

CV of Paolo Pistone

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PERSONAL INFORMATIONS

Name Paolo PISTONE
Date of birth September 23rd, 1987
Website <http://logica.uniroma3.it/pistone/>

POSITIONS

Sep. 2018- **Post-doctoral researcher**, *WSI Institute for Computer Science, University of Tübingen, Germany*
Sep. 2016-Aug. 2018 **Post-doctoral researcher**, *Dipartimento di Matematica e Fisica, Roma Tre University, Italy*
Oct. 2015-Aug. 2016 **Attaché temporaire d'enseignement et recherche (ATER)**, *Institut de Mathématiques de Marseille, Aix-Marseille University, France*
Jan. 2012-Mar. 2015 **PhD candidate**, *Institut de Mathématiques de Marseille, Aix-Marseille University and Dipartimento di Filosofia, Roma Tre University, France/Italy*

EDUCATION

Jan. 2012-Aug 2016 **Joint PhD in Mathematics and Philosophy**, *Aix-Marseille University and Roma Tre University, France/Italy*
Sep. 2009- Jul. 2011 **Master's degree**, *Roma Tre University, Italy*

PHD THESIS

Title On proofs and types in second order logic
Co-supervisors Jean-Yves Girard and Vito Michele Abrusci
Defense March 27th, 2015 at Roma Tre University, Italy
Reviewers Giuseppe Longo (CNRS), Jean-Baptiste Joinet (Lyon 3 University), Thomas Streicher (Darmstadt University)
Jury Vito Michele Abrusci (Roma Tre University), Pierre-Louis Curien (CNRS, Paris 7 University), Jean-Yves Girard (Aix-Marseille University), Jean-Baptiste Joinet (Lyon 3 University), Simone Martini (Bologna University), Enrico Moriconi (Pisa University)

AWARDS

Nov. 2016 **"Prix de thèse d'Aix-Marseille Université"**, award for best PhD thesis by Aix-Marseille University

May 2012

“Premio tesi 3+2”, award for best Master Thesis in Logic by the Italian Association for Logic and Applications

FELLOWSHIPS

- 2018 **1-year fellowship** awarded by Tübingen University, Germany
2016 **2-year fellowship** awarded by Roma Tre University, Italy
2015 **11-month fellowship (ATER)** awarded by Aix-Marseille University, France
2012 **3-year PhD fellowship** awarded by Roma Tre University, Italy

OTHER DEGREES

- Feb. 2016 *“Qualification aux fonctions de Maître de Conférences”*, sections 25 (“Mathématiques”) and 17 (“Philosophie”)
French title enabling applications for “Maître de Conférences” positions (roughly equivalent to the US Associate Professor position).

COMMUNICATIONS (INVITATIONS)

- Nov. 5th, 2018 **“Le même et l’autre : identité, orthogonalité et types” workshop**, Lyon 3 University, France
Sep. 3rd, 2017 **“Trends in Linear Logic and Applications” (TLLA)**, Oxford University, UK
May 25th, 2017 **“Beyond Logic” conference**, ANR “Beyond Logic”, Chateau de Cerisy, France
Mar. 3rd, 2017 **“Consequence and Paradox” workshop**, Tübingen University, Germany
Nov. 8th, 2016 **“Linear Logic and Philosophy” workshop**, Lyon 3 University, France
Nov. 29th, 2015 **“Logic, Philosophy and Computation of Proofs” workshop**, Keio University, Tokyo, Japan
Nov. 13rd, 2015 **“Computing, Logic and Types” workshop**, Lyon 3 University, France
Feb. 20th, 2015 **“Modeling hypothetical reasoning: validity, inference and paradoxes” workshop**, IHPST, Paris 1 University, France
Aug. 24th, 2014 **“Conference on hypothetical reasoning”**, Tübingen University, Germany
Jun. 26th, 2014 **“Ludics and Philosophy” workshop**, ANR LOCI, Casa San Bernardo (Rome), Italy
Sep. 1st, 2012 **“Transcendental Syntax: the conditions of possibility of language” conference**, PUC University, Paraty, Brasil
Feb. 6th, 2012 **“Logic and interactions 2012”**, conference, CIRM Marseille, France

