# Lorenzo Cardarelli - Curriculum Vitae
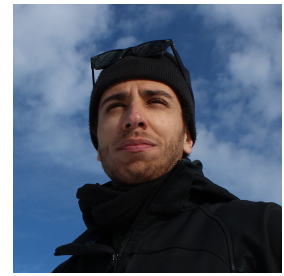
26th December 2023

Born:        24th July 1995

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## Bibliography, research interests and skills

I graduated with both a Bachelor's degree (2017) and a Master's degree (2019) from the University of Rome La Sapienza, with a focus on the study of ceramic materials from the settlement of Monte Cimino (Viterbo, Italy). In 2020, I began a fully funded PhD from the University of Bari Aldo Moro. During the period between March and June 2022, I had the opportunity to be a visiting researcher at the Österreichisches Archäologisches Institut in Vienna, Austria. Since April 2022, I am a associate researcher at the CNR - Istituto di Scienze del Patrimonio Culturale, Area della Ricerca Roma 1. My research interests are centered on material culture and societies from the Bronze Age to the Early Iron Age in Italy, with a particular emphasis on the topics explored in my research. Specifically, in addition to my in-depth knowledge of material culture and social aspects of protohistoric Italy, I have developed specialised skills in the application of quantitative methods, computer science tools and statistical programming - including machine learning and deep learning - for analysis and classification of materials, territorial analysis, database management, and sharing of results through dynamic and accessible web documentation. Other interests include the use of 3D modeling and rendering software for the reconstruction and visualisation of archaeological contexts. I am currently a research fellow at the University of Rome La Sapienza.

**Research interest**

- Quantitative and computational archaeology.

- Bronze and Iron Age of Italy.

- Machine Learning application in archaeology.

- GIS application in archaeology.

**Skills**

- In-depth knowledge of Bronze Age and Early Iron Age societies and culture in Italy.

- Programming languages (R, Python) with a specific focus on statistical aspects and data analysis (NumPy, Pandas, Scikit-learn, tidyr), plotting and data visualisation (Matplotlib, Seaborn, Plotly, ggplot2), network analysis (NetworkX).

- Familiarity with frameworks for neural network development (Pytorch).

- Proficiency in languages for creating and publishing scientific documentation (LaTeX, Markdown, Quarto) and generic web development (HTML, CSS).

- Understanding of the GIS environment (Qgis, SAGA), including geoprocessing, raster analysis and integration with programming languages (Rasterio, Folium, Geopandas).

- Database processing using SQL

- Proficiency in version control software (Git)

- Knowledge of software for 3D modeling and rendering of archaeological materials.

## Education

| 11/2020 – 11/2023 | **PhD** | 📍 *Bari, Italy* |

*Aldo Moro University*
PhD course in *Patrimoni archeologici, storici, architettonici e paesaggistici mediterranei*
Project title: *Variability and standardisation of vessel shapes in the 2$^{nd}$ and first half of the 1$^{st}$ millennium BC in continental Italy: a Data Science and Machine Learning project for the quantitative study of archaeological ceramic profiles*

In the context of my PhD, the topics I extensively explored and the tools I utilised included:

- Statistical analysis.
- SQL database management.
- Python programming.
- Version control using Git.
- Development of Deep Learning architectures.
- Territorial analysis through GIS.
- Creation of dynamic and accessible documentation via web frameworks.
- Documentation and digitization of extensive archaeological materials.
- Analysis of social components through material culture.

Tutor: Dr Marco Bettelli, Cotutores: Prof Andrea Cardarelli, Dr Paola Moscati

| 2019 | **Master's degree in Archaeology (LM-02)** | 📍 *Rome, Italy* |

*University of Rome La Sapienza*
Thesis title: *Produzione vascolare dalla vetta del Monte Cimino (VT)*
During the thesis work, I undertook the following tasks:

- Technical drawing of approximately 750 ceramic fragments.
- Material management using a relational SQL dataset.
- Statistical and quantitative analysis of the ceramic material.
- Typological analysis of the material and comparisons with contemporaneous sites.
- Social analysis of the context based on the archaeological record.

Supervisors: Prof Andrea Cardarelli, Dr Barbara Barbaro
Grade: 110 with honours/110

| 2017 | **Bachelor's Degree in Archaeological Sciences (L-01)** | 📍 *Rome, Italy* |

*University of Rome La Sapienza*
Thesis title: *Produzione vascolare dal contesto cultuale del Monte Cimino (VT)*
Supervisor: Prof Andrea Cardarelli

During the thesis work, I undertook the following tasks:

- Technical drawing of 350 ceramic fragments.
- Material management using a relational SQL dataset.
- Typological analysis of the material and comparisons with contemporaneous sites.
- Social analysis of the context based on the archaeological record.

