

Annotating ritual in ancient Greek tragedy: a bottom-up approach in action

Gloria Mugelli <gloria_dot_mugelli_at_gmail_dot_com>, Laboratorio di Antropologia del Mondo Antico, Università di Pisa
Federico Boschetti <federico_dot_boschetti_at_ilc_dot_cnr_dot_it>, CoPhiLab, ILC, CNR Pisa
Andrea Bellandi <andrea_dot_bellandi_at_ilc_dot_cnr_dot_it>, CoPhiLab, ILC, CNR Pisa
Riccardo Del Gratta <riccardo_dot_delgratta_at_ilc_dot_cnr_dot_it>, CoPhiLab, ILC, CNR Pisa
Anas Fahad Khan <fahad_dot_khan_at_ilc_dot_cnr_dot_it>, CoPhiLab, ILC, CNR Pisa
Andrea Taddei <andrea_dot_taddei_at_unipi_dot_it>, Laboratorio di Antropologia del Mondo Antico, Università di Pisa

Abstract

EuporiaRAGT is one of the pilot projects that adopt the Euporia system as a digital support to an historico-anthropological research on the form and function of rituals in the texts of ancient Greek tragedy. This paper describes the bottom-up approach adopted in the project: during the annotation stage, performed with a Domain Specific Language designed with a user-centred approach, the domain expert can annotate ritual and religious phenomena, with the possibility of registering different textual and interpretive variants; the design of a search engine, in a second phase of the work, allows the database to be tested and reorganized. Finally, the construction of an ontology allows to structure the tags, in order to perform complex queries on the database.

The Project and the Annotation System

This paper will describe a project for the digital annotation of ritual and religious facts in ancient Greek tragedy. The project in question is the result of a collaboration between the Institute of Computational Linguistics “A. Zampolli” at CNR, Pisa and the Laboratory of Anthropology of the Ancient World at the University of Pisa. As part of this collaboration an annotation system, named *Euporia* has been developed in order to offer digital support to the historico-anthropological study^[1] carried out by the first author, as part of her doctoral research, on the dramatic functions of rituals in ancient Greek tragedy, (Mugelli 2018b, defended on November 15 2018). The study in question involves the comparison of ancient Greek rituals as represented or described corpus of surviving Greek dramatic texts, with those same rituals as they have been reconstructed by scholars from literary, archaeological and epigraphic sources. The primary sources of this study were the texts of the surviving ancient Greek tragedies, texts which often allude to various kinds of rituals such as sacrifices, supplications, prayers, libations, funerary rites.^[2] Greek tragedies themselves were originally performed as rituals and were performed during religious festivals in honour of the god Dionysus.^[3] Their audiences were mostly composed of Athenian citizens who were participants in these festivals. It is important to note that a fifth century Athenian citizen would have gained a substantial amount of ritual experience through participating in various public religious festivals, in festivals or rites performed as part of a smaller group (e.g. the *demes* or the *phratries*) and in familiar rites performed by the citizens themselves.^[4]

The initial point of the departure of this historico-anthropological study was the idea that rituals as represented or described in the texts of ancient Greek tragedies do not constitute a faithful reproduction of the actual rites as they were performed in fifth century Athens. Indeed, when it comes to the representation of rituals in such works, compliance with the ritual norm was only one of the concerns of the tragic authors, along with respect of the performance rules and the function of the ritual in the dramatic plot, see Didonato (2010); Taddei (2015); Taddei (2016). Even though the rites represented in Greek tragedy had to be plausible enough to be recognisable as such by their intended audiences, the authors of Greek tragedy were able to make use of a series of different strategies to adapt the representation of these

rites to their tragic plots. These strategies included the use of allusion, the combination of different rites, and even modification of certain aspects of ritual norms [Mugelli 2018a]. In any case, the public would have had enough ritual experience to be able to immediately understand every reference to the actual rites as they were practised and to recognize variations from the norm ^[5]

The first step of the research was the retrieval and annotation of all the attestations of ritual facts in the corpus of tragic texts, with the purpose of establishing relationships between different passages in the corpus and then comparing this evidence with the rites as they have been reconstructed from other sources. The annotation system, Euporia, which was used to do this work was designed using a user-centred approach that was tailored to answer the specific research question [Hemminger 2009] [Gibbs and Owens 2012]. The system adopts a domain specific language (DSL) [Parr 2010] in order to avoid both a complex graphical user interface and verbose TEI-XML annotation. Translating Euporia DSL into a TEI-XML compliant document is easy as well as necessary in order to guarantee interoperability with other resources.