SELECTION OF OTHER INVITED COMMUNICATIONS

- Dec. 13th, 2018 **Chocola seminar**, LIP, ENS Lyon, France
Nov. 21st, 2018 **Parsifal seminar**, LIX, Palaiseau, France
Nov. 8th, 2018 **Seminar of the LIMD team**, Université de Savoie, Chambéry, France
Sep. 17th, 2018 **“Logic Seminars of the Department”**, Lisbon University, Portugal
Jun. 8th, 2018 **“Logic and Verification team” seminar**, LIPN, Paris 13 University, France
Oct. 17th, 2017 **“Logik und Sprachtheorie” group seminar**, Tübingen University, Germany
Nov. 30th, 2015 **Logic seminar**, Keio University, Tokyo, Japan
Jul. 23rd, 2015 **“Logik und Sprachtheorie” group seminar**, Tübingen University, Germany

COMMUNICATIONS (WORKSHOPS AND CONFERENCES)

- Oct. 9th, 2018 **Proof equivalence in second order multiplicative linear logic**, joint workshop GDRI-Crecogi-Elica, IRIF, Université Paris 7, France.
- Jul. 8th, 2018 **Proof nets, coends and the Yoneda isomorphism**, *Linearity/TLLA*, Oxford University, UK
- Oct. 23rd, 2017 **Polymorphism and Dinaturality from a Linear Logic Perspective**, 2nd Meeting of the *GDRI Linear Logic*, Roma Tre University, Italy
- Sep. 5th, 2017 **On dinaturality, typability and $\beta\eta$ -stable models**, *FSCD*, Oxford University, UK
- Sep. 2nd, 2016 **Parametric polymorphism and the completeness of type theory**, workshop *Parametricity, Logical Relations and Realizability*, affiliated to *CSL*, Aix-Marseille University, France
- Aug. 8th, 2015 **Untyped validity: from interaction to rules**, *Congress of Logic, Methodology and Philosophy of Science*, Helsinki University, Finland
- Aug. 6th, 2015 **Parametric polymorphism and the completeness of type theory**, *Logic Colloquium*, Helsinki University, Finland
- Jul. 15th, 2014 **Type equations and second order logic**, *Logic Colloquium*, Vienna University of Technology, Austria
- Jun. 19th, 2014 **From Herbrand's theorem to geometry of interaction**, *Triennial Conference of the Italian Society for Logic and Philosophy of Science*, Roma Tre University, Italy
- Apr. 25th, 2014 **On pragmatic circularity and reducibility in type theory**, workshop *PhDs in Logic VI*, Utrecht University, Netherlands
- Apr. 16th, 2014 **Rules, types and the transcendence of second order logic**, *XXV Meeting of the Italian Association for Logic and Applications*, SNS Pisa, Italy
- May 30th, 2013 **Second order logic: the Quinean critic and proof theory**, *Mid-term Postgraduate Conference in Logic and Philosophy of Science*, Urbino University, Italy
- Sep. 25th, 2012 **Rule-following and the limits of formalization: Wittgenstein's considerations through the lens of logic**, conference *Philosophy of mathematics: from logic to practice*, SNS Pisa, Italy

OTHER RESEARCH ACTIVITIES

- May 29th-30rd, 2018 **Co-organizer** of the *Groupe de travail sur la syntaxe transcendentale*, sponsored by the GDRI-LL, with T. Seiller, at LIPN, Paris 13 University, France
- May 21st-22nd, 2015 **Co-organizer** of the workshop *Beyond Logic*, with M. Abrusci, J. Fichot and J.-B. Joinet, at Roma Tre University, Italy
- Mar 26th-28th, 2015 **Co-organizer** of the workshop *"Proofs and Types", 25 years later*, with M. Abrusci, at Roma Tre University, Italy
- 2017-2018 **Reviewer** for the international conferences *CSL* and *LICS*
- 2017-2018 **Reviewer** for the international journals *BSL*, *JPL*, *TOPOI* and *Studia Logica*

