

The subtotal plus indirect costs are the total per year that you apply for.

Total budget

Specified costs	2016	2017	2018	2019	Total, applied	Other costs	Total cost
Salaries including social fees	939,971	966,121	985,248	1,026,602	3,917,942		3,917,942
Running costs	335,000	65,000	65,000	65,000	530,000		530,000
Depreciation costs					0		0
Premises	57,000	57,000	57,000	57,000	228,000		228,000
Subtotal	1,331,971	1,088,121	1,107,248	1,148,602	4,675,942	0	4,675,942
Indirect costs	322,491	309,336	315,074	327,481	1,274,382		1,274,382
Total project cost	1,654,462	1,397,457	1,422,322	1,476,083	5,950,324	0	5,950,324

Explanation of the proposed budget

Briefly justify each proposed cost in the stated budget.

Explanation of the proposed budget*

Budget and resources

Below is an explanation of the proposed budget:

Personnel: 1 PhD student will be employed full-time on the project for four years. Dr. Castellano plans to work on the project 40% of her time, while Prof. Barendregt will be involved for 20% of her time. This application will cover all personnel costs in the proposed project.

Equipment: equipment includes the robotic platforms necessary to perform studies in the test-bed scenario throughout the whole duration of the project. Specifically, the project will employ a NAO robot (a small 25 degree of freedom humanoid robot from Aldebaran, endowed with two embedded cameras, touch sensors, an inertial measurement unit and four directional microphones; torso-only and a full-body version, ca. 100kSEK) and a Zeno R25 (a highly expressive humanoid robot from RoboKind that can walk, move his arms, mimic advanced facial gestures and express emotions; ca. 70kSEK). Additional smaller pieces of equipment will be purchased, such as Microsoft Kinect sensors, and physiological sensors; ca. 30kSEK.

Travel, consumables, and other costs: I plan to encourage all team members to attend at least 1-2 conference per year (180kSEK; average cost for a conference trip: 15kSEK). Examples include ACM/IEEE HRI, IEEE/RSJ IROS, ICSR, RSS, ACII, ACM ICMI. Consumables and other costs include costs for software licenses, cameras, desktop and laptop computers, open access publications (ca. 150kSEK).

Office space:

Costs are included in relation to the time spent in the project (40%, 20% and 100% respectively) of a full (G. Castellano, W. Barendregt) and shared (PhD student) office.

Other funding

Describe your other project funding for the project period (applied for or granted) aside from that which you apply for from the Swedish Research Council. Write the whole sum, not thousands of SEK.

Other funding for this project

Funder	Applicant/project leader	Type of grant	Reg no or equiv.	2016	2017	2018	2019

CV and publications

CV

Curriculum vitae - Ginevra Castellano - http://user.it.uu.se/~ginca820/

1. Higher education qualifications

MSc, Bioengineering, University of Genova, Italy (graduated with honours) 2004
BSc, Biomedical Engineering, University of Genova, Italy 2002

2. Doctoral degree

PhD in Electronic and Computer Engineering 2008
University of Genova, Italy
Dissertation title: Movement Expressivity Analysis in Affective Computers: from Recognition to Expression of Emotion
Supervisor: Prof. Antonio Camurri

3. Postdoctoral positions

Postdoctoral research assistant March 2008 – August 2011
School of Electronic Engineering and Computer Science,
Queen Mary University of London

4. Qualification required for appointment as a docent

Application for Docent expected to be submitted in April 2015.

5. Current position

Associate Senior Lecturer in Intelligent Interactive Systems October 2014 – present
Department of Information Technology, Uppsala University
(Full-time employment; tenure track position; 75% research)

Birmingham Fellow (part-time; researcher) October 2014 – present
School of Electronic, Electrical and Systems Engineering,
University of Birmingham, United Kingdom

6. Previous positions and periods of appointment

Birmingham Fellow September 2011 – September 2014
(research assistant professor equivalent,
full-time, permanent faculty position; 75% research)
School of Electronic, Electrical and Systems Engineering,
University of Birmingham, United Kingdom

7. Interruption in research

Maternity leave February 2014 – June 2014

8. Supervision

Maike Paetzel (PhD student, Uppsala University; starting in August 2015)
Aidan Jones (PhD student, University of Birmingham; since February 2013)

Lee Corrigan (PhD student, University of Birmingham; since September 2012)
Fotios Papadopoulos (postdoc researcher, University of Birmingham; since January 2013)

9. Other merits of relevance to the application

Research grants awarded

EU FP7 project **EMOTE**, *EMbOdied-perceptive Tutors for Empathy-based learning* project, 2012-2015 (2.9 mEUR total, 660kEUR to University of Birmingham), **Project Coordinator**; PI at the University of Birmingham. Grant was awarded at the age of 32, 4 years after receiving my PhD and within 9 months of being employed in a faculty position.

