

INVESTIGATING GREEK PAINTED ICONOLOGY BY USING ARTIFICIAL NEURAL NETWORKS. MAENADS AND SATYRS ON ATHENIAN RED-FIGURE POTTERY

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1. INTRODUCTION

In the history of the studies on Athenian vase-painting, both the identity of the figures named “maenads” and the nature of their interactions with the satyrs have always been subjects of intense debate. The research here presented aims at exploring both the identity of the maenads and their multiple interactions with the satyrs on Athenian red-figure vases, moving from the necessity to formalise and abstract the different and often contrasting elements composing each iconographic picture (MOSCATI 1984, 1994a, 1995, 72-82).

This chapter presents the preliminary results of an ANN-based analysis applied to a dataset of 114 Athenian red-figure representing 478 figures (maenads and satyrs). Artificial Neural Networks, which have already been applied with encouraging results to different problems in Archaeology and History of Art, represent an innovative tool for the organisation, visualisation and analysis of complex data (RAMAZZOTTI 2010, 128-170; 2013). Technical definitions and data analysis have been conducted by Massimiliano Capriotti; Juliette Wayenberg has conducted the other parts of the present research, thanks to the great support and critical advices of Prof. M. Ramazzotti and Prof. M. Galli.

The interpretation of the huge amount of data has helped highlighting several interesting elements of the iconography of maenads and satyrs. The analysis has been carried out through the study of both the results and the various modern theories expressed by scholars.

2. STATE OF THE ART

The figures named “maenads” or “bacchae” are variously interpreted by modern scholars. The female companions of the satyrs are generally identified either as maenads (MCNALLY 1978; KEULS 1984; BÉRARD 1992) or as nymphs (HEDREEN 1994; CARPENTER 1997) according to their interpretation as human or as mythical figures: the maenads would be the human devotees of Dionysus, while the nymphs would always be mythical figures, personifications of the wild spaces, just as the satyrs. Some scholars simply call them “women” avoiding any further identification as nymphs or as maenads, and considering such rigid distinction between real and imaginary characters inapplicable to the

imagery (LINDBLOM 2011). Maenads have been considered to become hostile to the satyrs' sexual approach at the beginning of red-figure technique and such escalation of the hostility is supposed to reflect the arising of gender tensions in classical Athens (MCNALLY 1978). Some scholars (HEDREEN 1994; NEILS 2000) argue that the maenads/nymphs would always react with hostility to the satyrs' approaches: in such perspective, the satyrs would sexually harass the maenads but never achieve their goal with them (NEILS 2000).

Some other authors interpret the relationships between maenads and satyrs as the reflection of actual Dionysian rituals. The sexual hostility between maenads and satyrs would represent rites of antagonism that offered Athenian women a possibility to relieve from the tensions caused by their everyday subjection to male domination (KEULS 1984). According to Bérard, the erotic features of the satyr-maenad interaction should be considered as the visible part of a Dionysian mysteric ritual including the sexual union of satyr-dressed men and maenad-dressed women (BÉRARD 1992).

Approaching the subject with a quantitative methodology, LINDBLOM (2011) suggests that the relationships between the satyrs and their non-identified female companions are multiple and cannot be entirely attributed to the hostility type. The application of descriptive statistics is not unknown in iconographic studies. Though, the further application of advanced Knowledge Management and Knowledge Representation tools and methodologies in the archaeological research is offering new and interesting elements for the understanding of complex systems (SIGNORE *et al.* 2005). Di Ludovico has pointed out the importance of a non-linear approach for another iconographic question (the presentation scenes on Ur seals), in order to recognise the structural relationships existing between the different elements whilst ignoring the interpretations and prejudices of ancient and modern literature (DI LUDOVICO 2011).

In a previous phase of the research (WAYENBERG in press) descriptive statistics and chi-square tests were applied to the iconographic analysis of a selected database in order to redefine the identity of maenads and satyrs by means of their appearance (clothing and hairstyle), and the possible nature of their multiple interactions. The chi-square tests applied to different groups of two variables ascertained the significance of the distribution of many variables among the five analysed periods, highlighting a strong association between iconographic features and time and, in some cases, an evolutionary trend in the iconography of maenads and satyrs. Specifically, on the one hand the appearance of maenads and satyrs and the maenads' reaction to the satyrs' approach were demonstrated to vary significantly among the five analysed periods.

On the other hand, some variables highlighted an evolution in the iconographic definition of the figures, through the diffusion of characteristic iconographic elements, like the presence of the *thyrsus* as a maenadic attribute, the growing amount of non-ithyphallic satyrs and the diffusion of

the contemporary Athenian women's wardrobe for the representation of the maenads' appearance, which could be interpreted in terms of an always better distinction between nymphs and maenads on Athenian vases. Indeed, and as seen above, although the rigid distinction between maenads and nymphs is not always certain – and it is not always ascertained that there was, for the vases' users, a clear distinction between them – we have chosen to analyse only the characterised “maenads”, interpreted as creations of the imaginary, identified by some precise elements and not specifically defined as mythical characters.

3. OBJECTIVE OF THE RESEARCH AND METHODOLOGY

The framework of maenads and satyrs representations on Athenian red-figure vases is complex and many and contrasting are their modern interpretations. The aim of the present research is to contribute to the research on the identity of the figures represented on vases during a chronological period ranging from the beginning of red-figure technique to the end of the 5th century. BC and to explore the nature of their multiple interactions. Therefore, we have applied innovative ANN-based methodologies to a formalised dataset of statistically selected vases.

3.1 Dataset

The inclusion criterion is the presence, on each vase, of at least one satyr and one identified maenad. Maenads are identified by either Dionysian attributes (*thyrsus*, *nebris* or *pardalis*, ivy wreath) or by the presence in the field of the idol of Dionysus or of at least one maenad identified by Dionysian attributes. All the female figures represented without any attribute or accompanied only by satyrs have been considered as possible nymphs and thus excluded from the analysis. The vases were first selected from the Beazley Archive using a period-based statistical stratified method (10% of all vases for each period), based on the postulate that a 10% sample is to be considered statistically relevant, and then organised into a database. The dataset is composed of 114 Athenian red-figure vases, with 96 variables related to both shape (period, painter, function) and figures (appearance, hairstyle, behaviour, relationship).

3.2 Variables

Tab. 1 (a, b, c) presents the variables defined for the creation of the dataset, together with their frequency in terms of number and percentage.

The following variables require a specific definition and/or presentation:

1) Vases

– *Shapes*: five classes were defined according to the shape's primary function: drinking shapes (*kylix*, *skyphos*, *rhyton*, *kantharos*); mixing shapes (*stamnos*,