TEACHING EXPERIENCE

- Oct. 2017-Jan. 2018 **Theoretical Computer Science and Computation Models** (12 hrs tutorials), 1th year MSc in Mathematics, *Roma Tre University*, Italy
- Oct. 2017-Dec. 2018 **Logic and Communication** (18 hrs tutorials), 1th year BSc in Communication Sciences, *Roma Tre University*, Italy
- Mar. 2017-Jun. 2017 **Theoretical Computer Science and Computation Models** (12 hrs tutorials), 1th year MSc in Mathematics, *Roma Tre University*, Italy
- Apr. 2016-May. 2016 **Lectures on Second Order Logic** (12 hrs), 2nd year MSc in Mathematics, *Aix-Marseille University*, France
- Mar. 2016-Jun. 2016 **Logic and Mathematics** (18 hrs), 1th year MSc in Philosophy, *Aix-Marseille University*, France

- Mar. 2016-Jun. 2016 **Logic and Computation Theory** (12 hrs), 1th year MSc in Computer Science, *Aix-Marseille University*, France
- Mar. 2016-Jun. 2016 **Existence Postulates in Mathematics** (18 hrs), 1th year MSc in Philosophy, *Aix-Marseille University*, France
- Sep. 2015-Jan. 2016 **Logic and Computability** (40 hrs tutorials), 2nd year MSc in Mathematics, *Aix-Marseille University*, France
- Sep. 2015-Jan. 2016 **Linear Algebra 2** (30 hrs), 2nd year BSc in Mathematics, *Aix-Marseille University*, France
- Sep. 2015-Jan. 2016 **Introduction to Mathematics** (12 hrs), 1st year MSc in Philosophy, *Aix-Marseille University*, France

SCIENCE OUTREACH

- Mar. 14th, 16th, 19th, 2017 **Tournée de π** (<https://www.piday.fr/>) in Paris (Théâtre des Variétés), Marseille (Théâtre du Silo) and Lyon (Transbordeurs), France.
- Sep. 29th, 2017 **European Researchers Night**, Roma Tre University, <http://nottericerca.uniroma3.it/index.php>, Italy
- Sep. 30th, 2016 **European Researchers Night**, Roma Tre University, <https://romatrenottericercatori.wordpress.com/>, Italy
- May 10th, 2016 **Treize minutes Marseille - Jeunes Chercheurs**, <https://vimeo.com/167115532>, in Marseille (Alcazar Library), France
- Mar. 14th, 2016 **Journée de π** in Marseille (Théâtre de la Criée), France
- Jan. 25th-27th, 2016 **Hippocampe activity: correcting codes**, *Aix-Marseille University*, France
3-day stage for high school students who experience doing research in an academic laboratory, under the supervision of a researcher.
- Mar. 14th, 2016 **Journée de π** in Marseille (MuCEM), France