EU FP7 project **ILearnRW**, *Integrated Intelligent Learning Environment for Reading and Writing* project, 2012-2015 (1.8 mEUR total, 285kEUR to University of Birmingham), co-PI at the University of Birmingham (2012-2013).

PhD defence committee member

December 2014, Amir Aly (supervisor: Prof. Adriana Tapus), ENSTA ParisTech, France.

Invited presentations to conferences and advanced schools

1. Invited lecturer (together with world-leading researchers in social robotics) at the **Summer School on Social Human-Robot Interaction**, Cambridge, UK, August 2013
2. Invited speaker at the Workshop **"Festschrift for Roddy Cowie and Ellen Douglas-Cowie"**, 5th International Conference on Affective Computing and Intelligent Interaction, Geneva, Sept. 2013
3. Invited speaker at the event "Emotional Machines: Is society ready for robot companions" organised by **NESTA, the UK innovation agency**, in July 2013

Prizes and awards

2012 International Conference on Social Robotics 2012 - Best Student Paper Award
Leite, I., Castellano, G., Pereira, A., Martinho, C., and Paiva, A. (2012) Long-term Interactions with Empathic Robots: Evaluating Perceived Support in Children.

2014 ACM/IEEE International Conference on Human-Robot Interaction 2014 (number 1 conference in the field) - Best paper award nominee (late breaking reports). Corrigan, L.J., Basedow, C., Küster, D., Kappas, A., Peters, C., and Castellano, G. (2014). Mixing Implicit and Explicit Probes: Finding a Ground Truth for Engagement in Social Human-Robot Interactions.

Memberships of scientific societies and boards

- 2007-2009; 2011-Present: Elected by international experts to the **Management Board and Executive Committee of the Association for the Advancement of Affective Computing**
- Since 2014: Invited member of the **EU Topic Group on Natural Interaction with Social Robots**

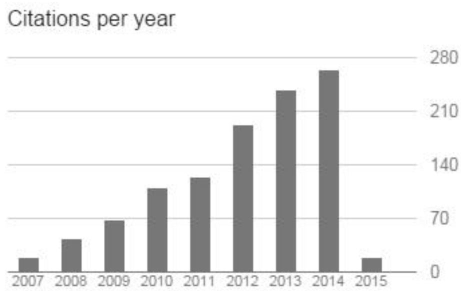
Conference organisation committee

2015: IEEE/RSJ Intl. Conference on Intelligent Robots and Systems (IROS): *Associate Editor*
2015: Intl. Conference on Social Robotics: *Workshop Chair*
2014: IEEE Intl. Symposium on Robot and Human Interactive Communication: *Special Session Chair*
2012: ACM Intl. Conference on Multimodal Interaction: *Publication Chair*
2011: Intl Conference on Affective Computing and Intelligent Interaction: *Workshop Chair*
Since 2011: Intl. Conference on Affective Computing and Intelligent Interaction: *Steering Committee*

Publication list

Publication list – Ginevra Castellano

I have co-authored 9 journal articles, 50 conference and workshop contributions, and 7 book chapters. All of these contributions are peer-reviewed. In addition, I have co-authored 5 invited papers and 4 editorials. My PhD supervisor has co-authored 2 journal, 3 book chapters, 9 conference and workshop publications and 1 invited paper. I have 1118 citations (980 since 2010), my H-index is 16, and my i-10 index is 31 (values are calculated using Google Scholar and are corrected as of 30/03/2015).



Publication list for the last eight years (the five publications that are most relevant to the project are marked with **):

1. Peer-reviewed original articles

** Castellano, G., Leite, I., Pereira, A., Martinho, C., Paiva, A., and McOwan, P. W. (2014). Context-Sensitive Affect Recognition for a Robotic Game Companion. *ACM Transactions on Interactive Intelligent Systems*, 4(2).

