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A THEATRICAL DOUBLE-FACED MASK PRESERVED AT THE MUSEUM OF LIPARI (MESSINA): STUDY AND 3D RECONSTRUCTION THROUGH PORTABLE EQUIPMENT

UNA MÁSCARA TEATRAL DE DOBLE CARA PRESERVADA EN EL MUSEO DE LIPARI (MESINA): ESTUDIO Y RECONSTRUCCIÓN 3D MEDIANTE EQUIPO PORTÁTIL

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Highlights:

- A 'mobile laboratory' consisting of portable equipment has been set up to perform 3D metric surveys on a selection of artefacts preserved at the Museum of Lipari.
- By means of an ultra-precision laser-scanner arm, a 3D survey on a miniaturistic double-faced mask, belonging to the classical theatrical terracotta, has been performed.
- A geometrically accurate and realistic 3D final model has been created. This helped the study and reconstruction of the two characters composing the mask.

Abstract:

The new tools for 3D survey and modelling (as portable scanners and software packages), often in combination with diagnostics, are nowadays able to provide indispensable elements for the study of archaeological artefacts; their applications to museum's heritage can be also useful to integrate the traditional graphic documentation and contribute to enhancement and dissemination. This paper shows the benefit of using the aforementioned tools to study the peculiar clay mask No. 11114-E, discovered in 1973 in the Greek necropolis of Lipára, inside tomb No. 1558. The specimen, now exhibited in the Classical Section of the Aeolian Museum, is considered unique both in the Aeolian Islands and in the ancient Greek world, as it is the only one merging two half faces attributable to different characters. This feature, unknown at the time of discovery, has been highlighted in 2018, thanks to a restoration intervention by which a hard concretion layer covering a large portion of the mask surface was removed, bringing to light a smiling young half-face next to an old one with Silenic features. In 2019, the mask was surveyed in situ through a portable and performing laser-scanner arm (the QuantumTM FaroArm by FARO) to produce a high-resolution 3D model useful to enhance the reading of the two halves (not evident enough, due to its state of preservation). The data processing was performed using the Geomagic Wrap software, able to align and merge multiple scans into a single model and to export results in multiple formats, easily shareable and viewable in free software or via the web. Finally, thanks to this method, the successful generation of a digital replica was performed; the resulting replica is useful for dissemination and as a support for the hypothetical reconstruction of the two prototypes taken as models by the craftsman who created the mask.

Keywords: 3D digitisation; theatrical masks; portable laser-scanner; digital museums; 3D documentation; digital archaeology; 3D reconstruction

Resumen:

Las nuevas herramientas para el levantamiento y el modelado en 3D (como son los escáneres portátiles y los paquetes de software), a menudo en combinación con equipos diagnósticos, pueden hoy en día proporcionar elementos indispensables para el estudio de objetos arqueológicos; sus aplicaciones al patrimonio del museo también pueden ser útiles para integrar la documentación gráfica tradicional y contribuir a su mejora y divulgación. Este artículo se refiere al estudio de un hallazgo peculiar procedente de la necrópolis griega de Lipára: la máscara de arcilla nº. 11114-E, descubierta en 1973 en el interior de la tumba nº. 1558 y ahora exhibida en la Sección Clásica del Museo Eólica.

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El espécimen se considera único, tanto en las Islas Eolias como en el mundo griego antiguo, ya que es la única que fusiona dos mitades atribuibles a diferentes personajes. Esta característica, desconocida en el momento del descubrimiento, se ha destacado en 2018, gracias a la intervención de restauración mediante la cual se ha eliminado una capa dura que cubre gran parte de la superficie de la máscara, sacando a la luz una media cara sonriente y joven, junto a una cara que muestra indicadores de vejez con rasgos selénicos. En 2019, la máscara se levantó in situ con un brazo de escáner láser portátil y funcional (FaroArm QuantumTM de FARO), con el objetivo de generar un modelo 3D de alta resolución útil que mejorara la lectura de las dos mitades (no visible debido a su estado de conservación). El procesamiento de datos se ha llevado a cabo empleando el software Geomagic Wrap capaz de alinear y fusionar múltiples escaneados en un solo modelo y exportarlo en múltiples formatos, fácilmente compartibles y visibles en software libre o vía web. Este método permitió, finalmente, la generación de una réplica digital que podría servir tanto para su divulgación, como de soporte que permita la reconstrucción hipotética de los dos prototipos que presumiblemente fueron de modelo para el artesano al crear la máscara.