^[6] The system is designed to be flexible enough to faithfully simulate the citation practices of classicists. Euporia's lightweight web user interface enables an entire text which is to be annotated to be visualised in a single page and allows the annotator to easily scroll up and down the page to copy and paste passages in the original text in order to quote them. The unique identifiers (IDs) which are necessary to create machine readable citations are embedded in the hidden HTML tags that surround the segments of the original texts which have been copied and pasted. The DSL deals with portions of text of varying lengths and as well as with discontinuous segments of texts.^[7] In addition, it also deals with textual operations (substitution, insertion, deletion and transposition), textual and interpretative variants and, finally, with constraints on the variants [Boschetti 2013]. The DSL is based on conventions that are similar to the conventions used in critical apparatuses and in philological, linguistic, historical or literary commentaries [Boschetti 2007]; [Lamé 2015, 17–19]. In addition it uses other conventions that will be familiar to classicists in the age of social media: for example, the annotations are expressed using Latin hashtags^[8] that, as in Twitter messages or del.icio.us taggings, are micro-annotations that can be retrieved in the context of other hashtags, in association with the document chunk that they annotate. The Latin language has been chosen for the sake of compatibility with *Memorata Poetis*, a project for the annotation of themes and motives in epigraphic and literary epigrams in Greek, Latin, Arabic and Italian languages (<http://www.memoratapoetis.it>). *Memorata poetis* combines a top-down approach (with a Latin taxonomy of an index of *rerum notabilium*), and a bottom-up approach, with unstructured tags that are organized in an ontology in a second phase of the work [Khan 2016].

Given the complexity of the ritual facts which were annotated during the course of this research, facts which are difficult to organize in fixed schemes, we decided not to establish a taxonomy or fixed set of tags *a priori*. Instead we adopted a completely bottom-up approach which allows the annotator the freedom to create new tags according to his or her needs, as well as to modify or delete of tags and even their hierarchical grouping within an ontology as part of an iterative process. In order to give an overview of the thousand tags which have been created so far, we can categorize the annotations in four different categories. Namely we can identify:

1. Passages in which an entire ritual is performed (ex. #sacrificium/sacrifice, #supplicatio/supplication). These tend to be longer passages
2. Parts of the ritual such as gestures, words, actions, objects (ex. #victimam_iugulare/slauther_the_victim, #gemitus/cry, #vestis/dress, #culter/cutter, #terror/fear) and even the emotions or the attitudes of those performing a ritual and the various moments or the spaces of the ritual itself
3. The main implications of the ritual (ex. #ritus_propositum/purpose_of_rite, #ritus_effectus/effects_of_rite, #ritus_irritus/ineffective_ritual)
4. Passages in which the characters or the chorus discuss the form or the implication of a ritual, or give instructions for how to perform it (#ritum_praescribere/order_the_rite; #ritus_parare/prepare_the_rite)

We are also using two macro-categories of tags which are employed in combination with other tags. The tag #scaenica/on_scene is used to indicate everything that present on stage (objects, costumes, scenic design) as well

as the movements and gestures performed on stage. This tag allows the annotator to indicate whether a rite is actually enacted on stage or whether it is simply described or alluded to. The tag `#hiera/sacred_things` indicates that an action may be considered as part of a ritual that is expected to be effective. This is useful for distinguishing those portions of the text which consist of references, mentions, or elements of a rite from those parts which are conceived of as real rites. In this paper we will illustrate the bottom-up approach adopted in this research by discussing some case studies related to three phases of the work: Section 2 gives an example of the annotation process by discussing the interpretation of a passage (Aesch. *Ag.* 228 ff.) where the annotator has registered multiple interpretive variants; Section 3 describes the functioning of the Euporia search engine with some examples of multiple-searches that can be performed on the database of the tags; finally, Section 4 describes the on-going process of the construction of the ontology which organizes and categorizes the tags in the annotation tagset.

An Annotation Case-Study: The Sacrifice of Iphigenia in Aesch. *Ag.* 228 ff.

