

## GUIDO SCHILLACI Dr. rer. nat.

Marie Skłodowska Curie Fellow  
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Born on Feb. 22nd 1982 in Palermo, Italy  
Family status: married with two kids (3, 6)

### Introduction

I am a Marie Skłodowska Curie Fellow, awarded with an Individual Fellowship by the EU-H2020 Research and Innovation programme ("Predictive Robots"). I am currently affiliated with the BioRobotics Institute of the Scuola Superiore Sant'Anna (Pisa, Italy).

My previous affiliation was the Adaptive Systems Group at the Computer Science Department of the Humboldt-Universität zu Berlin. I carried out my PhD studies within another Marie Curie fellowship (EU-FP7 Marie Curie Initial Training Network "Interactive Robotics" (INTRO), appointed as Early Stage Researcher) at the Humboldt-Universität zu Berlin, during which I spent a secondment at the Umeå University, Sweden. My background is in Computer Engineering (B.Sc. and M.Sc. at Università degli Studi di Palermo, Italy; spent a M.Sc. year as an Erasmus student at Universidad de Granada, Spain).

I investigate learning behaviours for robots inspired on infant development with the aim of making artificial systems more autonomous and adaptive. I study computational models inspired by human brain mechanisms, such as the formation and maintenance of internal body representations and predictive processes, and implement them into robots. I adopt different machine learning techniques for implementing these models, including self-organising neural networks and deep convolutional neural networks. I am particularly interested in online learning techniques.

I study mechanisms of anticipation of sensory and motor information for the implementation of basic cognitive skills in artificial agents. I found out that such processes can have an important role in capabilities like behaviour recognition and arbitration, tool-use and intelligent exploration behaviours driven by artificial curiosity. Moreover, my research on predictive and sensory attenuation processes aims at providing insights in the understanding of subjective experiences typical of humans, such as self-awareness, self-other distinction, sense of agency and sense of object permanence, and in the possibility of implementing an artificial Self into robots.

I have a long-standing experience in the design and implementation of computational models for predictive processes and of learning systems for robots inspired on infant development and on human brain processes. This experience has been acquired throughout different projects, including **two EU Marie Curie fellowships**<sup>1</sup> and **additional European**<sup>2</sup>, **German**<sup>3</sup> and **Italian**<sup>4</sup> projects.

I have a **strong international academic experience**, having carried out research and studies in several institutions from **four different European countries** (University of Palermo, Italy; University of Granada, Spain; Humboldt-Universität zu Berlin, Germany; Umea University, Sweden; Scuola Superiore Sant'Anna, Italy), and having **collaborated with scientists and partners from more than 15 academic institutions and industries from EU and non-EU countries**. These include: Bristol Robotics Lab (UK); Ben Gurion University of Negev (Israel); Institute for Advanced Architecture of Catalonia (Spain, Barcelona); Imperial College London (UK); Softbank Robotics (formerly Aldebaran, Paris, France); Sony Computer Science Laboratories (France); McMaster University (Canada), Tokyo University (Japan); Universidad Autonoma del Estado de Morelos (Mexico); Universidad Nacional Autonoma de Mexico (Mexico); Space Application Services (Belgium); RoboSoft

<sup>1</sup> *1st project*: Early Stage Researcher (PhD candidate position) in an EU-FP7 Marie Curie Initial Training Network ("Interactive Robotics" project) at the Humboldt-Universität zu Berlin; *2nd project*: EU-H2020 MSC Individual European Fellowship entitled "Predictive Robots" (my own postdoctoral project) at the Scuola Superiore Sant'Anna, Pisa, Italy

<sup>2</sup> *3rd project*: EU-FP7 "Embodied Audition for Robots" (EARS); *4th project*: EU-H2020 "Robotics for Microfarms" (ROMI) - both projects with a postdoctoral position

<sup>3</sup> *5th project*: DFG SPP "The Active Self" (involved also in one of the SPP coordinator teams); *6th project*: DFG project on initiation of international collaborations, entitled "Adaptive Architectures for Transferability of Greenhouse Models" (2019-2020), involved as international partner (at SSSA, Italy); *7th project*: PostDoc scholarship from Humboldt Graduate School; *8th project*: DFG project on initiation of international collaborations, entitled "Internal model-based decision making in robots" (2015), involved in the team of the German host institution (at HU-Berlin). All projects with a postdoctoral position.