MacroLabel	Variables	Variables Label	Frequency	%
Shape	Serving	SHAPE_Serving	29	25.4
	Mixing	SHAPE_Mixing	31	27.2
	Drinking	SHAPE_Drinking	48	42.1
	Hydria	SHAPE_Hydria	5	4.4
	Lekythos	SHAPE_Lekythos	1	0.9
Environment	Anthropic	ENV_Anthropic	13	11.4
	Natural	ENV_Natural	14	12.3
	Both	ENV_Both	13	11.4
	None	ENV_None	74	64.9
Other Representation	Dionysiac	OT_REPR_Dionysus	44	38.6
	Myth	OT_REPR_Myth	9	7.9
	Daily Life	OT_REPR_Daily Life	39	34.2
	None	OT_REPR_None	24	21.1
Of which: Daily Life	Youth	DLIFE_Youth	18	15.8
	Men	DLIFE_Men	9	7.9
	Women	DLIFE_Women	9	7.9
	Hetaira/e	DLIFE_Hetair*	1	0.9
	Symposium	DLIFE_Symposium	5	4.4
	Theatre	DLIFE_Theatre	2	1.8
	War	DLIFE_War	4	3.5
Period	1	P1	11	9.6
	2	P2	24	21.1
	3	P3	36	31.6
	4	P4	29	25.4
	5	P5	14	12.3
Other Figures	Dionysus	SHAPE_Dionysus	22	19.3

a

MacroLabel	Variables	Variables Label	Frequency	%
Satyrs' Appearance	Naked-Ithyphallic	S_APP_Naked-Ithyphallic	31	27.2
	Naked-Not-Ithyphallic	S_APP_Naked-Not-Ithyphallic	85	74.6
	Citizen	S_APP_Citizen	3	2.6
Satyrs' Hairstyle	Beard	S_HAIR_Beard	110	96.5
	Beardless	S_HAIR_Beardless	10	8.8
Satyrs' Attributes	Thyrus	S_ATT_Thyrus	22	19.3
	Nebris	S_ATT_Nebris	16	14.0
	Ivy Wreath	S_ATT_Ivy Wreath	20	17.5
	Vase	S_ATT_Vase	27	23.7
	Branch	S_ATT_Branch	1	0.9
	Animals	S_ATT_Animals	2	1.8
	Torch	S_ATT_Torch	8	7.0
	Instruments	S_ATT_Instr	20	17.5
	Satyrs' Behaviour	Quiet	S_BEHAV_Quiet	36
Slow Movement		S_BEHAV_SlowMov	34	29.8
Quick Movement		S_BEHAV_QuickMov	76	66.7
Music		S_BEHAV_Music	16	14.0
Wine Service		S_BEHAV_WineService	8	7.0

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	Dance	S_BEHAV_Dance	12	10.5
Satyrs' Action	Eye Contact	S_ACT_EyeContact	72	63.2
	Cordial	S_ACT_Cordial	42	36.8
	Grabbing/Grabbed	S_ACT_Grabb	37	32.5
	Approaching/ Approached	S_ACT_Appr	19	16.7
	Extended Hand	S_ACT_ExHand	50	43.9
	Physical Contact	S_ACT_PhysContact	8	7.0
	Procession	S_ACT_Procession	6	5.3
	Symposium	S_ACT_Symposium	5	4.4
	Dance	S_ACT_Dance	11	9.6
	Following/Followed	S_ACT_Foll	34	29.8
	Trying To Release	S_ACT_TryingToRelease	2	1.8

b

MacroLabel	Variables	Variables Label	Frequency	%
Maenads' Appearance	Naked	M_APP_Naked	6	5.3
	Open Chiton	M_APP_Open Chiton	12	10.5
	Citizen	M_APP_Citizen	97	85.1
	Winged Arms	M_APP_Winged Arms	10	8.8
Maenads' Hairstyle	Tied	M_HAIR_Tied	64	56.1
	Untied	M_HAIR_Untied	48	42.1
	Sakkos-Mitra	M_HAIR_Sakkos-Mitra	33	28.9
	With Diadem	M_HAIR_Diadem	34	29.8
Maenads' Attributes	Thyrsus	M_ATT_Thyrsus	106	93.0
	Nebris	M_ATT_Nebris	46	40.4
	Ivy Wreath	M_ATT_Ivy Wreath	26	22.8
	Snake	M_ATT_Snake	19	16.7
	Vase	M_ATT_Vase	20	17.5
	Branch	M_ATT_Branch	7	6.1
	Animals	M_ATT_Animals	15	13.1
	Instruments	M_ATT_Instr	13	11.4
Maenads' Behaviour	Asleep	M_BEHAV_Asleep	8	7.0
	Quiet	M_BEHAV_Quiet	42	36.8
	Slow Movement	M_BEHAV_SlowMov	15	13.2
	Quick Movement	M_BEHAV_QuickMov	67	58.8
	Ecstatic	M_BEHAV_Ecstatic	7	6.1
	Music	M_BEHAV_Music	10	8.8
	Wine Service	M_BEHAV_WineService	11	9.6
	Dance	M_BEHAV_Dance	15	13.2
Maenads' Relationship	Friendly	M_REL_Friendly	58	50.9
	Ambiguous	M_REL_Ambiguous	62	54.4
	Hostile	M_REL_Hostile	16	14.0
	None	M_REL_None	26	22.8
Maenads' Action	Eye Contact	M_ACT_EyeContact	71	62.3
	Cordial	M_ACT_Cordial	40	35.1
	Grabbing/Grabbed	M_ACT_Grabb	36	31.6

MacroLabel	Variables	Variables Label	Frequency	%
	Approaching/ Approached	M_ACT_Appr	19	16.7
	Extended Hand	M_ACT_ExHand	36	31.6
	Physical Contact	M_ACT_PhysContact	5	4.4
	Procession	M_ACT_Procession	7	6.1
	Symposium	M_ACT_Symposium	4	3.5
	Dance	M_ACT_Dance	14	12.3
	Following/Followed	M_ACT_Foll	34	29.8
	Trying To Release	M_ACT_TryingToRelease	23	20.2

c

Tab. 1 – Macro-labels, variables, variables labels, frequency and % of: a) Vases; b) Satyrs, and c) Maenads.

krater); serving shapes (amphora, *chous*, *oinochoe*, *pelike*, *kyathos*); water shape (*hydria*); domestic or funerary shape (*lekythos*).

– *Other representation*: other scenes eventually present on different parts of the vase were divided into mythical (when there is a clear mythical component), Dionysian (with the exclusion of the clearly mythical scenes), daily life (divided into seven daily life categories) and none.

– *Periods*: the five periods were defined according to Cook (COOK 1997): 1 (530-500 BC), 2 (500-480 BC), 3 (480-450 BC), 4 (450-425 BC) and 5 (425-400 BC).

– *Other figures*: presence or absence of Dionysus.

2) Figures

– *Satyrs' appearance*: satyrs can be either naked ithyphallic, naked not ithyphallic, or citizens (when wearing a *himation*).

– *Maenads' appearance*: maenads can be either citizens (when wearing a *chiton*, a *himation* or both), naked, with open *chiton* (when the dress is not entirely covering the legs) or with winged arms (when the arms are covered by the dress' sleeves).

– *Maenads' hairstyle*: tied, untied, with *sakkos* or *mitra* (when the hair are covered), with diadem (other than the ivy wreath).

– *Satyrs' behaviour*: quiet (immobile), slow movement (walking), quick movement (dancing or running); music, wine service, dance.

– *Maenads' behaviour*: asleep, quiet, slow movement, quick movement, ecstatic (defined by violent movements of the head or upper body forward and backward and rotating movements, as stated by Delavaud-Roux (DELAUVAUD-ROUX 1991, 2006); music, wine service, and dance.

– *Maenads' relationship*: defines the maenads' reaction to the satyrs' approach, which is either hostile (when the maenad reacts with clear violence to the satyr's approach, by pointing a weapon against him or by violently trying to

release herself from his contact); friendly (when there is a clear non violent interaction between the figures); ambiguous (when the maenad reacts with no clear violence or does not react to the satyr's approach); none (when there is no interaction between the figures).

3.3 Pre-processing

The pre-processing consisted in the creation of a unique dataset including both shape and figures variables, by attributing the figures variables to the shapes dataset. Each record corresponds to one vase, and the figures variables register the amount of each variable (appearance, hairstyle, etc.) per vase. We then grouped the variables into labelled macro-variables, and attributed labels to each variable for the data representation (Tab. 1).