Palabras clave: digitalización 3D; máscaras teatrales; escáner láser portátil; museos digitales; documentación 3D; arqueología digital; reconstrucción 3D

1. Introduction

The present study is part of a collaboration programof collaboration between the CNR -Institute of Chemical and Physical Processes of Messina and the Polo Museale Eoliano of Lipari, having as objective the study and the digitization of some interesting archaeological finds preserved in the classical section of the museum. Since May 2018, several measurement campaigns have been performed in situ through portable and handheld instrumentation (a Raman Spectroscopy and a 3D scanning device), basing on the different issues needed by each artefact. The first report including 12 theatrical clay masks, two figured calyx craters, a stone *arula* (miniaturistic altar) interested by an inscription difficult to read, a fragmentary clay head and a lid of *lekane* (large vessel) has been published by Giuffrida et al. (2019).

This paper, specifically, concerns one of the most interesting and debating theatrical masks found in Lipari: the mask No. 11114-E, discovered in 1973 inside the tomb 1558 and published by Bernabò Brea & Cavalier (1991, p. 79 and pp.108-109). The mask, difficult to read and to interpret, have been surveyed with an ultra-precision 3D scanner integrated into a measuring robotic arm in order to: (1) generate a detailed 3D model useful to improve and enhance the reading of its singular features; (2) get support on which to base the hypothetical reconstruction of the starting models (prototypes); (3) help the interpretation, dating and attribution through the analysis of stylistic and production technologies.

1.1. The museum and the collection of theatrical masks

The Museum of Lipari is located upon a volcanic plateau overlooking the port area (Fig. 1a) (a brief history of the Museum can be found in Martinelli & Vilardo 2019 and Martinelli & Mastelloni 2015). Interested by a succession of villages of huts dating from the Neolithic to the Bronze Age, in 580 BC, it became the *acropolis* of the Greek *apoikía* of *Lipára* (on the foundation see Cavalier, 1999, pp. 293-302; the ancient sources about the foundation are Diodorus Siculus, 5.9, 1-3; Pausanias, 10.11.3; Thucydides 3.88.2), later a fortified citadel (Ridgway 2004, p. 214-215), and finally a castle.

The importance of the Museum is given by the great information potential of its finds, all coming from the excavations carried out on the island from 1948 to 2000, a testimony of all the phases of life of the Aeolian Archipelago. The collection includes the richest and homogeneous *corpus* of theatrical *coroplastic* belonging to the ancient Greek heritage, consisting of over a thousand specimens of miniaturistic statuettes and masks (gr. *prósōpa*): a small part (150 pieces) is exhibited in the classic section of the itinerary (Fig. 1b, n. 4) while more than 800 other fragments are preserved in the warehouses (inaccessible for visitors).

(a)

(b)

Figure 1: Lipari Island, Messina, Italy: (a) Aerial view of the “rock of the Castle” with the structures of the Regional Archaeological Museum L. Bernabò Brea; (b) Map of the Museum: 1. Prehistoric section; 2. Epigraphic section; 3. Section smaller islands; 4. Classical archaeology section; 5. Volcanological section; 6. Palaeontology room of the quaternary. A: Spanish Fortification; B: Cathedral of S. Bartolomeo and monastery; C: Church of the Madonna delle Grazie; D: Reconstruction of a theatre (1978); E: Church of Maria SS. Immacolata; F: Church of Maria SS. Addolorata; G: Church of Santa Caterina; H: Archaeological excavations; I: Sarcophagi coming from the necropolis of c.da di Diana.

The largest number of specimens has been found as funerary equipment inside of tombs dating at 4th-3rd century BC (mainly within the urban necropolis of "Contrada Diana"); few others, rather, have been discovered inside votive pits or dumps located on the sideline of sanctuaries or even inside household shrines placed in urban and peri-urban areas (the excavations campaign have been published by L. Bernabò Brea and M. Cavalier in the *Meligunìs Lipára* series of monographs, voll. II, V, X and XI; see also Bernabò Brea & Cavalier (1981, pp. 11-14), Bernabò Brea & Cavalier (1991), and Mastelloni & Spigo (1998, p. 14).