<sup>4</sup> *9th project*: FRASI project, with a pre-doctoral position, funded by Italian Ministry of Research and Education

(France); INRIA (France); Ecole Normale Supérieure Lyon (France); Umea University (Sweden); Consiglio Nazionale delle Ricerche (Italy).

I am the author of ca. 40 publications (google scholar h-index: 10) in prominent international conferences and journals on the topic of cognitive and developmental robotics, AI and machine learning, human-robot interaction and computational neuroscience. I have supervised and coordinated the research of more than 10 B.Sc., M.Sc. and doctoral students, as well as carried out teaching activities in B.Sc. and M.Sc. courses and seminars on embodied artificial intelligence, cognitive robotics and programming. I have served as editor, programme committee member and reviewer for several international conferences and journals, as well as organised workshops and scientific events. I have contributed - also as a principal investigator - to different successful research grant proposals and projects at the European and German levels.

I have applied my research on different robotic platforms, including humanoids (I worked with Softbank Nao and Pepper robots in Germany, and iCub robot in Italy), micro-farming robots (Sony LettuceThink platform, Paris/Berlin), mobile search and rescue platforms (custom platform developed by SpaceApps, Belgium), underwater and marine robots (custom platforms that I designed and developed in Berlin and tested in the Mediterranean Sea), innovative greenhouses (installed at the BioSystems Engineering group, HU Berlin).



## Research Positions

May, 15 <sup>th</sup> 2019 - present	Marie Skłodowska Curie fellow in the EU-H2020 Marie Skłodowska Curie individual fellowship “Predictive Robots”, hosted by the BioRobotics Institute, Scuola Superiore Sant’Anna, Pisa, Italy. <a href="http://www.guidoschillaci.eu/predictive-robots">http://www.guidoschillaci.eu/predictive-robots</a>
May, 16 <sup>th</sup> 2014 - May 2019	Post-Doc (Wissenschaftlicher Mitarbeiter) at Adaptive Systems group - Humboldt-Universität zu Berlin. Involved in different EU and German projects.
December, 17 <sup>th</sup> 2013 – May, 15 <sup>th</sup> 2014	Humboldt Post-Doc Scholarship (Humboldt Graduate School, Excellence Initiative), Berlin.
September, 2010 - August 2013	Marie Curie Fellow (Early Stage Researcher - PhD candidate) in the EU-FP7 Marie Curie Initial Training Network (ITN): Interactive Robotics (INTRO) - <a href="http://introbotics.eu">http://introbotics.eu</a> . Host institution: Humboldt-Universität zu Berlin, Germany. Visiting scientist at secondment host institution: Umea University, Sweden
September, 2009 - August, 2010	Researcher (assegnista di ricerca) at Consorzio SIRIO - Palermo (Italian Research Project FRASI - FFramework for Agent-based Semantic-aware Interoperability).