3.4 Type of analysis

Thanks to Massimiliano Capriotti, we have been able to apply two different levels of analysis to the weighted Minimum Spanning Trees (MST) of the dataset whose weights are based on the Artificial Neural Network Auto Contractive Map (Auto-CM) designed by Prof. Paolo Massimo Buscema at the Semeion Research Center of Sciences of Communication (BUSCEMA, GROSSI 2007, 3457-63; 2008, 362-404; BUSCEMA *et al.* 2008a, 481-98; 2008b). All the elaborations here reported were performed with the research software ARCHEOSEMA Lab 1.0, written in C++ for Windows and created by Massimiliano Capriotti for the AA&AAS Laboratory at La Sapienza University of Rome. The MST produced by ARCHEOSEMA Lab are visualised and manipulated by the open-source software GEPHI v. 0.8.1, an interactive visualisation and exploration platform for all kinds of networks and complex systems, dynamic and hierarchical graphs (<https://gephi.org/>).

A Minimum Spanning Tree is a graph for data classification that is composed of a set of nodes and of a set of undirected edges connecting the nodes. The objective of a MST is to connect all the nodes in an acyclic graph, i.e. by using the minimum amount of connection values (weights), in order to help capturing the key essential information of a dataset without losing any essential information. The nodes of the MST are the entities of a dataset, in this case the variables. Through the weighted MST, we can thus define and display in a graph the network of associations that transform the entities into a structure containing the relevant correlations between the dataset entities, in order to create a coherent picture where the proximity between the entities and the strength of the connections reflect their associations. The two different levels of analysis here presented are:

1) Analysis of the global importance of the variables within the graph, through the analysis of Betweenness Centrality and Mean Weighted Degree of nodes.

The Betweenness Centrality is a measure of the centrality of a node within a graph and, when combined to other statistical measures, of the overall importance of this node for the network. In a weighted network, the edges connecting the nodes are not considered as binary interactions, but they are weighted proportionally to their capacity, influence, frequency, etc., adding another dimension of heterogeneity to the network. The Mean Weighted Degree of nodes is the sum of the connection values per node (rather than the presence/absence of connections). In a graph, the mean weighted degree allows to represent the importance of each node within the network. The analysis of the overall importance of the nodes, applied through the study of the variables with highest and lowest Betweenness Centrality and Weighted Degree values, offers many interpretative possibilities and a huge amount of expected and unexpected results. The expected results are those obtained when the representation of the variables in terms of frequency in the dataset corresponds to their high or low importance within the graph, expressed by their values of Betweenness Centrality and Mean Weighted Degree. The unexpected results are, on the contrary, those obtained when the values of Betweenness Centrality and Weighted Degree do not correspond to the frequency of the variables within the dataset.

2) Analysis of the clusters created by Modularity and of their evolution (persistence and modification) obtained by changing the resolution coefficient. Modularity is a clustering tool that identifies, within the network, different clusters (or “modules”), associating each node of the network to one of the modules. Clustering is a mathematical process in which different elements in a particular network are grouped together based on certain similarities between the different elements. Thus, Modularity helps to identify sub-networks within the network and to display in a graph how the nodes of a network are forming self-contained modules. A modularity value of 1 would suggest that the nodes are perfectly connected to other nodes forming self-contained clusters, while a value of 0 would suggest the opposite. The Modularity analysis allows to view the cluster to which each node has been associated with. In order to create the clusters, it is necessary to set the parameter of the resolution coefficient, from the default value of 1:0 to growing values providing a smaller amount of bigger clusters. The MSTs obtained with Modularity for a resolution coefficient growing from 1 (default) to 6 will be presented. The analysis of the differences and/or similarities in the evolution of the clusters obtained with different resolution coefficients furnishes different interpretative information. The analysis of the nodes with the highest values of Mean Weighted Degree within the clusters defined by the different Modularities consents to measure the local importance of the nodes as the centres of the connections of each sub-network. Therefore, the analysis of the weighted degree within the clusters consents to evaluate the local importance of a node in a defined sub-structure.

4. RESULTS OF THE DATA PROCESSING

4.1 The importance of figures as central nodes

Figs. 1 and 2 present respectively the Betweenness Centrality and the Mean Weighted Degree of nodes of the variables. The central nodes are here graphically presented. Tab. 2 presents the ten highest values of Betweenness Centrality (a) and Mean Weighted Degree (b), respectively. Six variables relating to the figures' appearance and behaviour are present among the highest values of Betweenness Centrality and Mean Weighted Degree. They are, for the satyrs, the beard (S_HAIR_Beard: 223 items, 93% of all satyrs), which is also the centre of the network, the appearance "naked not ithyphallic" (S_APP_Naked-Not-Ithyph: 166 items, 69%) and the "quick movement" behaviour (S_BEHAV_QuickMov: 138 items, 58%). Those are all expected results since they reflect the frequency of the variables within the dataset. For the maenads, the highest values belong to the citizen appearance (M_APP_Citizen: 196 items, 82% of all maenads), the action "dance" (M_ACT_Dance: 25 items, 10%) and the untied hair (M_HAIR_Untied: 89 items, 37%). Two unexpected results are: 1) the absence, among the highest values, of the tied hair (M_HAIR_Tied: 96 items, 40%), and the presence, instead, of the slightly less frequent untied hair; 2) the presence of the dancing maenads, which is quite poorly represented in the dataset, in the list of highest values.

The combined analysis of Betweenness Centrality, Mean Weighted Degree and Modularity consents to define the local importance of each one

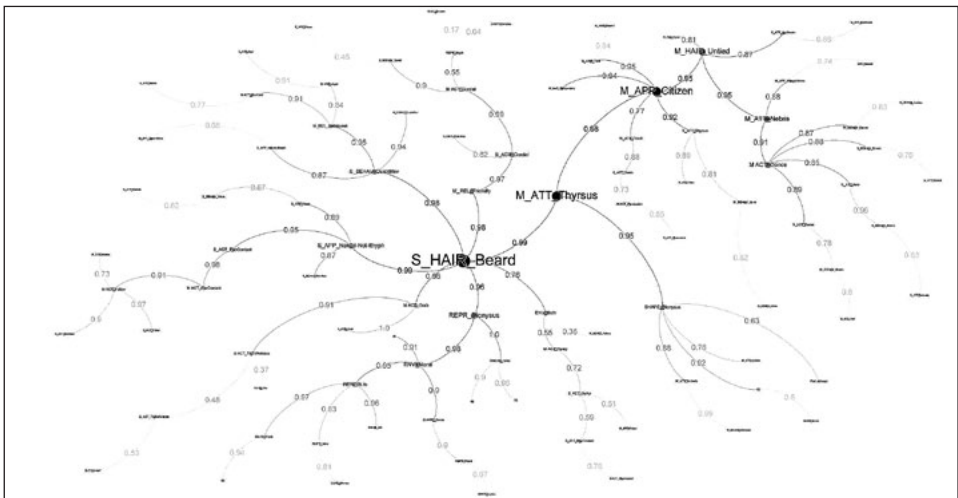


Fig. 1 – Betweenness Centrality.