All the masks of Lipari seem to have been produced locally by high-level craftsmanship. Using a matrix technique the relief of the face was first generated, while the rear cap was shaped by a strip of moulded clay functional to close the mask as a helmet. The surface colour, spread over a thin layer of kaolin before firing, when preserved, was often representative of the gender: brown red and generally darker for male characters; white and lighter, for female ones (Marraffa, 2017).

Conceived as miniaturistic replicas of the masks worn by the actors during their performance, the Aeolian masks were perhaps inspired to Athenian prototypes, which have been circulating for decades throughout the Mediterranean area together with the dramatic texts to which they were referred (Marraffa, 2017, p. 25, 84).

Conventionally, the identification of the characters represented was based on the *Onomasticón* by Julius Pollux's (Bearzot et al, 2007), a *thesaurus* dating to the 2nd century AD, which included about 44 different types for comedy; later Bernabò Brea added other types for tragedy and Satyr plays (Bernabò Brea & Cavalier, 2001, p. 7) developing a first chronological classification into three distinct groups (see Bernabò Brea & Cavalier 1981; Bernabò Brea et al., 1992, pp. 23-31). This first classification has been recently overcome by the newest study by Schwarzmaier (2011, p. 280), who first tried to analyze the finds in the light of the association with the other materials discovered in the same context, in order to value the possible link with ritual practices or religious beliefs. These results were also integrated by Mastelloni (2015, p. 30; 2018, pp. 709–720), according to whom the entire production of masks may be dated in a narrow time range between the first decades and the end of 4th century BC (the *terminus ante quem* is given by attack on the island by part of the Syracusan Agathocles in 304 BC). For this reason, the possibility of reading the masks based on models of the new comedy of Menander (who died in 292 BC) is not sustainable. The new typological seriation has been, thus, based on two groupings, which differs in terms of dimensions, craft techniques, chronology and formal characteristics: the first group comprehends a series of a few smaller masks, perhaps produced by a single workshop, in the half middle of 4th century BC; the second one counts numerous masks varying in size from about 10 cm to approx. 30 cm, characterized by a more evolved, complex, and varied formal conception and by a lively chromatism.

Many arguments of discussion have been opened among the scholars about the function of these findings and the link with cultural, religious and economic reasons. As suggested by La Torre (2019, p. 9), the use of theatrical masks in a not specifically theatrical context, but miniaturized and inserted in the funerary outfits, is also attested in Athens starting from the end of the 5th century BC and widespread in the 4th century BC elsewhere, with a clear reference to the Dionysian sphere.

A comparison regarding the use of small theatrical masks in extra-theatrical contexts can be found in Centuripe (Musumeci, 2010, p. 104-106; for the masks of new Comedy see also Bernabò Brea, 1974) and Taranto, where the presence of theatrical terracottas in funerary deposits is also attested (Graepler, 1997, pp. 231-234).

According to the suggestion given by L. Bernabò Brea and M. Cavalier, the particular concentration of miniaturistic masks the 4th century's Lipari may be explained with a strong presence of Dionysian cults and mysteries (Bernabò Brea & Cavalier 1981; La Torre, 2019), so grounded on the Aeolian island and testified also by the innumerable Dionysian and theatrical iconographies present on the vessels of the necropolis of 4th century BC. In the light of this key-interpretation, it would be necessary to reconsider the meaning of this production in light of the figure of Dionysus, Greek god of the productive force of the earth and in particular of wine (one of the most important goods in ancient economy), whose right consumption, was synonymous with civilization and belonging to Greek cultural traditions (La Torre 2019, p. 10). Moreover, Dionysus was also worshipped as the god of the mask and theatre as well of symposia, funeral rites (Vernant & Vidal Naquet, 1985), vegetation and transformation. Considering that only a small circle of adepts was introduced to Dionysian mysteries, which could guarantee the heavenly beatitudes after physical death, these objects, might have been used as a *status symbol*, or linked to educational sphere, to passage rites in life and from life to death. In the wake of these suggestions, De Cesare and Portale (2019, p. 99-139) also re-evaluate the characters represented on the clay masks and figurines, on one hand, and the "theatrical" vases, in the frame of a Dionysian cult: the two scholars, throughout an iconographical and contextual analysis, demonstrate how in Lipari the theatrical imagery would be closely linked with young people/children and maidens, marking graves (and sometimes clusters) of untimely deads and acting as an "access key" to a new identity and role.