## Research Projects

Oct. 2019 - Present	DFG grant for initiation of international collaborations. Role: principal investigator for the foreign institution (SSSA Pisa, Italy). Hosting PI: Dr. Luis Miranda, Biosystems Engineering group, Humboldt-Universität zu Berlin. Project title: Adaptive Architectures for Transferability of Greenhouse Models
Oct. 2019 - Present	European Open Science Cloud, granted voucher/credit to test the cloud services from the EU-H2020 Open Cloud for Research Environments (OCRE)
May. 2019 - Present	EU-H2020 Marie Skłodowska Curie Individual Fellowship “Predictive Robots”, main investigator for the project. Hosted by the BioRobotics Institute, Scuola Superiore Sant’Anna, Pisa, Italy
Jan. 2019 - Present	DFG-SPP “The Active Self” (SPP 2134), German Priority Programme. During my previous affiliation at HU-Berlin: involved as Post-Doc in the “Prerequisites for the development of an artificial self” sub-project. Role: co-supervision of research activities and of the PhD student involved in the project. During my current affiliation at SSSA Pisa (Italy): main investigator of a project associated to the network (my current Marie Skłodowska Curie project “Predictive Robots”); Co-supervising the PhD work of Ms. Y.K.Georgie (HU-Berlin); Mentoring PhD student Mr. Tim Möller (Berlin School of Mind and Brain).
Nov. 2017 - May 2019	EU-H2020 ROMI (Robotics for Microfarms) consortium. Involved as Post-Doc in the organisation and carrying out research activities, organisation and writing of project deliverables. Based at Humboldt-Universität zu Berlin.

July 2015 - Jan 2016	DFG grant for initiation of international collaborations. Role: group member of the hosting institution (HU-Berlin). International Partner: Prof. Dr. A. Winfield, Bristol Robotics Lab, University of West England, UK. Project title: Internal model-based decision making in robots
Jan. 2014 - Dec. 2016	EU-FP7 EARS (Embodied Audition for Robots) consortium. Involved as Post-Doc in the organisation and carrying out research activities, organisation and writing of project deliverables. Based at Humboldt-Universität zu Berlin.
Sept. 2010 - August 2013	EU-FP7 Marie Curie Initial Training Network INTRO (Interactive Robotics). Involved as Early Stage Researcher - Marie Curie Fellow, PhD candidate - in the organisation and carrying out research activities, organisation and writing of project deliverables. Based at Humboldt-Universität zu Berlin. Visiting scientist at Umea University, Sweden.
Sept. 2009 - August 2010	Italian Research Project FRASI (Palermo, Italy) - FRamework for Agent-based Semantic-aware Interoperability. Attended training courses and involved in research activities of the lab. Based at Università degli Studi di Palermo, Italy.

## Education

September, 1 <sup>st</sup> 2010 / December, 16 <sup>th</sup> 2013	Ph.D. ( <i>summa cum laude</i> , highest grade) in “Sensorimotor learning and simulation of experience as a basis for the development of cognition in robotics”, Humboldt-Universität zu Berlin, Mat-Nat-II, defended on Dec., 16th 2013. Supervised by Prof. V.V. Hafner (HU-Berlin).
April, 2012 / July, 2012	Visiting Doctoral Student at Umeå University, Sweden, (Prof. Thomas Hellström)
November, 2009	M.Sc. in Computer Engineering for Intelligent Systems (graded 110/110 with Honours) at the University of Palermo (Italy).
September, 2007 / Sept., 2008	Erasmus M.Sc. student at the Computer Science Faculty of the University of Granada (Spain).
November, 2004	Bachelor Degree in Computer Engineering (graded 107/110) at the University of Palermo (Italy).