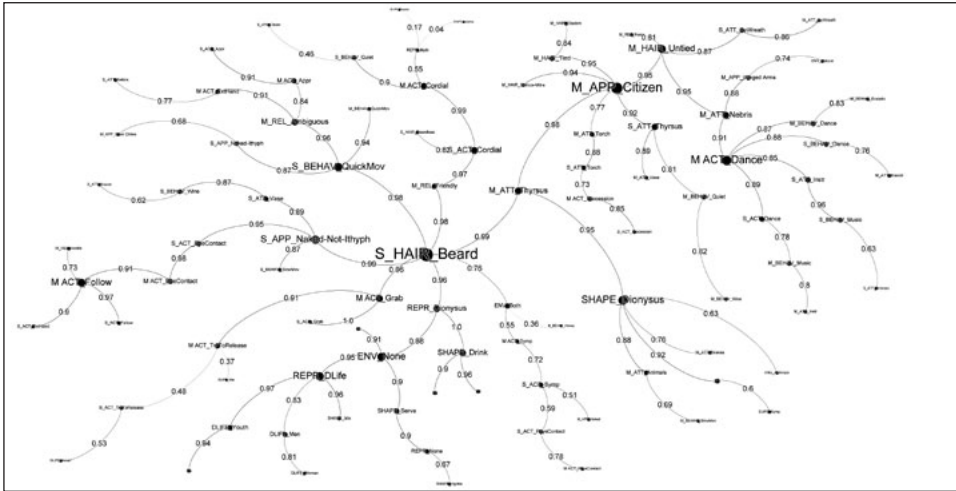


Fig. 2 – Mean Weighted Degree of Nodes.

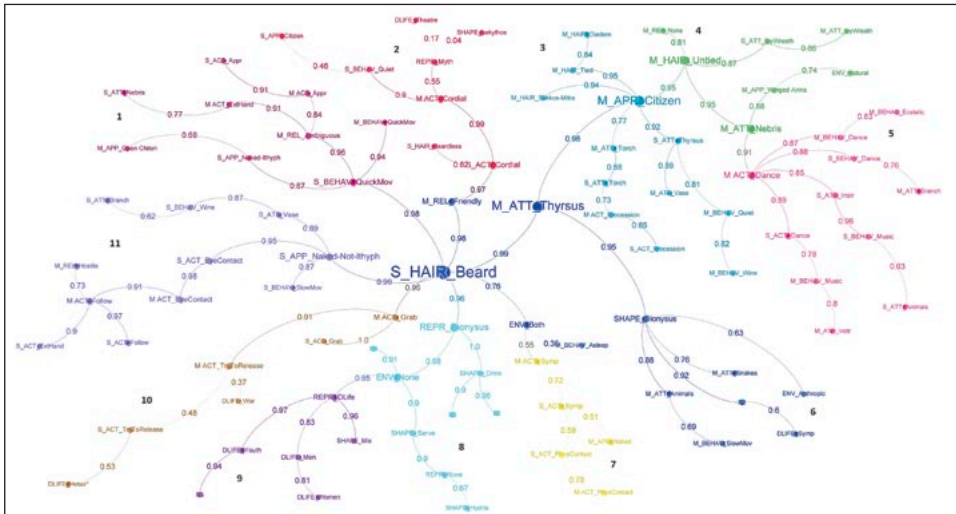


Fig. 3 – Modularity 1.

of those variables within the sub-structures (clusters) created by Modularity. Fig. 3 displays the first level of the Modularity analysis: with a resolution coefficient of 1, eleven clusters are defined. We can observe that the six

Variable	Label	BetC.
Satyrs : Beard	S_HAIR_Beard	0.78
Maenads : Thyrsus	M_ATT_Thyrsus	0.53
Maenads : Citizen	M_APP_Citizen	0.48
Maenads : Untied Hair	M_HAIR_Untied	0.30
Vases : Other Repr : Dionysiac	REPR_Dionysus	0.26
Maenads : Nebris	M_ATT_Nebris	0.24
Maenads : Dance	M_ACT_Dance	0.20
Vases : Environment : None	ENV_None	0.20
Satyrs: Naked not ithyphallic	S_APP_Naked-Not-Ithyph	0.20
Satyrs : Quick Movement	S_BEHAV_QuickMov	0.16

a

Variable	Label	WDeg.
Satyrs : Beard	S_HAIR_Beard	6.62
Maenads : Citizen	M_APP_Citizen	5.50
Maenads : Dance	M_ACT_Dance	4.40
Vases : Other Figure : Dionysus	SHAPE_Dionysus	4.13
Satyrs : Quick Movement	S_BEHAV_QuickMov	3.75
Vases : Environment : None	ENV_None	3.74
Vases : Other Repr : Daily Life	REPR_DLife	3.70
Satyrs: Naked not ithyphallic	S_APP_Naked-Not-Ithyph	3.70
Maenads : Untied Hair	M_HAIR_Untied	3.58
Maenads : Following/Followed	M_ACT_Follow	3.51

b

Tab. 2 – The ten highest values of: a) Betweenness Centrality (BetC.) and b) Weighted Degree (WDeg.)..

Cluster Nb.	Central Node	Variable	WDeg.
1	S_BEHAV_QuickMov	Satyrs : Quick Movement	3.75
2	S_ACT_Cordial	Satyrs : Cordial	2.78
3	M_APP_Citizen	Maenads : Citizen	5.50
4	M_HAIR_Untied	Maenads : Untied Hair	3.58
5	M_ACT_Dance	Maenads : Dance	4.40
6	S_HAIR_Beard	Satyrs : Beard	6.62
7	S_ACT_Symp	Satyrs : Symposium	1.81
8	ENV_None	Vases : Environment : None	3.74
9	REPR_DLife	Vases : Other Repr : Daily Life	3.71
10	M_ACT_Grab	Maenads : Grabbing/Grabbed	2.87
11	S_APP_Naked-Not-Ithyph	Satyrs: Naked not ithyphallic	3.70

Tab. 3 – Modularity 1: Clusters, Central Node, Corresponding Variable and Weighted Degree value (WDeg.).

figures variables with the highest values of both Betweenness Centrality and Mean Weighted Degree constitute the central nodes of different clusters, as highlighted in Tab. 3.

Variables	Nodes	WDeg.
Satyrs: Quick Movement	S_BEHAV_QuickMov	3.75
Maenads: Ambiguous	M_REL_Ambiguous	2.71
Maenads: Approaching/Approached	M_ACT_Appr	1.75
Maenads: Extended Hand	M_ACT_ExtHand	1.68
Satyrs: Naked Ithyphallic	S_APP_Naked-Ithyph	1.55
Maenads: Quick Movement	M_BEHAV_QuickMov	0.94
Satyrs: Approaching/Approached	S_ACT_Appr	0.91
Satyrs: Nebris	S_ATT_Nebris	0.77
Maenads: Open Chiton	M_APP_Open Chiton	0.68

Tab. 4 – Cluster 1, Modularity 1-3: Nodes and Mean Weighted Degree.

Degree. With Modularity 4, this group of variables is absorbed by the big cluster focused on the satyrs' beard (see *infra*, Fig. 5). As presented in Tab. 4, Cluster 1 does also include various maenads' variables, first of all the ambiguous reaction to the satyrs' approaches: we can therefore consider that the quick movement and ithyphallic iconographic elements are strongly correlated to the type of reaction enacted by maenads.