The representation of sacrifice and other rituals is one of the main themes of Aeschylus' *Agamemnon* and of the entire *Oresteia* trilogy which was performed for the first time in Athens in 458 BCE. The *Oresteia* trilogy makes substantial use of so-called *pervverted sacrifice*, that is, of sacrificial images and metaphors in the description of violence and murder^[9] Indeed, the main event of the plot of *Agamemnon*, the murder of Agamemnon, is described using sacrificial metaphors. In line 1433 of *Agamemnon*, for instance, Clytemnestra confirms that she has sacrificed (the verb *sphazo* meaning "ritually slaughter") her husband to Ate and to the Erinyes.

5

Κλυταιμῆστρα

1431 καὶ τήνδ' ἀκούεις ὀρκίων ἐμῶν θέμιν·
 1432 μὰ τὴν τέλειον τῆς ἐμῆς παιδοῦς Δίκην,
1433 Ἄτην Ἐρινύν θ', αἴσι τόνδ' ἔσφαξ' ἐγώ,
 1434 οὐ μοι φόβου μέλαθρον ἐλπίς ἐμπατεῖ,
 1435 ἕως ἂν αἴθη πῦρ ἐφ' ἐστίας ἐμῆς
 1436 Αἴγισθος, ὡς τὸ πρόσθεν εὖ φρονῶν ἐμοί.

Clytaemestra: You will now also hear this righteous oath I swear: by the fulfilled Justice that was due for my child, **[1433] by Ruin and by the Fury, through whose aid I slew this man**, no fearful apprehension stalks my house, so long as the fire upon my hearth is kindled by Aegisthus and he remains loyal to me as hitherto; for he is an ample shield of confidence for me.^[10]

In order to annotate this passage we made use of the tags `#sphage/ritual_slaughter`, that marks all the words in the semantic field of ritual slaughter, and `#homicidium_sicut_sacrificium/homicide_as_sacrifice`, to indicate a metaphor that compares a homicide to a human sacrifice.^[11]

☛ [1433 αἴσι τόνδ' ἔσφαξ' ἐγώ] #sphage/ritual_slaughter
 #homicidium_sicut_sacrificium/homicide_as_sacrifice ☛

Example 1.

In lines 228 ff. of *Agamemnon* we come across an example of actual human sacrifice. The tragic chorus recalls and describes the famous sacrifice of Iphigenia, carried out by her father to appease Artemis' anger and to allow the departure of the Greek army for Troy.

228 λιπὰς δὲ καὶ κληδόνας πατρώους
 229 παρ' οὐδὲν αἰῶ τε παρθένειον
 230 ἔθεντο φιλόμαχοι βραβῆς.
 231 φράσεν δ' ἀόζοις πατήρ μετ' εὐχάν
 232 **δίκαν χιμαίρας ὑπερθε βωμοῦ**
 233 πέπλοισι περιπετεῖ παντὶ θυμῷ προνωπῆ
 235 **λαβεῖν ἀέρδην**, στόματός

236 τε καλλιπρώρου φυλακᾶ κατασχεῖν
237 φθόγγον ἀραῖον οἴκοις,
238 βία χαλινῶν τ' ἀναύδω μένει.

Chorus	Her pleas, her cries of “father!”, and her maiden years, were set at naught by the war-loving chieftains. [231] After a prayer, her father told his attendants to lift her right up over the altar with all their strength, like a yearling goat, face down, so that her robes fell around her , [235] and by putting a guard on her fair face and lips to restrain speech that might lay a curse on his house.
---------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

5

☞ [228 λιτὰς... 249 ἄκραντοι] #hiera/sacred_things #hominem_sacrificare/human_sacrifice ☞
☞ [229 παρθένειον] #virgo/virgin #victima/victim ☞

Example 2.