Grade: 110 with honours/110

## Work experience

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**12/2023 – present**    **Research fellowship**    📍 *Rome, Italy*
*Dipartimento di Scienze dell'Antichità, University of Rome La Sapienza, Piazzale Aldo Moro 5*
Research grant within the project **HERDS. Animal Husbandry and its Economic Role in the Development of Central Mediterranean Protohistoric Societies**.
GIS and statistical analysis, communication and presentation of results through web frameworks

**04/2022 – present**    **Associate researcher**    📍 *Rome, Italy*
*CNR - Istituto di Scienze del Patrimonio Culturale, Area della Ricerca Roma 1*
Staff Prehistory and Protohistory Research Group; Staff MAD-Lab | Modelling Archaeological Data
Position held within the project "**Mobility, Social Integration, and Culture Change in the Mediterranean Bronze Age**" with a specific focus on GIS analysis related to territorial movement using statistical programming, including statistical and network analysis.

**09/2023 – 10/2023**    **Archaeological excavation**    📍 *Fratta Polesine (RO), Italy*
*Società Archeologica SAP. Via Fienili 39/a, 46020 Quingentole, Mantova (MN)*
Archaeological excavation of the protohistoric settlement of Frattesina (Fratta Polesine, RO) Directors: Prof. Andrea Cardarelli, University La Sapienza, Rome; Prof. Paolo Bellintani, Soprintendenza per i Beni Archeologici della Provincia Autonoma di Trento.
Archaeological operator; Compilation of US sheets; Reliefs and photoplans; Laboratory and cataloguing activities.

**09/2022 – 10/2022**    **Archaeological excavation**    📍 *Arcevia (AN), Italy*
*Archeosistemi Cooperative Society. Via Nove Martiri, 11/A 42124 Reggio Emilia (RE)*
Archaeological excavation of the protohistoric settlement of Monte Croce-Guardia (AN) Director: Prof. Andrea Cardarelli, University La Sapienza, Rome.
Archaeological operator; Compilation of US sheets; Reliefs and photoplans; Laboratory and cataloguing activities.

**09/2021 – 12/2021**    **3D reconstructions of buildings and artefacts**    📍 *Rome, Italy*
*University of Rome La Sapienza, Piazzale Aldo Moro 5*
Realisation of 3D reconstructions of dwellings and artefacts from the protohistoric settlement of Monte Croce-Guardia (AN) for the video "*Il villaggio prostorico di Monte Croce Guardia 1200-950 a.C.*", presented in "*Se tremila anni sembran tanti… Il villaggio protostorico di Monte Croce Guardia - Arcevia 1200-950 a.C.*" (Arcevia - AN, 09/07/2022).
Using a completely open-source framework, a series of dwellings discovered during archaeological investigations were reconstructed in a philological manner. This reconstruction included material selection, modeling texturing, and was achieved through the analysis of archaeological documentation from the site, as well as from contemporaneous or comparable contexts. Additionally, a wide range of materials, such as ceramics, weaponry, tools, and furniture, were meticulously reconstructed.

**09/2021 – 11/2021**    **Archaeological excavation**    📍 *Arcevia (AN), Italy*
*Archeosistemi Cooperative Society. Via Nove Martiri, 11/A 42124 Reggio Emilia (RE)*
Archaeological excavation of the protohistoric settlement of Monte Croce-Guardia (AN) Director: Prof. Andrea Cardarelli, University La Sapienza, Rome.
Archaeological operator; Compilation of US sheets; Reliefs and photoplans; Laboratory and cataloguing activities.

**09/2020 – 11/2020**    **Archaeological excavation**    📍 *Arcevia (AN), Italy*
*Akhet S.R.L., Closellinaz, 44/A, 11010 Roisan (AO)*
Archaeological excavation of the protohistoric settlement of Monte Croce-Guardia (AN) Director: Prof. Andrea Cardarelli, University La Sapienza, Rome.
Archaeological operator; Compilation of US sheets; Reliefs and photoplans; Laboratory and cataloguing activities.

## Publications

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| **Journal article** 2023 | **Traditional and digital typologies compared: the example of Italian protohistory.** Cardarelli L., *Origini*, XLVII (*forthcoming*) |
| **Journal article** 2023 | **Defining Southern Etruria Final Bronze Age settlement models using an integrated GIS and machine learning approach.** Cardarelli L., *Archeologia e Calcolatori*, 34, 2 |
| **Journal article** 2023 | **Tracing the human movements of three thousand years ago by volcanic grinding tools in the Final Bronze Age settlement of Monte Croce Guardia (Arcevia-Marche Region, central Italy)** Santi P., Cardarelli A., Bettelli M. Di Renzoni A., Cardarelli L., Paniccia C., Renzulli A., *Scientific Reports* 13, 7022 |
| **Journal article** 2023 | **Money or ingots? Metrological research on pre-contact Ecuadorian "axe-monies"** Montalvo Puente C. E., Lago G., Cardarelli L., Pérez Molina J. C., *Journal of Archaeological Science: Reports*, 49 |
| **Journal article** 2022 | **A deep variational convolutional Autoencoder for unsupervised features extraction of ceramic profiles. A case study from central Italy.** Cardarelli L., *Journal of Archaeological Science*, 144 |
| **Preprint** 2022 | **Money or ingots? Metrological research on pre-contact Ecuadorian 'axe-monies'** Montalvo Puente C. E., Lago G., Cardarelli L., Pérez Molina J. C. |
| **Journal article** 2022 | **Dimensionality reduction for data visualization and exploratory analysis of ceramic assemblages** Cardarelli L., Lapadula A., *Archeologia e Calcolatori*, 33, 2 |
| **Journal article** 2020 | **Capienza delle forme vascolari, da un metodo open source all'uso di modelli regressivi: il caso dell'insediamento protostorico del Monte Cimino** Cardarelli L., *Archeologia e Calcolatori*, 31, 1 |