## Academic Service

Organisation of scientific events and special issues in journals	Organiser of a workshop on “Predictive processes for motor and cognitive development in robots” at Scuola Superiore Sant’Anna (Pisa, Italy), featuring five talks and invited speakers: Prof. Bruno Lara (UAEM Mexico, Alexander von Humboldt fellow), Dr. Alejandra Ciria (UEAM and UNAM Mexico), November 22, 2019. Link: <a href="http://www.guidoschillaci.eu/2019/11/22/ws-santanna/">http://www.guidoschillaci.eu/2019/11/22/ws-santanna/</a>
	Associate Editor for the IEEE International Conference on Developmental Learning and Epigenetic Robotics (ICDL-Epirob) 2016, 2017, 2018
	Guest Associate Editor of a special issue in Frontiers in Robotics and AI, Specialty Section: Humanoid Robotics. Editing Research Topic on: Re-enacting sensorimotor experience for cognition. 2015. Proceedings available here: <a href="http://www.frontiersin.org/research-topics/3747/re-enacting-sensorimotor-experience-for-cognition">www.frontiersin.org/research-topics/3747/re-enacting-sensorimotor-experience-for-cognition</a>
Program Committee and Review Board Member	Program Committee member for Artificial Life (ALIFE) conference: 2016, 2018, 2019, 2020 Program Committee member for ECAL 2017 (14th European Conference on Artificial Life). Program Committee member for RSS 2013 Workshop on Active learning in robotics: Exploration, Curiosity, and Interaction (International Conference in Robotics Science and Systems 2013). Reviewer for IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2018, 2019. Reviewer for IEEE Transactions on Cognitive and Developmental Systems, 2016, 2017, 2018, 2019 Reviewer for IEEE Robotics and Automation Letters (RA-L and IROS) 2019 Reviewer for IEEE International Conference on Robotics and Automation (ICRA), 2016, 2019, 2020. Reviewer for IEEE International Conference on Developmental Learning and Epigenetic Robotics (IEEE ICDL EpiRob) , 2014, 2015, 2016, 2017, 2018, 2019. Reviewer for Frontiers in Computational Neuroscience, 2018. Reviewer for Frontiers in Psychology, section Cognition, 2018. Reviewer for Frontiers in Neurobotics, 2018. Reviewer for inTech International Journal of Advanced Robotics Systems (IJARS), Dec. 2015. Reviewer for 8th IEEE International Conference on System of Systems Engineering (SoSE), Hawaii, USA. 2013. Meta-reviewer for ACM/IEEE Human-Robot Interaction Conference HRI2012 and HRI2013 (Late Breaking Reports/Video session). 2012-2013.

Supervision of theses and student projects	<p>Mentor of Mr. Tim Möller, PhD candidate at Berlin School of Mind and Brain (DFG SPP The Active Self)</p> <p>Supervising PhD work of Ms. Jasmin Kim Georgie (HU-Berlin - DFG SPP The Active Self)</p> <p>Supervisor of M.Sc. theses of Sarah Bechtle (2016), Hidai Gertel (2017), Claus Lang (2018) Bernstein Center for Computational Neuroscience, Berlin.</p> <p>Tutored more than 10 master and bachelor student projects and lab rotations at HU-Berlin and Bernstein Center for Computational Neuroscience in Berlin.</p>
M.Sc. and Ph.D. defense committee member	<p>Member of the PhD Committee and Reviewer for PhD Thesis of Juan Manuel Acevedo Valle, Universidad Politecnica de Catalonia, Spain (November 6, 2018).</p> <p>Member of the PhD committee for Oswald Berthold Humboldt-Universität zu Berlin (June 17, 2019)</p> <p>Member of the M.Sc. committee for Ms. Sarah Bechtle (2016), Hidai Gertel (2017) and Claus Lang (2018), Bernstein Center for Computational Neuroscience, Berlin.</p>
Teaching	<p>Grundlagen der Programmierung @HU Berlin (Fundamentals of Programming - Exercise sessions in Java, 2h per week), Bachelor in Computer Science, Winter Semester 2017/2018</p> <p>Schülergesellschaft @HU Berlin (teaching robotics to pupils - 2h per week), Summer Semester 2016/2017</p> <p>From September 2010, occasionally supported courses and exercise sessions for Embodied Artificial Intelligence and Cognitive Robotics courses (Prof. Hafner @HU Berlin)</p>

## Selected Publications

Full list available here: <http://www.guidoschillaci.eu/publications/>

### PhD Thesis

- [1] **Schillaci, G.** (2014), *Sensorimotor learning and simulation of experience as a basis for the development of cognition in robotics*; Dissertation, Humboldt-Universität zu Berlin, Mathematisch - Naturwissenschaftliche Fakultät II, published March 2014, urn:nbn:de:kobv:11-100215988