Sacrifices of virgins and human sacrifices in general are attested in Greek myth and in ancient Greek tragedy, but they were not a common fact of life in fifth century Athens [Bonnechere 1994]; [Georgoudi 1999]; [Bonnechere and Gagné 2013]; [Nagy and Prescendi 2013] [Georgoudi 2015]. Since our research is focused on the reception of tragic rituals by the audience of Greek tragedy, our main intention in annotating the scenes of human sacrifices is not to establish relationships between those scenes and traces of human sacrifices in ancient Greece. The tragic scenes of human sacrifice are annotated so they can be used to compare aspects of the ritual (use of objects, attitude of the victims) with the actual ancient Greek animal sacrifice. Various sources represent the sacrifice of Iphigenia in a form that is very close to animal sacrifice; in Euripides' *Iphigenia in Aulis* the young girl is substituted with a deer just before the ritual slaughter. In Aeschylus' *Agamemnon* we can find a trace of the similarity between Iphigenia's sacrifice and an animal sacrifice at line 232, where the girl is lifted up on to the altar “like a yearling goat” [12]. The passage in question is annotated with the tag **#capra/goat** specifying the type of animal victim mentioned. The tag **#virgo_sicut_victima/virgin_as_victim** can be used either in scenes of human sacrifice or in scenes of homicide, to indicate that a virgin is being compared to an animal victim.

6

☞ [232 δίκαν χιμαίρας] #capra/goat #virgo_sicut_victima/virgin_as_victim ☞

Example 3.

From line 228 to line 232 (included the words λαβεῖν ἀέρδην at line 235) the sense of the passage is quite clear: Agamemnon, indifferent to his daughter's prayers, orders the soldiers to lift the girl up on to the altar. The action has to be carried out after the ritual prayer, at the moment of the slaughter of the victim.

7

☞ [232 δίκαν... ὑπερθε βωμοῦ ~ 235 λαβεῖν ἀέρδην] #victimam_tollere/lift_the_victim ☞

Example 4.

The translation of line 233 is less straightforward and scholars have imagined three different situations, that the annotator chose to register as interpretive variants, since they involve major changes in the interpretation of the ritual. [13] The three different solutions depend on the translation of the two words περιπετῆ and προνωπῆ that describe the attitude of Iphigenia at the moment of the sacrifice. According to [Maas 1951] πέπλοισι περιπετῆ means “enwrapped in her robe” and προνωπῆ means “prone.”

☞ [233 πέπλοισι περιπετῆ] #victimam_vincire/tie_the_victim #vestis/dress Maas1951 ☞

Example 5.

Maas' interpretation is based on a comparison between the sacrifice of Iphigenia and the sacrifice of Polyxena as it is represented on a well-known black figured amphora, where the young girl is lifted upon the altar by soldiers, with her

dress tight to her body.



Figure 1. Attic red-figured amphora, Timiades Painter, ca. 570 BC - ca. 560 BC, London British Museum 1897.7-27.2, © Marie-Lan Nguyen / Wikimedia Commons.

According to Maas' interpretation the dress is used to tie Iphigenia. The image of the tied sacrificial victim recurs after two lines, when Agamemnon orders to gag Iphigenia to avoid her speaking words of bad omen and cursing her family.

```
☛ [235 στόματός... 238 μένει] #victimae_dissensus/dissent_of_victim  
#os_opprimere/hold_the_mouth #victimam_vincire/tie_the_victim ☛
```

Example 6.

The consent of the sacrificial victim has been identified as an essential trait in representations of ancient Greek sacrifice. Meuli (1946) invented the theory of the “comedy of innocence,” which was subsequently adopted (with different solutions) by Burkert (1972) and Detienne-Verdant (1979) followed by Durand (1986). The theory, which asserts that participants in a sacrificial ritual felt themselves under the necessity of masking every sign of violence towards its victims,^[14] was supported by evidence from the iconography of sacrifice which rarely represents tied animals. In addition late sources describing the origins of Greek sacrifice and of the *Bouphonia* festival interpreted by Durand (1986), represent the ox voluntary walking towards the altar and offering itself for sacrifice; finally, some sources show the victim nodding at the altar, ideally showing its consent to the sacrifice.^[15] The idea of the willingness of the sacrificial victim has recently been questioned, however, thanks to a new attention to the sources that shifted the focus to attestations of tied, forced or recalcitrant animals [Bonnechere 1999]; [Georgoudi 2005]; [Georgoudi 2008]; [Naiden 2007]. The binding and gagging of Iphigenia in Aeschylus' *Agamemnon* is therefore worthy of attention, in contrast with the well-known conclusion of Euripides' *Iphigenia at Aulis*, where the girl is eventually convinced to offer herself in sacrifice. A comparison with the sacrifice of Polyxena in Euripides' *Hekabe* is useful for the parallels it offers to the Aeschylean passage: at the beginning of the rite a group of young men has been assigned the task to hold the victim. However Polyxena decides to offer herself voluntarily as she refuses to be touched by the soldiers, Eur. *Hec.* 525-527, 545-549. E. Medda, in [Medda 2012] and in his recent commentary [Medda 2017, 158–163], has reassessed for the word προνυπή in Aesch. *Ag.* 233, a translation proposed by LSJ9 and adopted by Fraenkel (1950), according to which the expression means “to take her as she fell, fainting forward.”