1.2. State-of-the-art

The technological progress of the last decade has significantly reduced the quality gap between the traditional big-size/bench-top instrumentation and portable ones. In the field of cultural heritage, this has opened many perspectives and applications of using handheld and portable devices (as laser-scanners, spectroscopes, XRF, etc.) to set up 'mobile laboratories' and perform 'in situ' analyses. The latter can be, in fact, particularly suitable in all those situations requiring a rapid and safe data acquisition (e.g. for the progressive documentation of archaeological excavations, or document artefacts exposed to destructive risk) (Alby et al. 2019) as well as to plan diagnostic or digitizing campaigns within archaeological areas or museums (Santos et al., 2017; Gonizzi Barsanti & Guidi, 2013; Hess & Robson, 2012).

If, on the one hand, moving artworks or finds from the place of preservation to specific laboratories can often result impossible or difficult (for their fragility, big sizes, risk of damage, lack of authorizations or other reasons), from the other hand the execution of metric and compositional analyses has become necessary and preliminary steps to any kind of intervention (restoring, exhibition, conservative interventions, etc.). Considering this, the use of compact instruments can be useful to overcome these difficulties.

The most requested technologies for in situ analyses include:

- Non-destructive chemical-physical investigations (portable Raman and FT-IR spectrometers, XRF, etc.) aimed at obtaining detailed information about the composition of materials (pigments, binding, media, etc.) and answering to specific diagnostic questions as well as attribution, dating or provenience (Bitossi et al., 2006; Clementi et al., 2009);
- Metric surveys aimed at generating three-dimensional and realistic reproductions of objects (Simon et al., 2009; Hess et al., 2012) performed by means of range-based tools as triangulation laser-scanners (fixed or mounted on mobile mechanical arms) and digital photogrammetry (an image-based technique), exploited in association with each other or independently (Russo et al., 2011).

Their deployments are having a great success among the different organisms involved in the study to conservation, up to fruition.

1. For museums, digitization and diagnostic campaigns in situ could be an opportunity to increase the information potential and the accessibility to collections (including not-exhibited artefacts) and to create ‘digital archives’ (containing all metric data and/or archaeometric analysis results) to be used as a basis for the study, restoration or dissemination (Nishanbaev, 2020);
2. Scholars and specialist can, instead, centralize the digitization of a great multitude of samples in the same place of their preservation (without any risk related to their transport), and then be able to manage and use the resulting data from anywhere;
3. Users can, instead, benefit from all these additional data and improve their experience of visiting.

2. Material and methods

2.1. The mask 11114-E from the tomb 1558

The mask No. 11114-E, belonging to the tomb No. 1558 (excavation XXXIV, 1973, Leone property), is the most peculiar and debating find of the whole class of findings. Attributable to the oldest group of masks, the specimen (7.8 cm frontal height) is the only one including two iconographies: it represents two different half-faces side by side. It was found as funerary equipment, within protection in raw clay together with a kylix, three small plates, an achromatic lamp and five theatrical masks. Inside the sarcophagus, there was also a bronze strigil with a double handle.

At the time of discovery the character on the left was not well visible (Fig. 2) as it was covered by a hard concretion of manganese dioxide (see Bernabò Brea & Cavalier, 1991, p. 79 ss., pp.108-109). Only after its removal, thanks to a restoration intervention promoted in 2017 by the former Director of the Museum, the presence of a smiling young half face, strongly different from that already visible and interpreted as Satyr (Bernabò Brea & Cavalier, 1981, p. 46) was highlighted.

This singular iconography makes the find unique not only in the context of the Aeolian Islands but in the whole Mediterranean landscape.

Figure 2: The mask 11114-E at the time of discovery (from Bernabò-Brea, 1981, p. 65).