Cluster 6 is focused on the global central node, the satyrs' beard, but its inner structure appears to be poorly compact. Indeed, the nodes belonging to the bearded satyr's cluster change with each modification of the resolution coefficient. At Modularity 1 and 2 it contains the node of the *thyrsus* as a maenadic attribute, which is then absorbed in the cluster focused on the maenads' citizen appearance. Fig. 4 presents the Modularity graph obtained with a resolution coefficient of 3, and shows the evolution of the clusters into six bigger clusters. Cluster 11 of Modularity 1 (Fig. 3) is focused on the non ithyphallic appearance of the satyrs, and does not present a strong structure. As soon as Modularity 2 part of Cluster 11 is absorbed by Cluster 2; at Modularity 3 the whole Cluster is part of Cluster 2 (Fig. 4). The evolutions of Clusters 1 and 11 of Modularity 1 and their alternating inclusion in the bigger Cluster 2, which is focused on the bearded satyrs, between Modularity 3 and 4 is presented in Fig. 5. It is interesting to note that at Modularity 4 the inclusion of Cluster 1, which is focused on the quick movement and includes the ithyphallic satyrs, implies the exclusion of the group based on the non-ithyphallic appearance of the satyrs, which now forms Cluster 1. Therefore, the ithyphallic and non-ithyphallic appearances are maintained in different clusters (respectively 1 and 11 of Modularity 1; 1 and 2 of Modularity 3; 2 and 1 of Modularity 4) until Modularity 5.

Another interesting result is the association, in Cluster 11, of non-ithyphallism and other dignifying elements of the iconography of satyrs with the clearly hostile reaction of the maenads. This association splits with Modularity

2, when the sub-group focused on the hostile maenads are forming a small, independent cluster, but reunite at Modularity 3, as shown in Fig. 4. As presented in Tab. 3 and Fig. 3, the small Cluster 2 is focused on the satyrs' cordial action and it includes three peripheral vases variables and four variables related to figures' appearance and behaviour: the maenads' cordial actions, the citizen and the beardless satyrs, and the quiet behaviour of the satyrs. It is interesting to note that, while in the general structure of the graph the same behaviour and actions related to the two figures are often directly correlated, in this case the quiet behaviour of the maenads is classified in another cluster (Cluster 3) until Modularity 6. Cluster 2 is absorbed by Cluster 6 since Modularity 2.

4.3 *The citizen maenads and other variables*

As seen in Fig. 3, the central node of Cluster 3 is the citizen appearance of the maenads. The Cluster maintains its inner structure for only two levels of Modularity (1 and 2), then it includes the sub-group focused on the *thyrsus* and remains stable until Modularity 5. The *thyrsus* as a maenadic attribute (M_ATT_Thyrsus: 165 items, 69% of all maenads) presents, as expected and in conformity with its high frequency, the second highest value of Betweenness Centrality but, unexpectedly, it is not even present among the highest Mean Weighted Degree values. Another unexpected element is represented by the evolution of the *thyrsus*' inclusion in different clusters: at Modularity 1 and 2, the *thyrsus* is part of the Cluster focused on the bearded satyrs (Fig. 3); from Modularity 3 to 5 (Fig. 4) it is included, more logically, in Cluster 3, which comprises many maenadic elements; at Modularity 6, with the final visualisation of three big clusters, the *thyrsus* returns, surprisingly, to be correlated with the bearded satyr (Fig. 6). The general evolution of Cluster 3 at Modularity 3 is exposed in Fig. 4. Two sub-clusters that steadily remain in Cluster 3 might inform us on the cultural relationships of satyrs and maenads: the first is composed of torch and procession, the second is focused on the *thyrsus* as a satiric attribute. Tab. 5 displays the nodes contained in Cluster 3, classified by their Weighted Degree values, for Modularity 1-2 (a) and 3-5 (b).

Clusters 4 and 5 of Modularity 1 are respectively focused on the untied hair and on the dance action of the maenads. They both include various alterity variables, such as the attribute of the animal skin (*nebris*) and the ecstatic behaviour. Cluster 4, which is focused on the untied hair, is also correlated to the absence of reaction of the maenads to the satyrs' approaches. Since Modularity 2 the two small clusters merge and form bigger Cluster 4 (Fig. 4), maintaining the same structure up to Modularity 5. Tab. 6 presents the nodes contained in Clusters 4 and 5.

The composition and evolution of Clusters 3, 4 and 5 are very interesting. As already seen, they are all focused on a different and important maenadic component, respectively citizen appearance, untied hair, and dance. We

Variables	Nodes	WDeg.
Maenads : Citizen	M_APP_Citizen	0.48
Satyrs : Thyrsus	S_ATT_Thyrsus	0.06
Maenads : Torch	M_ATT_Torch	0.06
Satyrs : Torch	S_ATT_Torch	0.04
Maenads : Tied Hair	M_HAIR_Tied	0.02
Maenads : Quiet	M_BEHAV_Quiet	0.02
Maenads : Procession	M_ACT_Procession	0.02
Maenads : Sakkos-Mitra	M_HAIR_Sakkos-Mitra	0.00
Maenads : Diadem	M_HAIR_Diadem	0.00
Maenads : Vase	M_ATT_Vase	0.00
Maenads : Wine Service	M_BEHAV_Wine	0.00
Satyrs : Procession	S_ACT_Procession	0.00

a

Variables	Nodes	WDeg.
Maenads : Thyrsus	M_ATT_Thyrsus	0.53
Maenads : Citizen	M_APP_Citizen	0.48
Vases : Other Figure : Dionysus	SHAPE_Dionysus	0.12
Satyrs : Thyrsus	S_ATT_Thyrsus	0.06
Maenads : Torch	M_ATT_Torch	0.06
Satyrs : Torch	S_ATT_Torch	0.04
Maenads : Animals	M_ATT_Animals	0.02
Period 1	P1	0.02
Maenads : Tied Hair	M_HAIR_Tied	0.02
Maenads : Quiet	M_BEHAV_Quiet	0.02
Maenads : Procession	M_ACT_Procession	0.02
Vases : Environment : Anthropic	ENV_Anthropic	0.00
Vases : Other Repr : Daily Life (Symp.)	DLIFE_Symp	0.00
Maenads : Snakes	M_ATT_Snakes	0.00
Maenads : Slow Movement	M_BEHAV_SlowMov	0.00
Maenads : Sakkos-Mitra	M_HAIR_Sakkos-Mitra	0.00
Maenads : Diadem	M_HAIR_Diadem	0.00
Maenads : Vase	M_ATT_Vase	0.00
Maenads : Wine Service	M_BEHAV_Wine	0.00
Satyrs : Procession	S_ACT_Procession	0.00

b

Tab. 5 – Cluster 3, Modularity 1-2 (a) and 3-5 (b): Nodes and Mean Weighted Degree.

can observe that two different and strong groups of maenadic elements, the first (Cluster 3) focused on the matron appearance and the second (Clusters 4 and 5, then 4) on wilder components, maintain an inner cohesion and remain separate until Modularity 5. Finally, at Modularity 6, they merge and form a huge maenad-determined cluster (Fig. 6, Cluster 3). As seen in Figs. 3 and 4, the small Cluster 7 (then 5) of Modularity 1 remains an independent small cluster composed of infrequent variables until Modularity 3. It includes only five vari-

Variables	Nodes	WDeg.
Maenads : Untied Hair	M_HAIR_Untied	0.31
Maenads : Nebris	M_ATT_Nebris	0.24
Maenads : Dance	M_ACT_Dance	0.20
Satyrs : Instrument	S_ATT_Instr	0.04
Satyrs : Dance	S_ACT_Dance	0.04
Maenads : Winged Arms	M_APP_Winged Arms	0.02
Satyrs : Ivy Wreath	S_ATT_IvyWreath	0.02
Satyrs : Music	S_BEHAV_Music	0.02
Satyrs : Dance	S_BEHAV_Dance	0.02
Maenads : Music	M_BEHAV_Music	0.02
Maenads : Dance	M_BEHAV_Dance	0.02
Vases : Environment : Natural	ENV_Natural	0.00
Maenads : Ivy Wreath	M_ATT_IvyWreath	0.00
Maenads : Relationship : None	M_REL_None	0.00
Satyrs : Animals	S_ATT_Animals	0.00
Maenads : Branch	M_ATT_Branch	0.00
Maenads : Instrument	M_ATT_Instr	0.00
Maenads : Ecstatic	M_BEHAV_Ecstatic	0.00

Tab. 6 – Evolution of Clusters 4 and 5 of Modularity 1 (then Cluster 4, Modularity 2-5): Variables, Nodes and Mean Weighted Degree (WDeg.).