Example 7.

This interpretation, which is corroborated by a comparison with the red-figured oinochoe of the Schuwalow painter, does not exclude the image of the young girl being enwrapped in her dress, but does exclude any explicit dissent on the part of the victim (at least at this moment of the ritual) which forces the soldiers to bind her.



Figure 2. Attic red-figured oinochoe, Schuwalow painter, 430-420 a.C. Kiel inv. B 538.

A third interpretation of the passage, proposed by Lloyd Jones (1990) and adopted by Bonanno (2006) in her article on the dramatic function of the messenger's speech describing the sacrifice in the *Agamemnon*, shows Iphigenia supplicating to her father by touching his dress (literally "falling with the arms around his dress"). This interpretation entails some radical changes to our sacrificial image: we have to imagine Iphigenia falling forward, and grasping her father's knees. If we accept this interpretation then we have to add two tags that mark two common gestures in scenes of supplication: the act of falling at someone's knees and the gesture of touching someone's dress.

8

☛ [233 πέπλοισι ... προνωπή] #supplicatio/supplication legit Lloyd Jones ☚ ☛ [233 πέπλοισι περιπετή] #vestem_tangere/touch_the_dress (cum 233 #supplicatio/supplication Lloyd Jones) ☚ ☛ [233 προνωπή] #ad_genua_accidere/fall_at_knees (cum 233 #supplicatio/supplication Lloyd Jones) ☚

Example 8.

This last interpretation would certainly imply an act of dissent the part of Iphigenia, who in the middle of the sacrificial ritual and after the ritual prayer, continues begging her father and attempting to move him to pity. This hypothesis of the supplication also changes the reading of the two words παντι θυμῷ, "with all the heart" in line 233: in the two previous cases they refer to sacrificants who have to follow Agamemnon's order without hesitation. If we assume that Iphigenia is in the act of supplicating then the two words are referred to the suppliant's attitude.

```

# [233 παντι θυμῶ] #animus_supplicis/attitude_of_suppliant (cum 233
#supplicatio/supplication Lloyd Jones) [233 παντι θυμῶ}
#animus_sacrificantis/attitude_of_sacrificant (recusando 233
#supplicatio/supplication Lloyd Jones)

```

Example 9.

The supplication of Iphigenia to her father is known from Euripides' *IA* 1211 where the young girl is still trying to escape death (as we noticed earlier, in Eur. *IA* Iphigenia is represented as a willing victim at the very moment of the sacrifice). Scenes of supplication to Agamemnon are also shown on two terracotta reliefs which were directly inspired by the Euripidean play^[16].

Searching the Database

In the second phase of the project, once the annotation had been carried out using the criteria illustrated above, an SQL-based search engine was developed in order to query and to subsequently reorganize the database of the hashtags (The first version of EuporiaSearch is available at <http://cophilab.ilc.cnr.it/euporiaSearchx/>). The Euporia search engine allows users to search the database by matching up to three keywords which are represented as hashtags. The results show the list of the passages on which the three keywords co-occur along with the list of other hashtags co-occurring with the keywords on those passages. The user can specify:

1. Up to three different keywords;
2. The range of words within which the keywords should co-occur (ex. 0, 0 for the intersection between the keywords, 10, 10 for a query on 2 hashtags in a range of +/- 10 words);
3. The range of words on which the hashtags visualized in the results have to co-occur (e.g. 10, 10 to show all the hashtags co-occurring within a range of +/- 10 words from the passages retrieved)

An example will help to clarify the operation of the search engine. For instance, in order to retrieve all of the passages in the corpus in which a virgin is the victim of a sacrifice the user can match the 2 keywords **#virgo/virgin** and **#victima/victim** (within a range of 0 words) and ask the system to show all the other hashtags coinciding within a range of +/- 10 words. EuporiaSearch will then list all of the passages retrieved; the entire list of other hashtags coinciding with the passage is also displayed by clicking on each result. Using the search engine, we can perform multiple searches that check the coherence and the consistency of the tags. We decided to start testing our first search engine from the tragedies related to the Atreides' cycle in order to have a well defined sub-corpus for our initial trials of the annotation system. A few examples dealing with the theme of the perverted sacrifice and the interference between homicide and sacrifice will help to illustrate the first results which we obtained.