(a)

(b)

Figure 3: (a) The double face represented by the mask 11114-E, visible after the restoration; (b) no breackline is visible on the rear.

An accurate description of the find, the first that refers to both the side of the mask, is provided by M.A. Mastelloni on the sidelines of a wider work dealing with the interpretation of the whole production (Mastelloni, 2018, p. 716, “Postilla”). The scholar describes the half face of the character on the right (Figs. 3a & 9) as a Silenus with receding hair, frowning forehead, big and raised eyebrow, grim look, rounded cheekbones, globular eye, marked iris and pupil, evident eyelids, broad-based snub nose, whisker long and pointed, open mouth, flat lower lip, beard with thin furrows, and goatee in relief. This figure, as can be noted by the proportions of the two faces, covers just over half of the right surface of the entire mask. The other half (Figs. 3a & 9) on the left represents a young and smiling character with wavy locks of hair that frame the forehead and reach the shoulder from the top of the head, thin eyebrows, elongated eye, marked eyelids, plump cheek, open mouth with evident lips and deep dimple on the chin. The construction of the figure, not so clear, can result more evident by looking at the profile of the piece and making a rotation around the horizontal axis.

The eyes, as in the whole Aeolian and some Athenian specimens (Schwarzmaier, 2011, 264, tav. 8 c/d), are naturalistic, with full globe and not pierced, unlike other specimens found in Megara Hyblaea, Syracuse, Paestum, or Athens itself.

The fusion of the two faces is very accurate that no line of discontinuity can be perceived: no thickening effects on the central axis (Fig. 3a,b) (element that may suggests the union of two parts coming from two independent matrices) can be observed. For this reason it is possible to hypothesize that the craftsman has specifically produced a matrix with two different half images.

In relation to the interpretation of the iconography, M. A. Mastelloni argues that the young face might belong to a male character, due to its physiognomy, and excludes that it could represent a satyr and a maenad. Following a hypothetic interpretation in a Dionysian key, the characters may be read as a Silenus (in the role of a pedagogue) next to his disciple. The association between the figure of the satyr next to the effigy of Dionysus, in fact, would precede chronologically the later herms, who combine a bearded satyr's head with that of a young crowned and smiling Bacchus (Mastelloni, 2018, p. 716).

Although no comparisons are known in the vast documentation already examined, it currently seems clear, as Mastelloni has underlined in her study, that the characteristics of the finding could hardly be attributed exclusively to the free imagination of the artist but it must take a particular meaning in relation to some religious worship or belief.

2.2. Geometric survey: instruments and procedures

In 2018, the mask has been subjected to a new survey deploying contactless and non-invasive methods, with the aim to record the morphological features of the piece and try to reconstruct the prototypes used as a model by the artist for the realization of each half face imprinted onto the matrix.

For this purpose, one of the most efficient 3D coordinate measuring machines (P-CMM) available on the market has been deployed: the laser scanner arm Quantum™ FaroArm produced by FARO - Europe GmbH & Co. KG (Fig. 4). It is a portable and device which can be simply used on-site as a digitizer or an advanced digital pen to measure and record the shape of an object in three dimensions.

Accuracy:	±25 μm (±0.001 in)
Repeatability:	25 μm, 2σ (0.001 in)
Stand-off:	115 mm (4.5 in)
Depth of field:	115 mm (4.5 in)
Effective scan width:	Near field 80 mm (3.1 in); Far-field 150 mm (5.9 in)
Points per line:	2000 points/line
Minimum point spacing:	40 μm, (0.0016 in)
Scan rate:	300 frames/second, 300 fps × 2000 points/line = 600,000 points/sec
Laser:	Class 2M
Weight:	485 g (1.1 lb)

Figure 4: The FaroArm and the laser line probe specification.

The choice of this system is justified by the features of the sample, as it can boast a wide application for the detection of small-sized objects with irregular and porous surfaces (as ceramic of archaeological interest), well documented in the literature (Barba, 2008; White, 2015). The high precision and accuracy of the FARO arm, in line with the most rigorous ISO 10360-12:2016 standards, is guaranteed by its advanced components, which include interchangeable probes (Faroblu™ laser line probe HD) and blue laser technology: the device, through a suitable optic, is able to produce a coherent and monochromatic light blade, which is detected by two CCDs (Charge-Coupled Device) and subsequently processed through a triangulation process. The blue laser by virtue of the shorter wavelength compared to red one is able to deliver improved scanning results with higher resolution and with a 50% reduction in speckle-noise, and to capture the smallest details. Once connected to a PC running Geomagic Wrap CAD software, the device is ready to acquire geometric data with a speed of over 600000 points per second and to show in real-time the resulting dense cloud.