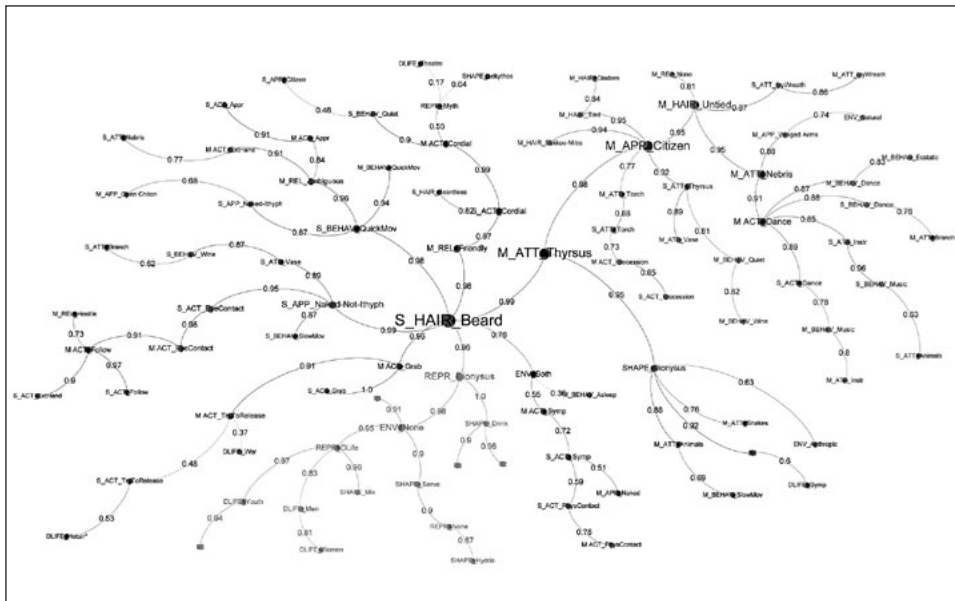


Fig. 6 – Modularity 6.

ables, all connected through low weighted values and somehow related to the symposiac iconography. Finally, Fig. 6 shows the final division into three clusters at Modularity 6: we can observe that the central variables relating to each figure are maintained in separate clusters. Cluster 1 includes the three central satyrs variables, beard, quick movement and not ithyphallic. Cluster 3 encompasses the three central maenads' variables, the untied hair, the citizen's appearance and the dance. The smaller Cluster 2 is only composed of vases variables, highlighting an interesting result that should be discussed in a further part of the research.

5. BEARDED SATYRS AND CITIZEN MAENADS: THE DATA INTERPRETATION

5.1 *The beard*

As expected having regards to its diffusion, the beard of the satyrs is the central element of the graphs. On the one hand, such result expresses the coherence of the applied methodology, in terms of adherence between the results and the distribution frequency of the variables within the dataset, since the graph has recognised as central a characterising element of the iconography of satyrs. The adult satyrs are always represented bearded, and this element characterises them as male characters. Indeed, on Athenian vase-painting, the beard is an iconographic element of the male, adult citizen, and the beardless face, as for the iconography of satyrs, is generally reserved to young men, as presented in some homoerotic scenes of seduction. On the other hand, the visualisation graphs here presented also go deeper in the exploration of the qualitative and quantitative centrality of the satyrs' beard, by presenting its connections with other elements, in particular the *thyrsus* that would represent its maenads' counterpart, in terms of specificity and sensibility, and the central elements of the two clusters comprising satyrs' appearances and maenads' reactions.

5.2 *Sexuality and reaction*

As already stated in our previous paper, and in contrast with the traditional interpretation of the satyrs, in our sample the satyrs are mostly represented naked but not ithyphallic. The importance of the non-ithyphallic appearance of the satyrs is now confirmed by the ANN-based analysis, which highlights its centrality for the global structure of the graph and its importance as the central node of one quite compact cluster. The non-ithyphallic appearance expresses a deliberate humanisation of the satyrs on red-figure vases. This humanisation of the satyrs depicted as maenads' companions on symposium vases might have enhanced a certain degree of identification between the figures and the vases' beholders, in this case the Athenian citizens gathered for the symposium. Given that Athenian citizens' figures are rarely represented in Dionysian iconography, the representation of moderate satyrs may have



Fig. 7 – Cup by the Kleophon Painter, 430-420 BC, Oxford 1925.621 (ARV2 1147,68).

offered the citizens a possibility to identify themselves with the figures, which might thus be interpreted as “symmetrical doubles” of the citizens.

The results have also demonstrated that the two different appearances of the satyrs defined by sexuality, ithyphallism and non-ithyphallism, are never united in the formation of iconographic types. They represent two different ideal types of the iconographic creation of satyrs: on one side the sexually innocuous, somehow humanised satyr, on the other the hybrid man-beast being defined by his chaotic gestures and wild sexuality. The first iconographic type, which is focused on the satyrs’ non-ithyphallic appearance, presents an intriguing correlation with the clearly hostile reaction of the maenads to the satyrs’ approaches. Such association might mean that the maenads’ clear violence does not generally derive from an evident visual threaten of the satyrs. Indeed, the action variables expressing a physical contact between the figures are not correlated to the maenads’ violence. According to this interpretation, the maenads would react with violence only to the non-explicit approaches of the satyrs, maybe expressing, through the dichotomy between humanised satyr and violent woman-maenad, the otherness of maenads rather than that of satyrs. Fig. 7 shows the external scenes on a cup by the Kleophon Painter:

four maenads are reacting with a clear hostility to the approaches of four non-ithyphallic satyrs, threatening them with their attributes (*thyrsus*, torch and rock) used as weapons.

The maenads are here all well-dressed with a long, decorated *chiton*, and tied hair. In this case study, the altered figures, in the male imaginary, might have been the women becoming hunters rather than the satyrs, transmitting two different visual messages to the vases' beholders: on one side, the otherness of satyrs is tacit, since it represents a very common literary and iconographic stereotype to the Athenian community; on the other side, the satyrs do also represent a masculine principle as opposed to the women and their supposed wild nature, which constitutes another popular stereotype, even more, we can imagine, in a male-dominated assembly like the *symposium*. The image on the tondo of the same cup seems to emphasise such reading: a non-ithyphallic satyr is playing pipes next to Dionysus: the proximity and intimacy between the God and his attendant highlight the men-God intermediary function held by satyrs.

Indeed, the satyrs are hybrid beings standing at the intersection between man and beast but also between man and God. In this perspective, the man coming closer to Dionysus through the ritual wine consumption would go through a symbolic satiric transformation, and the non-ithyphallic satyrs of the externals might recall the one on the tondo, enhancing the man-satyr identification by means of the contact with the God. In other words, the tondo would allow a first level of identification between the drinker and the satyr, through the emptying of the wine contained in the cup, the satyr becoming the symmetrical double of the male citizen. The external figures would then emphasise such identification through the genre contrast: in the presence of two wild figures, the male principle will always appear more understandable to the male imaginary than the female one.