Leite, I., Castellano, G., Pereira, A., Martinho, C., and Paiva, A. (2014). Empathic Robots for Long-term Interaction: Evaluating Social Presence, Engagement and Perceived Support in Children. *International Journal of Social Robotics*, 6(3): 329-341.

** Castellano, G., Leite, I., Pereira, A., Martinho, C., Paiva, A, and McOwan, P. W. (2013). Multimodal Affect Modelling and Recognition for Empathic Robot Companions. *International Journal of Humanoid Robotics*, 10(1).

Castellano, G., Mancini, M., Peters, C., and McOwan, P.W. (2012). Expressive Copying Behavior for Social Agents: A Perceptual Analysis. *IEEE Transactions on Systems, Man and Cybernetics, Part A - Systems and Humans*, 42(3), 776-783.

Castellano, G., and Peters, C. (2010). Socially Perceptive Robots: Challenges and Concerns. *Interaction Studies*, 11(2), John Benjamins Publishing Company.

Castellano, G., Leite, I., Pereira, A., Martinho, C., Paiva, A, and McOwan, P. W. (2010). Affect Recognition for Interactive Companions: Challenges and Design in Real World Scenarios. *Journal on Multimodal User Interfaces*, 3(1-2), 89-98, Springer.

Kessous, L., Castellano, G., and Caridakis, G. (2010). Multimodal Emotion Recognition in Speech-based Interaction using Facial Expression, Body Gesture and Acoustic Analysis. *Journal on Multimodal User Interfaces*, 3(1-2), 33-48, Springer.

Camurri, A., Castellano, G., Glowinski, D., Varni, G., and Volpe, G. (2009). Il Gesto Espressivo nell'Interazione Uomo-Macchina. In C. Pelachaud, N. De Carolis, and F. De Rosis (Eds.), La Ricerca sui Sistemi Intelligenti in Italia. *In Cognito - Quaderni Romanzi di Science Cognitive*, 4(1-2).

Castellano, G., Mortillaro, M., Camurri, A., Volpe, G., and Scherer, K. R. (2008). Automated Analysis of Body Movement in Emotionally Expressive Piano Performances. *Music Perception*, 26(2), 103-119,University of California Press.

2. Peer-reviewed conference papers

Deshmukh, A., Jones, A., Janarthanam, S., Hastie, H., Ribeiro, T., Aylett, R., Paiva, A., and Castellano, G. (2015). An Empathic Robotic Tutor in a Map Application. To appear in Proceedings of the 2015 International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS).

Ribeiro, T., Alves-Oliveira, P., Di Tullio, E., Petisca, S., Sequeira, P., Deshmukh, A., Janarthanam, S., Foster, M.-E., Jones, A., Corrigan, L. J., Papadopoulos, F., Hastie, H., Aylett, R., Castellano, G., and Paiva, A. (2015). The Empathic Robotic Tutor: Featuring the NAO Robot. *In Proceedings of the ACM/IEEE International Conference on Human-Robot Interaction 2015,* Portland, USA.

Deshmukh, A., Jones, A., Janarthanam, S., Foster, M.-E., Ribeiro, T., Corrigan, L. J., Aylett, R., Paiva, A., Papadopoulos, F., and Castellano, G. (2015). Empathic Robotic Tutors: Map Guide. *In Proceedings of the ACM/IEEE International Conference on Human-Robot Interaction 2015*, Portland, USA.

Jones, A., Bull, S., and Castellano, G. (2015). Open Learner Modelling with a Robotic Tutor. In *Proceedings of the HRI Pioneers Workshop, ACM/IEEE International Conference on Human-Robot Interaction 2015,* Portland, USA.

** Jones, A., Castellano, G., and Bull, S. (2014). Investigating the Effect of a Robotic Tutor on Learner Perception of Skill Based Feedback. *In Proceedings of the 6th International Conference on Social Robotics*, Sydney, Australia, 27-29 October 2014.

Aylett, A., Barendregt, W., Castellano, G., Kappas, A., Menezes, N., and Paiva, A. (2014). An Embodied Empathic Tutor. *AAAI Fall Symposia AI and HRI, AAAI Fall Symposium Series* 2014.

Ribeiro, T., Di Tullio, E., Corrigan, L. J., Jones, A., Papadopoulos, F., Aylett, R., Castellano, G., and Paiva, A. (2014). Developing Interactive Embodied Characters Using the Thalamus Framework: A Collaborative Approach. *In Proceedings of the 14th International Conference on Intelligent Virtual Agents (IVA)*, Boston, MA, USA, August 27-29, 2014.