### Journal articles

- [2] **Schillaci, G.**, Hafner, V.V. and Lara, B. (2016a), *Exploration behaviours, body representations and simulation processes for the development of cognition in artificial agents*, *Frontiers in Robotics and AI*, doi: 10.3389/frobt.2016.00039.
- [3] Escobar-Juárez, E., **Schillaci, G.**, Hermosillo-Valadez, J. and Lara-Guzmán, B. (2016), *A Self-Organized Internal Models Architecture for Coding Sensory-Motor Schemes*, *Frontiers in Robotics and AI*, section Humanoid Robotics, 3:22. doi: 10.3389/frobt.2016.00022
- [4] **Schillaci, G.**, Bodiroža, S., & Hafner, V. V. (2013). *Evaluating the effect of saliency detection and attention manipulation in human-robot interaction*. *International Journal of Social Robotics*, 5(1), 139-152.

### Articles in conference proceedings

- [5] Georgie, Y. K., **Schillaci, G.**, & Hafner, V. V. (2019). *An interdisciplinary overview of developmental indices and behavioral measures of the minimal self*. In 2019 Joint IEEE 9th International Conference on Development and Learning and Epigenetic Robotics (ICDL-EpiRob) (pp. 129-136). **BEST PAPER AWARD NOMINEE**
- [6] Miranda, L., **Schillaci, G.** (2019), *Adaptive architecture towards portability of greenhouse models*, Proceedings of Greensys 2019 – Int. Symposium on Advanced Technologies and Management for Innovative Greenhouses, Angers, France.
- [7] **Schillaci, G.**, Ritter, C. N., Hafner, V.V. and Lara, B. (2016b). *Body Representations for Robot Ego-Noise Modelling and Prediction. Towards the Development of a Sense of Agency in Artificial Agents*, ALife XV: Simulation and Synthesis of Living Systems.
- [8] Schmerling, M., **Schillaci, G.**, Hafner, V.V. (2015), *Goal-Directed Learning of Hand-Eye Coordination in a Humanoid Robot*, Proceedings of the IEEE 5th Int. Conf. on Development and Learning and on Epigenetic Robotics, pp. 168-175. **BEST STUDENT PAPER AWARD**
- [9] Lang, C., **Schillaci, G.** and Hafner, V.V. (2018), *A Deep Convolutional Neural Network Model for Sense of Agency and Object Permanence in Robots*, Proceedings of the 8th Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics (ICDL-EpiRob), pp. 260-265.
- [10] Dindo, H. and **Schillaci, G.** (2010), *An Adaptive Probabilistic Approach to Goal-Level Imitation Learning*, in Proceedings of the 2010 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS2010), Taipei, Taiwan. October, 2010.



## Grants, Awards and Scholarships

October 2019	European Open Science Cloud, granted voucher/credit to test the cloud services from the EU-H2020 Open Cloud for Research Environments (OCRE)
August 2019	Best paper award nominee, IEEE Intern. Conf. on Development and Learning and on Epigenetic Robotics (ICDL-EpiRob 2019). Georgie, Y. K., <b>Schillaci, G.</b> , & Hafner, V. V. (2019, August). <i>An interdisciplinary overview of developmental indices and behavioral measures of the minimal self.</i>
March 2019	Granted a EU-H2020 Marie Skłodowska-Curie Individual Fellowship hosted by the BioRobotics Institute at the Scuola Superiore Sant'Anna, Pisa, Italy
August 2015	Best student paper award, IEEE International Conference on Development and Learning and on Epigenetic Robotics (ICDL-EpiRob 2015). Schmerling, M., <b>Schillaci, G.</b> , Hafner, V.V., <i>Goal-Directed Learning of Hand-Eye Coordination in a Humanoid Robot</i>
December, 2013 – May 2014	Humboldt Post-Doc Scholarship. Humboldt Graduate School (German Excellence Initiative).
September 3rd-14th, 2012	Best Student Project Award (Project on Sensory substitution). The Barcelona Cognition, Brain and Technology summer school 2012. University of Pompeu Fabra, Barcelona, Spain. Travel Scholarship for the Barcelona Cognition, Brain and Technology summer school (BCBT2012). University of Pompeu Fabra, Barcelona, Spain.
March 5th-8th, 2012	Student Volunteer Scholarship. ACM/IEEE Int. Conf. Human Robot Interaction, Boston (USA)
November 7th-11th, 2011	Best Student Project Award (Project on Urban Search and Rescue robot), Autumn School on Human-Robot Cooperation organised by TNO & FP7 NIFTi. Soestesberg (Holland).
September 2010- August 2013	EU-FP7 Marie Curie Fellowship (Early Stage Researcher), which funded my Ph.D. studies.
September, 2009	Scholarship at Consorzio SIRIO, Palermo, Italy. FRASI project.
September, 2007	EU Erasmus Scholarship (hosted by Universidad de Granada, Spain)
September 2001-2009	ERSU Palermo (Italy). Student scholarship (3 academic years).