The workflow, from the acquisition to processing, editing and exporting, (Fig. 5) has followed a standard methodology, where each step is reversible, repeatable and strictly linked to the previous one.

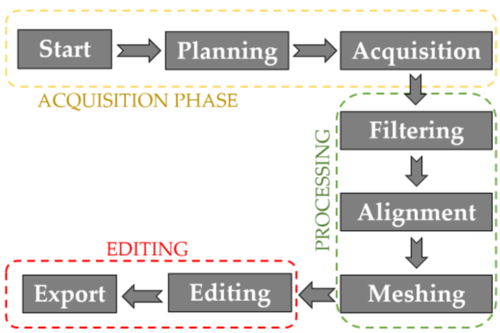


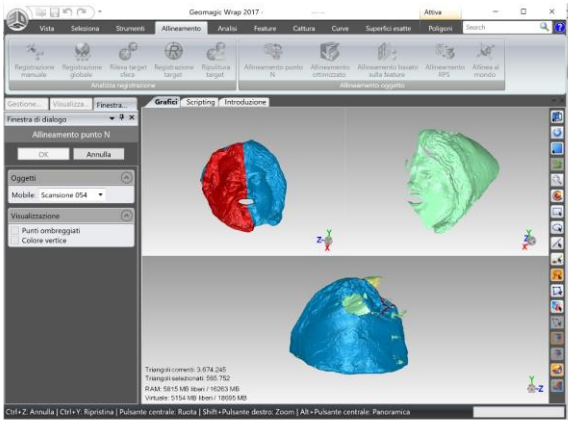
Figure 5: Diagram of acquisition, processing and editing.

The number of scans to be used on the sample has been determined by the need to obtain a model with no information gaps (holes) in the surface or shadow areas:

between one scan and another the mask was rotated on vertical and horizontal axes, keeping an overlay between adjacent scans at least equal to 30% (Fig. 6a).

Once the acquisition from different perspectives was completed and saved into a survey project, the processing has been developed in laboratory. The work-flow has been performed using the software Geomagic Wrap v. 2017.0.1 (Fig. 6b), as it offers a plenty of utilities and a user-friendly interface. This program has got also better capabilities in generating mesh surfaces starting from the point clouds and in handling the texture mapping of 3D models. One of the pros is that it offers several popular output file formats (WRP, STL, VRML, OBJ, PDF3D) increasing the portability between different photo-retouch, computer graphics, reverse engineering and 3D models management software, so that also freeware software users can read these files (cfr. Barba et al., 2011).

(a)



(b)

Figure 6: The image (a) shows the moment of the scan of the mask No. 11114-E; (b) the laser arm, suitably connected to a PC can display real-time the recorded point cloud and the operator can choose to do a first check registration on-site.

The processing stage followed several steps:

1. Filtering/registration of the single scans, and identification of at least three homologous points between every different scan (Fig. 6b), in order to merge all the different scans and to generate a single point of cloud model;
2. Elimination of the external scanned part, irrelevant to the archaeological reconstruction;
3. Generation of the 3D mesh, a triangulated irregular surface;
4. Visual inspection of the mesh surface in order to remove imperfections and fill small holes that can be generated by the algorithm;
5. Reduction of the number of polygons, by means of algorithms, in order to obtain a more smooth surface.
6. Sectioning of the mask along its vertical axis in order to isolate the halves of the faces belonging to the two characters;
7. Mirroring of each half of the mask and reconstruction of the two characters (Fig. 9);
8. Export of the final products. A light model, for web fruition has been uploaded into one of the most popular 3D platforms (accessible by everyone through this link: https://skfb.ly/6RuNM.

Between all export format, PDF/3D format deserves particular attention as it allows the visualization of the 3D final model with Adobe-Reader and also allows anyone to interact with the 3D model in an intuitive way by making linear and volumetric measurements or crossing section.