Since we made the decision to annotate only those actions which were actually conceived and performed as rituals with the tag **#sacrificium/sacrifice** or **#hominem_sacrificare/human_sacrifice**, a search into the intersection between homicide and sacrifice will return those cases of homicides carried out within the context of a sacrifice, like the killing of Aegisthus during the sacrifice to the Nymphs in Euripides' *Electra*. A search using the tag **#homicidium_sicut_sacrificium/homicide_as_sacrifice** returns the passage of the killing of Agamemnon discussed above (Aesch. *Ag.* 1433) and the passage of the killing of Clytaemestra in Euripides' *Electra* (Eur. *El.* 1142). A broader perspective on sacrificial metaphors can be gained by carrying out queries using both tags **#homo_sicut_victima/human_as_victim** and **#virgo_sicut_victima/virgin_as_victim**. These will return a list of passages in which a human being is compared to a sacrificial victim amongst which there are various passages referring to Iphigenia's sacrifice in Eur. *IA*, where the virgin is sacrificed as if she were an animal victim. We will also find Aesch. *Ag.* 1297, where Cassandra is invited to enter the house of Agamemnon to perform a sacrifice: "how comes it that you are walking boldly towards it like an ox driven by god to the altar?" The hashtag list shown in the search results will help users to understand the various contexts of the different occurrences of the keyword: for example, a query on the single hashtag **#libatio/libation** returns all the occurrences of libation events. Browsing the list of co-occurring hashtags returned by this query, the user can verify if the libation is performed on stage (as it is in

Aesch. *Cho.*, 15 where the tag #libatio/libation co-occurs with the tag #scaenica/on_stage) or whether it is simply mentioned or discussed by the characters (as it is for example in Soph. *El.* 52, where Electra and her sister discuss a libation that has to be performed on Agamemnon's tomb, and the tag #libatio/libation co-occurs with the tags #ad_ritum_ire/go_to_rite and #tumulus/tomb #extra_scaenam/off_stage).

Structuring the Tags

Semantic technologies can be exploited to identify and structure the knowledge embedded in literary texts. They can support experts in defining hierarchical and associative relationships between semantically annotated chunks of text denoting relevant entities and thus allow for the visual structuring of knowledge. This knowledge, formally coded as part of an ontology, can then be used by scholars and students as an aid to further analysis of the text. In particular, the use of semantic technologies aims at facilitating intelligent searches on the text in a more sophisticated way in comparison to traditional keyword-based search as a means to the discovery of implicit information/knowledge. In the next two subsections, we will introduce the basics of formal ontologies along with the approach that we will use for structuring the tags, respectively.

11

Knowledge Representation Background and Standards

Formal ontologies have nowadays become a standard means of representing knowledge about concepts and the relations among them in various different domains. The term ontology itself derives from philosophy and was first applied within the field of Information Systems in the late seventies to describe formal representations of knowledge about a given domain typically expressed in a manner that can be easily processed by machines (in a way that unstructured text generally cannot). More specifically, an ontology (in the Information Systems sense of the term) is a computational resource that explicitly represents the types of entities that can exist in a domain, the properties these entities can have, and the relationships they can have to one another. It also describes how these entities are decomposed into parts, and the events and the processes in which they can participate. A number of ontology definition languages has been developed over the past few years. One of the most popular such languages is the Ontology Web Language (OWL <https://www.w3.org/OWL/>) [Heflin 2007], a recommendation of the W3C (<https://www.w3.org>). OWL was designed to meet the need for an ontology language for the Semantic Web (RDF: <https://www.w3.org/standards/semanticweb>). It is based on the use of a common data framework, the Resource Description Framework (<https://www.w3.org/RDF>) in which the knowledge is represented as a series of statements each of which is in the form of a <subject-predicate-object> triple. These triples usually consist of three separate resource IDs (although they can also be so called blank nodes or literals in the case of objects), so called uniform resource identifiers (URIs), and this allows for the easy representation of such knowledge as graph structures. Figure 3 (a) provides a simple example showing the involvement of participants in a sacrifice, by listing some RDF triples, such as <_h2,rdf:type,Human> meaning that _h2 is a Human, <_h2,rdf:predicate,_s> meaning that _h2 participates to the sacrifice _s, and so on.