PUBLICATIONS IN JOURNALS

- 2018 Pistone, **Polymorphism and the obstinate circularity of second order logic, a victims' tale**. *The Bulletin of Symbolic Logic*, vol. 4 Issue 2, pp. 1-52
Contents. The investigations on higher-order type theories and parametric polymorphism constitute the technical counterpart of the old foundational problem of impredicativity. The epistemological significance of such investigations has not received much attention in the contemporary foundational debate. Through a comparison between the faulty consistency arguments given by Frege and Martin-Löf, respectively for the logical system of the Grundgesetze (shown inconsistent by Russell's paradox) and for the intuitionistic type theory with a type of all types (shown inconsistent by Girard's paradox), and the normalization argument for second order type theory (or System F), we indicate some mathematical problems hidden behind the hazardous idea of impredicative quantification, constituting a vast (and largely unexplored) domain for foundational research.
- 2018 Pistone, Petrolo M., **On paradoxes in normal form**. *TOPOI* [Special Issue Inferences and Proof], <https://doi.org/10.1007/s11245-018-9543-7>
Contents. The usual proof-theoretic notion of paradox is that of a closed derivation of absurdity with no normal form. Drawing on the remark that all derivations of a given proposition can be transformed into derivations in normal form of a logically equivalent proposition, we investigate the possibility of paradoxes in normal form. We compare usual paradoxes and paradoxes in normal form from the viewpoint of the computational interpretation of proofs and from the viewpoint of proof-theoretic semantics.
- 2017 Tranchini L., Pistone, Petrolo M., **The naturality of natural deduction I**. *Studia Logica* [Special Issue General Proof Theory], online first, <https://doi.org/10.1007/s11225-017-9772-6>
Contents. It is well known that the usual Russell-Prawitz translation of intuitionistic connectives in propositional second order logic NI2 does not preserve the relations of identity among derivations induced by the permutative conversions and immediate expansions for the definable connectives. On the basis of the categorial interpretation of NI2, we introduce a new class of equations expressing what in categorial terms is a naturality condition satisfied by the transformations interpreting NI2-derivations. We show that the Russell-Prawitz translation does preserve identity of proof with respect to the enriched system by highlighting the fact that naturality corresponds to a generalized permutation principle.

PUBLICATIONS IN CONFERENCE PROCEEDINGS

- 2019 Pistone, **Proof nets, coends and the Yoneda isomorphism**, accepted for publication in the EPTCS post-proceedings of Linearity-TLLA 2018, <https://arxiv.org/abs/1810.01252>
- Contents.** Proof nets provide permutation-independent representatives of proofs and are used to investigate coherence problems for monoidal categories. We investigate a coherence problem concerning Second Order Multiplicative Linear Logic *MLL2*, that is, the one of characterising the equivalence over proofs generated by the interpretation of quantifiers by means of ends and coends. By adapting the “rewiring approach” used in the proof net characterisation of the free $*$ -autonomous category, we provide a compact representation of proof nets for a fragment of *MLL2* related to the Yoneda isomorphism. We prove that the equivalence generated by coends in this fragment is fully characterised by the rewiring equivalence over proof nets.
- 2017 Pistone, **On dinaturality, typability and $\beta\eta$ -stable models**, *2nd International Conference on Formal Structures for Computation and Deduction (FSCD 2017)*, Leibniz International Proceedings in Informatics (LIPIcs), vol. 84, pp. 29:1–29:17, Schloss Dagstuhl–Leibniz-Zentrum fuer Informatik, Dagstuhl, Germany
- Contents.** We present two results which relate dinaturality with a syntactic property (typability) and a semantic one (interpretability by beta-eta-stable sets). First, we prove that closed dinatural lambda-terms are simply typable, that is, the converse of the well-known fact that simply typable closed terms are dinatural. The argument exposes a syntactical aspect of dinaturality, as lambda-terms are type-checked by computing their associated dinaturality equation. Second, we prove that a closed lambda-term belonging to all beta-eta-stable interpretations of a simple type must be dinatural, that is, we prove dinaturality by semantical means. To do this, we show that such terms satisfy a suitable version of binary parametricity and we derive dinaturality from it.
- 2014 Aubert C., Bagnol M. Pistone and Seiller T., **Logic Programming and Logarithmic Space**, in *Programming Languages and Systems, 12th Asian Symposium APLAS 2014, Singapore*, volume 8858 of Lecture Notes in Computer Science, pp. 39-57, Springer
- Contents.** We present an algebraic view on logic programming, related to proof theory and more specifically linear logic and geometry of interaction. Within this construction, a characterization of logspace (deterministic and non-deterministic) computation is given via a syntactic restriction, using an encoding of words that derives from proof theory. We show that the acceptance of a word by an observation (the counterpart of a program in the encoding) can be decided within logarithmic space, by reducing this problem to the acyclicity of a graph. We show moreover that observations are as expressive as two-ways multi-heads finite automata, a kind of pointer machines that is a standard model of logarithmic space computation.