The non-ithyphallic satyrs are also correlated, as expected, to some dignifying elements, especially one sub-cluster involving cult components (the satyrs' wine service and the attributes of vases and branches) which might express a transformation of men into satyrs for the worship of Dionysus, as argued by some scholars (FRONTISI-DUCROUX 1986; BÉRARD, BRON 1986; BÉRARD 1992). The interpretation of satyrs as male worshippers is a complicated question that would require a specific iconological analysis. Indeed, if the lack of male citizens in the Dionysian imagery might incite the reading of satyrs as men, at the same time in the Athenian classical society the satyrs fulfil a number of meanings that sometimes seem to contradict such idea, in the overall context of a civilised and integrated Dionysism.

The second category in the iconography of satyrs is focused on the attitude of quick movement and it includes the ithyphallic appearance and the maenads' ambiguous reaction to the satyrs' approach. The turbulent gestures

of the satyrs, run or dance, would need further characterisation in order to better define their possible meanings. Nonetheless, certain components are already recognisable. On the one hand, the association between ithyphallism and non-human, or at least non-citizen gestures might express the satyrs' bestiality, in continuity with the archaic type of black-figure silens, and therefore enhance their intermediate man-beast status.

The *nebris* as a satiric attribute would, in this perspective, emphasise the visual characterisation of satyrs as hybrid beings, in a century where the humanisation of satyrs seems to have been the rule. On the other hand, the gestuality of the satyrs might have expressed the *thiasos* component of the scenes. The association of ithyphallism and quick movement with maenads' variables quick movement and open *chiton* might strengthen this interpretation. Indeed, the quite rare open *chiton* might have represented an element of continuity with the archaic type of the uncharacterised nymph in the Dionysian cortege. At this stage of the analysis we can identify two different iconographic groups based on the sexual appearance of the satyrs: the first group expresses a typically classical iconography, which appears with the red-figure technique and is characterised by progressively dignified satyrs; the second group, on the contrary, follows the tradition of the black-figure representations of the Dionysian *thiasos*, defined by ithyphallic satyrs and by a confusion in the identity of the female followers.

As confirmed by the graphs, the ithyphallic appearance of the satyrs is strongly correlated to the ambiguous reaction of the maenads. In most cases the scenes are suspended in an undefined moment of the satyr-maenad interaction. While the satyr's wild sexuality is clearly exposed in other satiric iconographies (LISSARRAGUE 1987), with the maenads the intercourse is never represented. The association between satyrs' ithyphallism and maenads' ambiguity shows that, when the satyrs' erotic intention is clear, the maenads' possible reaction is never foregone.

This peculiar choice of the vase-painters was probably employed in order to let the beholder decide on the possible conclusion of the scene (intercourse or maenad's hostile reaction) according to their convictions and prejudices about maenadism in particular and women's behaviour in general. Both the possible conclusions of the scene are present in Euripides' tragedy *The Bacchae*, composed at the end of the century (405 BC circa), where Pentheus' diffidence about the conduct of Thebes' women transformed in maenads by the god (vv. 217-225) contrasts with their effective cast behaviour (vv. 686-688). Fig. 8 presents, on the tondo of a cup by Makron, the strong correlation between ithyphallism and ambiguity which is now confirmed by the Modularity analysis.

The ithyphallic satyr is grabbing the maenad's shoulders with one hand and introducing his other hand under her dress. While her arms and legs seem to suggest that she is trying to release herself, her chest is twisted towards



Fig. 8 – Cup by Makron, 490-480 BC, Paris G144 (ARV2 462,43).



Fig. 9 – Cup by the Euaion Painter, 440 BC circa, Frankfurt 5TV6 (ARV2 790,11).

him, she embraces him, an intense eye contact is established, and their faces almost touch each other. The ambiguity is here clearly expressed by both the contrasting movements of her body and her attributes. The leopard she is grabbing by the tail characterises her as a hunter, expressing the hidden otherness of women practicing a typical male activity, but might also insinuate some kind of polysemy between the female animal (characterised by the breasts of a nursing female) and the woman holding it, introducing an additional genre element to the scene. And the *thyrsus*, which is emphasised by its horizontal close-up position, might, in the hypothetical violent conclusion of the scene, become a weapon used by the maenad to attack the satyr. The maenad here depicted might either react with violence to the erotic approach of the satyr or succumb to his advances. The conclusion of the interaction is up to the beholder, the male citizen which is drinking the wine contained into this cup, revealing the image and all its possible meanings.

Some rare representations of citizen-dressed or beardless, young satyrs are always related to the cordial attitudes of both the figures. Citizen-satyrs are quite rare on both black and red-figure vases and they would require a specific iconological study in order to understand all the possible implications of such iconographic choice. In our sample they are always depicted in cordial scenes together with friendly maenads (Crater London E467; Crater Paris G422; Crater Warsaw 142355). The rare beardless satyrs are young or children who are depicted in some particular iconographies of a satyr family including an adult satyr, a maenad and a young, beardless satyr (Crater London E467; Stamnos London E447; Crater Karlsruhe 208; Crater Madrid 11075), as servants of matron-dressed maenads (Pelike Taranto 143547; Crater Paris

G422), or in other unique iconographies (Crater Compiègne 1025; Chous Berlin 3242; Pelike Oxford 284).

5.3 *The maenads*

In our sample, the maenads appear to be represented mostly as Athenian women, with the long Ionian *chiton* eventually covered, partially or completely, with a *himation*. The iconographic type of the matron-dressed maenad represents an element of disruption with the archaic type of the half-naked nymph, while the continuity with this fortunate female figure would have been represented by the rare open *chiton*, as described above. The citizen maenads also appear to be identified by different elements of matron-hairstyle, i.e. the tied hair sometimes adorned with a diadem, and the headband covering entirely or partially the hair, as clearly displayed by the connections between the variables. The variables identifying citizen maenads are strongly correlated to two interesting sub-clusters.

The first sub-group includes the “wine service” attended by maenads, a wine-pouring gesture that can be interpreted either as ritual or as a daily life wife-husband interaction, since it appears to reproduce the model of such common iconographies: on one side, the ritual wine libation, on the other the wife serving wine to her husband. In the first case, the rituality of the action would characterise the figures as human or mythical worshippers. In the second case, the transposition of a normal, human genre interaction to the world of maenads and satyrs might have emphasised their function of symmetrical doubles of the Athenian citizens. In any case, the maenadic wine service is a peripheral variable which is correlated to the *thyrsus* as a satiric attribute. The *thyrsus*-bearer satyrs are quite rare in our dataset (10% of all satyrs) and they might either introduce an element of visual confusion between male worshippers of Dionysus and satyrs, or even characterise the satyrs as worshippers. In both cases, the satyrs in such iconographies would be interpretable as an exploration of different aspects of male identity in all those contexts in which representing Athenian citizens would not have been considered appropriate (LISSARRAGUE 1998, 2000).

The second sub-cluster which is connected to the citizen maenads comprises the procession and the torch attributed to both the figures. Such association confirms the nocturnal nature of Dionysian processions, as stated by sources and modern studies (VILLANUEVA-PUIG 1992), and might introduce a further element of humanisation of the figures to the general picture of the maenads and satyrs identities. Furthermore, the nocturnal processions involving maenads and satyrs and represented through the presence of torches might have strengthened the confusion introduced by the God of the mask in the human life: just as the wine, the moving lights of the nocturnal torches would blur the participants’ identities, allowing an analogy on one side between the

symposium and the representation, on the other side between the otherness of the figures participating in nocturnal processions and the one of the male citizens gathered for the wine ritual.