12

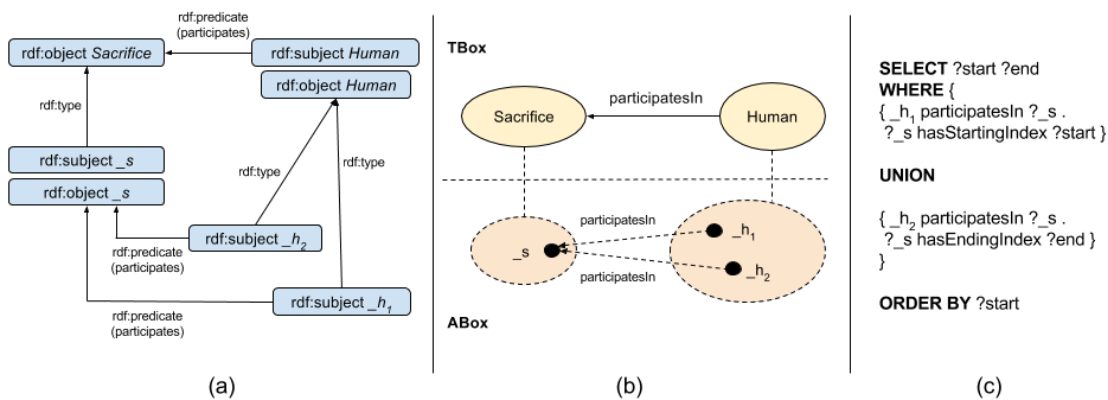


Figure 3. (a) RDF fragment of knowledge example. (b) Correspondent OWL ontology. (c) pseudocode of SPARQL query that retrieves all the sacrifices (i.e., the related text passages) which have `_h1` or `_h2` as participant.

OWL is a decidable fragment of first order logic and a so called Description Logic (DL) [Baader et al. 2005], a class of languages specially intended for purposes of Knowledge Representation (KR). Ontologies created in OWL can be split up into two parts: an intentional and an extensional part. The former, the so called *TBox*, contains knowledge about concepts (i.e., classes) and complex relations between them (i.e., roles). The latter part, the so called *ABox*, contains knowledge about entities (i.e., individuals) and how they relate to the classes and roles from the *TBox*. Figure 3 (b) shows the same example as before but encoded in OWL. OWL provides a sophisticated mathematical semantics for the interpretation of RDF triples: the resource *Sacrifice* is interpreted as a set, *Sacrifice*, which stands for the class of sacrifices, the resource *Human* is a set, *Human*, standing for the class of humans, and the predicate is defined as a semantic relation between the class *Human* and the class *Sacrifice*. Formally, the domain of *participatesIn* is the class *Human* and its range is defined by the class *Sacrifice* (note that we could further elaborate the semantic of *participatesIn*, by for example defining cardinality constraints, and so on). One of the most widely used tools for managing OWL ontologies is called Protégé (<https://protege.stanford.edu/>). It is free, open-source and is supported by a strong community of users working both in academia as well as in industry.

13

Another important Semantic Web related standard is SPARQL (<https://www.w3.org/TR/rdf-sparql-query/>), a powerful query language which allows users to make queries over RDF knowledge bases by carrying out graph pattern matching on RDF triples. Figure 3 (c) shows a query related to the example. We assume that the individuals to be modelled take part in two different relations, for example *hasStartingIndex* and *hasEndingIndex*, which specify the sections in the text to which the related tags refer. The example shows how it is possible to retrieve all text passages referring to sacrifices in which at least one of the two specific humans (`_h1` and `_h2`) is a participant.

14

One of the great benefits of developing Semantic Web based resources is the fact that it is straightforward to reuse and to link to other datasets. In this case, for example, we can make use of other already existing semantic web ontologies to provide a layer of more general, abstract concepts without having to create these from scratch ourselves.