PUBLICATIONS IN COLLECTIONS

- 2018 V.M. Abrusci, Pistone, **Le direzioni della ricerca logica in Italia: la logica lineare e i suoi sviluppi**, in Hykel Hosni, Gabriele Lolli, Carlo Toffalori, editors, *Le direzioni della ricerca logica in Italia 2*, p. 1-47, Edizioni ETS, Pisa
- 2017 Pistone, Petrolo M., **A normal paradox**, in Arazim P. and Lávička T., editors, *The Logica Yearbook 2016*, p.173-184, College Publications, London
- 2016 Pistone, **On the “no-deadlock criterion”: from Herbrand’s theorem to Geometry of Interaction**, in *New Developments in Logic and Philosophy of Science*, SILFS series, College Publications
- 2015 Pistone, **Rule-following and the limits of formalization: Wittgenstein’s considerations through the lens of logic**, in *From Logic to Practice, Italian Studies in the Philosophy of Mathematics*, volume 308 of Boston Studies in the Philosophy and History of Science, Springer
- 2014 V.M. Abrusci, Pistone, **On transcendental syntax: a Kantian program for logic?**, in *Second Pisa Colloquium in Logic, Epistemology and Philosophy of Language*, ETS, Pisa

OTHER PUBLICATIONS

- 2017 Pasquali F., Pistone, **L’Hotel di Hilbert e l’imbarazzo della scelta**. *Archimede*, vol. 1/2017, Le Monnier, 2017 (Italian journal on the didactics of mathematics)

SUBMITTED PAPERS

- 2018 Pistone, **On completeness and parametricity in the realizability semantics of System F** , <https://arxiv.org/abs/1802.05143>
- Contents.** We investigate completeness and relational parametricity in the realizability semantics generated by closure operators over sets of λ -terms. First, we show that, for a wide class of semantics, completeness holds for positive second order types, by generalizing some completeness results in the literature. Then we show that parametricity can be formulated within the realizability semantics which are stable by union. We prove a parametricity theorem stating that closed realizers of a given type are parametric. Finally, we prove that, for positive second order types, parametric terms are dinatural. Our results show that, for positive second order types, realizability, parametricity, dinaturality and typability are equivalent properties of closed normal lambda-terms.

Pistone, **Proof nets and the instantiation overflow property**, <https://arxiv.org/abs/1803.09297>

Contents. Instantiation overflow is the property of those second order types for which all instances of full comprehension can be deduced from instances of atomic comprehension. A type has instantiation overflow when one can type, by atomic polymorphism, "expansion terms" which realize instances of the full extraction rule applied to that type. This property was investigated in the case of the types arising from the well-known Russell-Prawitz translation of logical connectives into System F, but is not restricted to such types. Moreover, it can be related to parametricity and dinaturality. In this paper we investigate instantiation overflow by using linear logic proof nets. Through this geometric approach we obtain a deeper understanding of the structure of expansion terms and Russell-Prawitz types. Our main result is a characterization of the class of types of the form $\forall X A$, where A is a simple type, which enjoy the instantiation overflow property.

IN PREPARATION

In prep.

Pistone, Tortora de Falco L., **Observational equivalence in Second Order Multiplicative Linear Logic**

Contents. We investigate the observational equivalence relation in MLL2. We first provide a syntactic characterization by means of a translation of second order proof nets into finite sets of MLL proof nets. Then we define two models of MLL2 which extend the usual relational interpretation of MLL and use them to provide a semantic characterization of observational equivalence.

In prep.

Pistone, Tranchini L, Petrolo M., **The naturality of natural deduction II: on instantiation overflow**

Contents. We show that the instantiation overflow technique, which is the basis of a revised Russell-Prawitz translation recently proposed by Ferreira and Ferreira, can be expressed and generalised through the naturality condition described in the first paper of this series. We relate this construction to the Yoneda lemma, obtaining a "Yoneda translation" which inverts the translation by Ferreira and Ferreira. A consequence of such results is that the derivations arising from the two translations have the same denotation in all parametric models of System F.