## Media and invited talks

February, 11, 2019	Invited talk on "Implementation of prediction error dynamics", Workshop on Prediction Errors organised by Prof. Bruno Lara (UAEM, Mexico) and Prof. Alejandra Ciria (UNAM, Mexico) at HU-Berlin
November, 22, 2019	Talk on "Predictive processes and the minimal self", Workshop on predictive processes for motor and cognitive development in robots, Scuola Superiore Sant'Anna, Pisa, Italy.
October, 15, 2019	Invited talk on "Predictive processing: implementations", Workshop on predictive processing organised by Prof. Bruno Lara (UAEM Mexico) and Prof. Alejandra Ciria (UNAM, Mexico) at HU-Berlin.
July, 06, 2019	Invited talk on Marie Skłodowska Curie actions and presentation of the Predictive Robots project., The BioRobotics Institute conference, Volterra, Italy.
June, 14, 2019	Invited Talk on "Predictive models for robot perception and control" at the EU-H2020 ROMI Workshop on Machine Learning, Ecole Normale Superior Lyon, France.
September 20, 2018	Invited Talk on "AI in Cognitive Robotics" for the Postdoctoral Researchers Networking Tour 2018 organised by DAAD (German Academic Exchange Service) at HU-Berlin.
December 8, 2016	Lecture on "Developmental Robotics" at Embodied Artificial Intelligence class (lead by Prof. V.V.Hafner), Humboldt-Universität zu Berlin.
July, 9, 2015	Media news: Deutschlandfunk - Forschung aktuell - Hörübungen für Roboter - Nao lernt seinen Körper Kennen: <a href="http://www.deutschlandfunk.de/hoeruebungen-fuer-roboter-nao-lernt-seinen-koerper-kennen.676.de.html?dram:article_id=325002">http://www.deutschlandfunk.de/hoeruebungen-fuer-roboter-nao-lernt-seinen-koerper-kennen.676.de.html?dram:article_id=325002</a>
April, 2015	Media news: Technology Review 4/2015, Das Kind im Roboter. <a href="https://www.heise.de/tr/artikel/Das-Kind-im-Roboter-2724219.html?seite=all">https://www.heise.de/tr/artikel/Das-Kind-im-Roboter-2724219.html?seite=all</a>
December 1, 2014	Invited Talk at Minerva School on Cognitive Robotics, Berlin, Germany.
November 30, 2014	Invited Talk at ISACS 2014 (International Symposium on Attention in Cognitive Systems) on Joint Attention in Humans and Robots.
September 15th, 2011	Media news: Interview at Scientific American, Blogs, Robots and New Technologies: Programmed to Understand and Interact—Keep It Future-Friendly! <a href="http://blogs.scientificamerican.com/guest-blog/2011/09/15/robots-and-new-technologies-programmed-to-understand-and-interact-keep-it-future-friendly">http://blogs.scientificamerican.com/guest-blog/2011/09/15/robots-and-new-technologies-programmed-to-understand-and-interact-keep-it-future-friendly</a>