3. Results and discussion

3.1. Technical and qualitative aspects

The method and the workflow shown allowed to obtain, from a detailed 3D model of the sample, a hypothetical virtual reconstruction of each character composing the whole mask (Fig.9, the “satyr” and the “young”).

The result of the processing can give an idea of the level of detail this instrumentation is able to reach. The laser-scanner is, in fact, the most accurate methodology in defining the geometry of objects (and the only one suitable for all those activities, which require maximum precision as digital restoration): the accuracy of our final point-cloud has been evaluated through the calculation of the standard deviation, visible in Fig. 7. However, this version of instrument is lacking in photorealistic rendering, so it was necessary to acquire the original texture using digital photogrammetry, while a fake texture was applied to the final 3D model in order to enhance their feature and improve its reading.

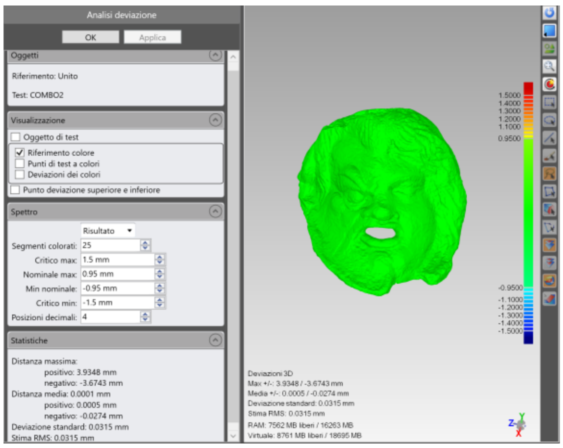


Figure 7: Standard deviation analysis of the model.

The laser-based and the photogrammetric model are, however, absolutely complementary to finally get an 'integrated model' (as well as demonstrated in the last literature the techniques can be combined in order to achieve the best advantages from different recording techniques (see Fazio & Lo Brutto, 2020).

3.2. Methodological aspects

Before concluding some considerations about the final 3D reconstruction are necessary: while the 'older' character represented on the right face is almost perfectly reconstructed in its entirety, thanks to the fact that it occupies more than 50% of the front surface of the entire mask, the 'young' on the left side has smaller dimensions and a slightly different inclination. This peculiarity was already appreciable in the original sample and even more evident in our 3D model, where the reconstruction of the nose seems to belong almost entirely to the figure with silenic features; also the beard and goatee have left some trace in the reconstruction of the youthful face, so that in the 3D reconstruction of the young man it turns out to be a little unnatural.

A second consideration concerns the limits of this technique of virtual reconstruction, unlike what may be obtained from a virtual restoration aimed to integrate small missing parts: in this case, the result obtained is not the real representation the two characters (never existed as a single), but rather a hypothetical reconstruction functional to simplify and enhance the reading of the ideal models of the two characters, not so evident in the original sample. The third element to keep in mind reading the two reconstructive models is that the other single-faced masks never have the two halves perfectly mirroring each other, but, on the contrary, by virtue of the expression they wanted to convey, they were deliberately shaped with strong differences in their two profiles (already present in the matrices). For this reason, any attempt to find a comparison between the two reconstructions obtained through this technique is doubtless strongly spoiled by this element; nevertheless, it is possible to isolate some types of masks which, although not identical, presents morphological and dimensional characteristics comparable with ours. These common elements might however constitute starting points to improve the chronological and stylistic attribution of our sample, and its interpretation.

3.3. Interpretative aspects

As already suggested by M.A. Mastelloni, the iconography of the old character with silenic feature, always interpreted as a Satyr (Bernabò Brea, 1981, p. 46 n. B2, fig. 34) or as "precursor of Lykomédeios" (in Bernabò Brea & Cavalier, 1981, p. 65, fig. 59), can be compared with the mask inv. 2343 A (MTL, 45, B1, tav. IX and Fig. 18, inv. From T. 449; fr. Inv. 3075, Tr. XXIII - III) and with the Mask 9729 (Fig. 8b). The second iconography, undocumented, has been resulted similarly to that of the larger mask inv. 10829 A, T. 1315 (MTL, A 8, "Laius"), of which, however, it does not share the plastic performance of the facial muscles and to the other, female and of smaller dimensions (inv. 11114-B) coming from the same T. 1558 (Bernabò Brea & Cavalier, 1981, Fig. 58, C 10, Fig. 54) and well-matched in dimensions (Fig. 8a).