## Experience gained during university education

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| 09/2019 – 11/2019; 09/2018 – 11/2018; 09/2017 – 11/2017; 09/2016 – 11/2016; 09/2015 – 11/2015 | **Archaeological excavation**  📍*Arcevia (AN), Italy* <br> *University of Rome La Sapienza, Piazzale Aldo Moro 5* <br> Archaeological excavation of the protohistoric settlement of Monte Croce-Guardia (AN) Director: Prof. Andrea Cardarelli, University La Sapienza, Rome. <br> Archaeological operator; Compilation of US sheets; Reliefs and photoplans; Laboratory and cataloguing activities. |
| 06/2016 – 07/2016; 06/2015 – 07/2015 | **Archaeological excavation**  📍*Soriano nel Cimino (VT), Italy* <br> *University of Rome La Sapienza, Piazzale Aldo Moro 5* <br> Archaeological excavation of the settlement and place of worship at Monte Cimino (VT). Director: Prof. Andrea Cardarelli, La Sapienza University, Rome. <br> Archaeological operator; Compilation of US sheets; Reliefs and photoplans; Laboratory and cataloguing activities. |
| 11/2019 | **Systematic archaeological survey**  📍*Fratta Polesine (RO), Italy* <br> *University of Rome La Sapienza, Piazzale Aldo Moro 5* <br> Systematic archaeological survey of the protohistoric settlement of Frattesina di Fratta Polesine (RO). Director: Prof. Andrea Cardarelli, La Sapienza University, Rome. <br> Archaeological operator; Laboratory and cataloguing activities. |
| 01/2017 – 11/2017; 01/2019 – 12/2019 | **Laboratory work on archaeological material**  📍*Rome, Italy* <br> *University of Rome La Sapienza, Piazzale Aldo Moro 5* <br> Laboratory activities on archaeological material from the protohistoric settlement of Monte Cimino (VT). <br> Drawing ceramic materials; Cataloging via SQL database. |

## Conference talks

**2023**          **Conversation - Museo Numismatico, Banco Central del Ecuador** Avances sobre los estudios de las hachas-monedas, Montalvo Puente C. E., Lago G., Cardarelli L., Pérez Molina J. C., Quito (ECU), 23 july 2023

**2023**          **13° International Congress on the Archaeology of the Ancient Near East (ICAANE)** Workshop Serialising, standardising, specialising: Investigating a techno-social nexus underlying social complexity. Cardarelli L., Computerised approaches for investigating the morphological standardization ofArslantepe VI A pottery, Copenhagen, 24 may 2023.

**2020**          **IAS – Incontri di Archeologia 2020.  Digital Humanities Session I-II** Cardarelli L., Capienza delle forme vascolari, un metodo basato su strumenti e formati open source che include l'uso di modelli regressivi: il caso dell'insediamento protostorico del Monte Cimino. Rome, 19 november 2020.

## Didactic activity

**02/2022**          **Python vs R - An archaeological challenge** Applied programming languages course to archaeology.  XXXVI and XXXVII cycle of the Doctorate in *Patrimoni archeologici, storici, architettonici e paesaggistici mediterranei*. University of Bari 'Aldo Moro'.

**03/2021**          **QGIS basic course** Basic QGIS application to archaeology. XXXVI cycle of the Doctorate in *Patrimoni archeologici, storici, architettonici e paesaggistici mediterranei.*  University of Bari 'Aldo Moro'.

## Editorial work

**Peer-review**          Journal of Archaeological Science

## International experience

03/2022 – 07/2022     **Visiting Researcher**                                        📍 *Vienna, Austria*
                      *Österreichisches Archäologisches Institut*

## Funding and grants

**2020 – 2023**          PhD scholarship, Aldo Moro University, Bari. €40000 approx.

## IT skills

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| **OS** | Windows<br>GNU-Linux |
| **Office & Editing** | Microsoft Office<br>Adobe Photoshop<br>Adobe Illustrator<br>Adobe InDesign<br>GIMP |
| **Editing video & content creation** | Adobe Premiere Pro<br>Adobe AfterEffects |
| **GIS Softwares** | Qgis<br>Arcgis<br>SAGAgis |
| **Version control** | Git |
| **Database** | Microsoft Access |
| **Programming & markup** | R<br>Python<br>HTML<br>CSS<br>Markdown<br>Bash<br>SQL<br>LaTeX |
| **Statistical software** | Past<br>SPSS |
| **Computer graphics** | Blender<br>Unreal Engine<br>Quixel Mixer<br>Substance Painter<br>Armor Paint |

## Language Skills

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| **Italian** | Native |
| **English** | Intermediate |

## Additional information

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| **Driving Licence** | B |