Serholt, S., Barendregt, W., Leite, I., Hastie, H., Jones, A., Paiva, A., Vasalou, A., and Castellano, G. (2014). Teachers' Views on the Use of Empathic Robotic Tutors in the Classroom. *In Proceedings of the IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)* 2014.

Jones, A., Castellano, G., and Bull, S. (2014). Open Learner Modelling with a Robotic Tutor for Children. In *Proceedings of Child-Robot Interaction Workshop, International Conference on Interaction Design and Children (IDC),* 2014.

Mancini, M., Ermilov, A., Castellano, G., Liarokapis, F., Varni, G., and Peters, C. (2014). Effects of gender mapping on perception of emotion from upper body movement in virtual characters. *Virtual, Augmented and Mixed Reality. Designing and Developing Virtual and Augmented Environments, Lecture Notes in Computer Science, Volume 8525, 2014, pp 263-273. 6th International Conference, VAMR 2014, Held as Part of HCI International 2014,* Heraklion, Crete, Greece, June 22-27, 2014, Proceedings, Part I.

Corrigan, L.J., Basedow, C., Kuster, D., Kappas, A., Peters, C., and Castellano, G. (2014). Mixing Implicit and Explicit Probes: Finding a Ground Truth for Engagement in Social Human-Robot Interactions. *In Proceedings of the ACM/IEEE International Conference on Human-Robot Interaction (HRI'14),* Bielefeld, Germany, March 2014.

Corrigan, L., Peters, C., and Castellano, G. (2013). Social-Task Engagement: Striking a Balance between the Robot and the Task. *In Proceedings of the Workshop on Embodied Communication of Goals and Intentions, International Conference on Social Robotics*, Bristol, United Kingdom, October 2013.

Serholt, S., Barendregt, W., Ribeiro, T., Castellano, G., Paiva, A., Kappas, A., Aylett, R., and Nabais, F. (2013). EMOTE: Embodied-Perceptive Tutors for Empathy-based Learning in a Game Environment. *In Proceedings of the 7th European Conference on Games Based Learning*, Porto, Portugal, October 2013.

Serban, O., Castellano, G., Pauchet, A., Rogozan, A., and Pecuchet, J.-P. (2013). Fusion of Smile, Valence and NGram Features for Automatic Affect Detection. *Proceedings of the 5th Humaine Association Conference on Affective Computing and Intelligent Interaction (ACII'13),* Geneva, Switzerland, September 2013.

Papadopoulos, F., Corrigan, L., Jones, A., and Castellano, G. (2013). Learner Modelling and Automatic Engagement Recognition with Robotic Tutors. *Proceedings of the 5th International Workshop on Affective Interaction in Natural Environments (AFFINE): Interacting with Affective Artefacts in the Wild, 5th Humaine Association Conference on Affective Computing and Intelligent Interaction (ACII'13)*, Geneva, Switzerland, September 2013.

Corrigan, L., Peters, C., and Castellano, G. (2013). Identifying Task Engagement: Towards Personalised Interactions with Educational Robots. *Proceedings of the Doctoral Consortium of the 5th Humaine Association Conference on Affective Computing and Intelligent Interaction (ACII'13)*, Geneva, Switzerland, September 2013.

Kappas, A., Castellano, G., Paiva, A., Barendregt, W., Aylett, R., Nabais, F., and Kuster, D. (2013). Affective Loops between Children and Artificial Embodied Tutors: The EMOTE

Project. *Poster presented at the International Society for Research on Emotions (ISRE) Conference 2013*, Berkeley, CA, USA, August 2013.

Bhargava, S., Janarthanam, S., Hastie, H., Deshmukh, A., Aylett, R., Corrigan, L., and Castellano, G (2013). Demonstration of the EmoteWizard of Oz Interface for Empathic Robotic Tutors. *In Proceedings of SIGDIAL*, August 2013, Metz, France.

** Castellano, G., Paiva, A., Kappas, A., Aylett, R., Hastie, H., Barendregt, W., Nabais, F., and Bull, S. (2013). Towards Empathic Virtual and Robotic Tutors. *Proceedings of the 16th International Conference on Artificial Intelligence in Education (AIED'13)*, Memphis, USA, July 2013.