In any case, both the sub-clusters connected to the citizen maenads, the procession and the wine service, are inspired by human iconographies, either as worship representations or as parodic deformations of human genre relationships. Fig. 9 presents one of those ritual or daily life scenes of wine-pouring, on the tondo of a cup by the Euaion Painter: a naked, non-ithyphallic satyr, holding a *kantharos* and a small branch is facing a graceful maenad with a *thyrsus* who is holding an *oinochòe*. The eye contact between the two, the quietness of the whole scene and another *thyrsus* standing in the field behind the satyr communicate a perfect harmony between the figures. This calm, respectable representation of wine-pouring clearly appeared to the citizen while he was emptying his wine cup. Reaching an inebriated state, the symposiast's reading of the scene may have evolved to his own identification with the quiet satyr and, by association, to the interpretation of the female figure as a feminine component of his life, either as the *hetaera* in charge of the wine service at the symposium or as the wife serving her husband.

The presence of the maenads' untied hair as the central variable of one strong cluster constitutes one of the most interesting results of this research. Indeed, while the citizen maenads are defined mostly by their dresses, as displayed in the graphs, the untied hair and their coherent associations appear to have a bigger influence on one specific iconographic type of the maenads than the accurate feminine hairstyle. The centrality of the untied hair for the creation of an iconographic type is partly joining the traditional conclusions of many scholars, who consider the untied hair as a determinant trait of maenads (DELAUVAUD-ROUX 2011).

However, through the clear separation and aggregation of the variables in clusters, the Modularity analysis is now allowing to interpret the untied hair as the central element not of all maenads but only of one of the possible types of maenads. The untied hair might have two different meanings. The first possible meaning of the untied hair is the wild and ecstatic behaviour of the maenads, where the hair would untie under the force of the violent dance movements. In this case the untied hair would represent a means of visual expression for the movement. The second possible meaning of the untied hair is an indication of the social status of the maenad: indeed, we know that the untied hairs in classical Athens were generally reserved to unmarried girls (DELAUVAUD-ROUX 2011).

Though it is not possible, on the basis of the current dataset, to establish the marital status of the maenads, their untied hair might be interpreted, on the basis of their association with other elements of alterity within Cluster 4, as the visual expression of the non-compliance with the social norms imper-



Fig. 10 – Hydria by the Kleophrades Painter, 490-480 BC, Basel XXXX0.1721 (ARV2 189,73).

sonated, for the male community, by the maenads. Indeed, the other variables contained in this cluster appear to be very coherent with the visual idea of wildness. The animal skin (*nebris* or *pardalis*) characterises the maenads as hunters, i.e. as women practicing a typically masculine activity, emphasising their diversity with the social rules regulating the life of women in Athenian society (LISSARRAGUE 1990). The winged arms represent an iconographic element used mostly between 480 and 425 BC, which could express visually either the cold, windy wild spaces where the maenads were evolving or the rapid dance movements of the figures (EDWARDS 1960).

The clearly dancing maenads are not very frequent on the vases here analysed. Though, according to different scholars (VILLANUEVA-PUIG 1988; DELAUAUD-ROUX 1991), the dance is one of the characterising elements of maenadism. Such traditional interpretation is now partially confirmed by the Modularity analysis. Indeed, the dancing maenads represent the centre of a cluster comprising mostly, but not only, elements defining both dance and music. The dance should then be considered as a characterising element of one specific type of the maenads' iconography, while the other types defined by the Modularity analysis are focused respectively on the citizen appearance and untied hair. Since Modularity 2, the cluster focused on dance and music joins the “alterity cluster” focused on the untied hair.

The graph thus presents two possible iconographic types of maenads. The first type is the citizen maenad: her hair are tied and sometimes covered with a headband, she is represented while attending ritual or daily life activities.

She is the maenad presented in Fig. 9 facing the standing, dignified satyr. The second ideal iconographic type of the maenad is presented in Fig. 10: three maenads are dancing to the music of pipes played by a lying satyr. Their hair are untied, their hands are covered by the long sleeves of their *chiton*. The first maenad on the left is represented in trance, facing the vase's beholder through the frontality which is rarely used on Athenian vase-painting, and always to express an altered state of consciousness (TEFNIN 2003). The two definitive ideal types in the representation of maenads on Athenian red-figure vase-painting, the citizen maenad and the altered one, which contains the dancing figures, appear to be maintained deliberately separated. They might have expressed two different male interpretations of the maenads' behaviour, oscillating from the accepted, calm maenads whose appearance and behaviour would have instilled dignity, to the wildest attitudes attributed by men to those women who released themselves from their rigid social control.

6. CONCLUSIONS

The results of the data processing have highlighted several interesting elements. First of all, the importance of the figures' appearance in the definition of the satyr-maenad iconography, which had already been pointed out by previous researches, is now confirmed and extended to their different associations with other iconographic elements. In particular, the maenads' reaction to the satyrs' approach have been demonstrated to be strongly correlated to the sexual-based appearance of the satyrs. On the one hand, the ambiguous reaction of the maenads, which would have deliberately left the beholders decide the possible conclusions of the scenes according to their individual and social convictions about women's behaviour, appears to be strongly correlated to the non-ithyphallic appearance of the satyrs.

Such correlation, which highlights the absence of clear erotic approach of the satyrs, seems to confirm the ambivalence of male-based interpretations of the feminine lascivious or cast attitudes highlighted in Euripides' *Bacchae*. On the other hand, the maenads are clearly hostile mostly when their companions are not represented in the unambiguous erotic appearance of ithyphallism. The association of hostile maenads with non-ithyphallic satyrs might have enhanced ambivalent interpretations: in such correlation, which figure would represent the wildness, the humanised satyr or the hunting maenad? Such representations might have enhanced some genre-identity confusion among the beholders. Secondly, the very coherent division of the maenads' appearance into two strong structures, the first focused on the citizen appearance and the second on the untied hair, consented to define two different iconographies of maenads on Athenian red-figure vases. The first iconography is based on Athenian-looking maenads, well-dressed and accurately coiffed.

The second one comprises most of the alterity variables, highlighting the importance of the untied hair for the characterisation of wild maenads. Finally, the peculiar position, within the graph structure, of some of the variables, in particular the *thyrsus* as a maenadic attribute, and the iconological analysis of some of the elements here presented, would require a specific development and will be the subject of further researches. In conclusion, the interesting preliminary results of the application of ANN-based methodologies to the formalised study of Athenian iconography are opening new perspectives to the research. A further exploration of such methodologies, associated to a better definition of the dataset and to an expansion of the analysed variables, will allow innovative and important interpretative solutions to the study of the complex maenads-satyrs interactions on Athenian red-figure vases.

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ABSTRACT

This study aims at exploring both the identity of the maenads and their multiple interactions with the satyrs on Athenian red-figure vases by presenting the preliminary results of an ANN-based analysis applied to a dataset of 114 vases representing 478 figures (maenads and satyrs). The encouraging results seem to confirm the highly significant role of ANN-based methodologies as innovative tools for the organisation, visualisation and analysis of complex data in History of Art and Archaeology. Further explorations of these methodologies, associated with higher levels of data formalisation, should open new perspectives for the research on Athenian iconography and iconology.