Judging the archaeological documentation provided by the necropolis of the Diana district, we agree with Bernabò Brea and La Torre that the only key to currently interpret this mask, as well as all the rest of the production, is to read them within the frame of the cult of Dionysus, highly developed in Lipari from the 4th century BC. Despite the absence of explicit literary sources, it is, however, suggested by the presence, other than of the same theatrical terracotta, of the Dionysian and theatrical iconographies on the vessels coming from the necropolis (see e.g. crater of the painter of Adrasto from tomb 1155 with the theatrical scene).

(a) (b)

Figure 8: (a) Mask 11114-B (h. 7.2 cm) from tomb 1558; (b) Mask 9729 (h. 7.9 cm).

4. Conclusions

The study-case reported shows the potential of creating 'mobile laboratories' inside museums using portable instruments in order to study and document archaeological artworks and findings: specifically a peculiar theatrical mask belonging to the wide collection of Greek find of the Museum has been measured by means of a performing 3D laser scanner.

Despite all the reconstructive limits explained above, the method used allowed to obtain a detailed 3D model and a virtual reconstruction of the artefact, useful for various purposes: metrological analyzes, research, conservation status, monitoring, computer cataloguing, test of restoration activities (without intervening directly on the object), creation of a virtual museum accessible remotely by Internet, promotion, interactive fruition of unexposed pieces.

One of the advantages of digitalization is that the final model will remain always available to scholars, and if printed in 3D, it can help to prevent the wearing caused by repeated handling of original pieces (Tucci & Nobile, 2011). Furthermore, due to digital supports, it is possible to explore heritage in a new interactive way (e-learning, video games, multi-modal interfaces, etc.) (Bertacchini et al., 2007). It could be a revolution for students, scholars and potential users unable to reach Museums or archaeological sites.

Regarding this aspect, we have to underline how the use of technologies has also become essential in the process of re-evaluating the role of cultural heritage, no longer seen as the exclusive domain of specialized scholars, but as an economic resource to be exploited for the growth of local communities and regions: digitization, can, in fact, help to spread the knowledge about ancient artworks and guarantees that they will be passed to future generations.

Since a large number of exhibits have already been acquired and processed (Giuffrida et al., 2019) and many more will be acquired in the future, the next goal is to

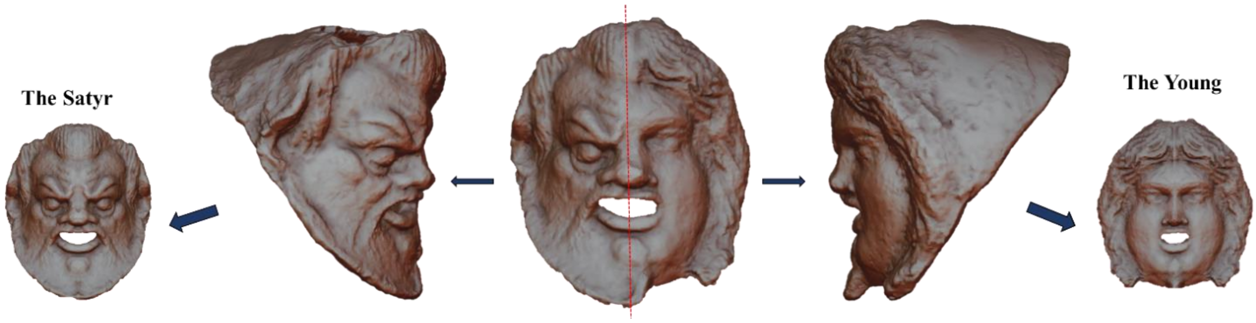


Figure 9: 3D reconstruction of the mask 11114-E; and hypothetical virtual reconstruction of the two characters.

create a database where 3D models can be stored for study purposes; at the same time, the plan is to create an interactive online showcase where the archaeological information and the results of the analyzes are associated with the 3D models.

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