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Deshmukh, A., Castellano, G., Kappas, A., Barendregt, W., Nabais, F., Paiva, A., Ribeiro, T., Leite, I., and Aylett, R. (2013). Towards Empathic Artificial Tutors. In *Proceedings of the ACM/IEEE International Conference on Human-Robot Interaction (HRI'13)*, Tokyo, Japan, March 2013.

Castellano, G., Leite, I., Pereira, A., Martinho, C., Paiva, A., and McOwan, P.W. (2012). Detecting Engagement in HRI: An Exploration of Social and Task-based Context. In *Proceedings of the ASE/IEEE International Conference on Social Computing*. IEEE, Amsterdam, The Netherlands.

Leite, I., Castellano, G., Pereira, A., Martinho, C., and Paiva, A. (2012) Long-term Interactions with Empathic Robots: Evaluating Perceived Support in Children. In *Proceedings of the International Conference on Social Robotics*. Chengdu, China. ***Best student paper award.***

Leite, I., Castellano, G., Pereira, A., Martinho, C., and Paiva, A. (2012). Modelling Empathic Behaviour in a Robotic Game Companion for Children: an Ethnographic Study in Real-World Settings. In *ACM/IEEE International Conference on Human-Robot Interaction (HRI'12)*. ACM, Boston, MA, USA.

Castellano, G., Mancini, M., and Peters, C. (2011). Emotion Communication via Copying Behaviour: A Case Study with the Greta Embodied Conversational Agent. *Proceedings of the 4th International Workshop on Affective Interaction in Natural Environments, International Conference on Multimodal Interaction (ICMI'11)*, Alicante, Spain, November 2011.

Mancini, M., Castellano, G., Peters, C. and McOwan, P.W. (2011). Evaluating the Communication of Emotion via Expressive Gesture Copying Behaviour in an Embodied

Humanoid Agent. *Proceedings of the 4th International Conference on Affective Computing and Intelligent Interaction (ACII2011)*, Memphis, Tennessee, October 2011.

Leite, I., Pereira, A., Castellano, G., Mascarenhas, S., Martinho, C. and Paiva, A. (2011). Social Robots in Learning Environments: a Case Study of an Empathic Chess Companion. *Proceedings of The International Workshop on Personalization Approaches in Learning Environments (PALE), International Conference on User Modeling, Adaptation and Personalizarion (UMAP 2011), CEUR Workshop Proceedings*, Girona, Spain, July 2011.

Sanghvi, J., Castellano, G., Leite, I., Pereira, A., McOwan, P. W., and Paiva, A. (2011). Automatic Analysis of Affective Postures and Body Motion to Detect Engagement with a Game Companion. *Proceedings of the ACM/IEEE International Conference on Human-Robot Interaction (HRI'11)*, Lausanne, Switzerland, March 2011.

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6. Other publications

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CV

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Birthdate: 19800610	**Academic title:** Doktor
Gender: Female	**Employer:** Uppsala universitet

Research education

Dissertation title (swe)

Dissertation title (en)

Organisation	Unit	Supervisor
University of Genova, Italy Not Sweden - Higher Education institutes		
Subject doctors degree	**ISSN/ISBN-number**	**Date doctoral exam**
10206. Datorteknik		2008-04-28

Publications

Name: Ginevra Castellano	**Doctorial degree:** 2008-04-28
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Castellano, Ginevra has not added any publications to the application.

Register

Terms and conditions

The application must be signed by the applicant as well as the authorised representative of the administrating organisation. The representative is normally the department head of the institution where the research is to be conducted, but may in some instances be e.g. the vice-chancellor. This is specified in the call for proposals.

The signature*from the applicant*confirms that:

- the information in the application is correct and according to the instructions form the Swedish Research Council
- any additional professional activities or commercial ties have been reported to the administrating organisation, and that no conflicts have arisen that would conflict with good research practice
- that the necessary permits and approvals are in place at the start of the project e.g. regarding ethical review.

The signature *from the administrating organisation* confirms that:

- the research, employment and equipment indicated will be accommodated in the institution during the time, and to the extent, described in the application
- the institution approves the cost-estimate in the application
- the research is conducted according to Swedish legislation.

The above-mentioned points must have been discussed between the parties before the representative of the administrating organisation approves and signs the application.

Project out lines are not signed by the administrating organisation. The administrating organisation only sign the application if the project outline is accepted for step two.

Applications with an organisation as applicant is automatically signed when the application is registered.