15

The Bottom-up Approach

The annotation strategies adopted on the passages of Aeschylus' *Agamemnon* and which were discussed in Section 2 should have made it clear that the variation of details, such as the consciousness or the willingness of the victim, its gestures or movements, the presence of blood and the use of particular garments, can strongly affect the tragic representation of the ritual. This is because every ritual has its own norms, varying through space and time, that govern the ritual: its actions, words and gestures, the use of objects in it, and even the right mood in which to perform the rite. At the same time, ritual norms are not always strictly followed. They can be modified depending on the circumstances or (in certain cases) they can even be subverted. Moreover, the same gestures, actions or words can have different

16

meanings depending on the context.^[17]

The bottom-up approach adopted in this project allows the annotator to create and to organize the tags in order to follow the complex intersections between textual, interpretative and ritual issues. The organization of the tags is an iterative process, performed as a process of ontology construction establishing relations between single tags and groups of tags. More precisely we organise the tags by defining the different relations between ritual actions, gestures, words, objects as part of a formal ontology. This allows us to connect a single action to the ritual contexts in which it can be performed, and to indicate the main implications of a ritual performed in a certain way.^[18]

As was shown in the annotation example in Section 2, the sacrifice of Iphigenia in Aeschylus' Agamemnon is annotated in our corpus as a human sacrifice with a virgin in the role of victim and as discussed in Section 3, passages like this can be retrieved using the search engine, by matching two keywords (virgin and victim, or human sacrifice and virgin). However, a query on these keywords would not be sufficient to find all the occurrences of sacrifices of virgins in the database. In fact it became evident during the annotation process that there exist a number of tragic passages that, although they refer to human sacrifice in general, are actually alluding to the sacrifice of a virgin, even if the identity of the victim is not directly stated in the text. This happens, for example, in Euripides *IA*, where a large part of the drama relies on the ambiguity between the rites for the fake marriage of Iphigenia and Achilles and the sacrifice of Iphigenia herself [Foley 1982], [Foley 1985]. In this tragedy it is therefore important to distinguish between passages alluding to sacrifices in general and passages alluding to the sacrifice of Iphigenia. The annotator found it useful, for the sake of clarity, to mark the sacrifices of virgins with the more specific tag `#virginem_sacrificare/sacrifice_of_virgins`. The two annotation strategies (the more general tag `#hominem_sacrificare/human_sacrifice` with the specification of the type of victim involved, or the more specific tag `#virginem_sacrificare/sacrifice_of_virgins`) are not contradictory and can be managed in the construction of the ontology.

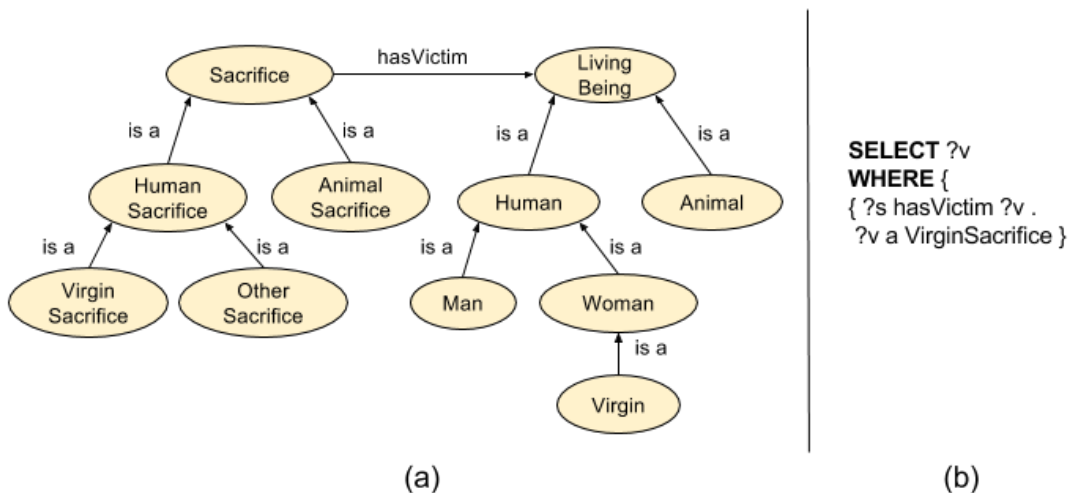


Figure 4. (a) Hypothesis of a fragment of knowledge concerning Sacrifices and victims. (b) pseudocode of SPARQL query that retrieves all the sacrifices of virgins.

We can do this by arranging the tags in a hierarchy so that whenever we carry out a query using the more general tag we will also get all the results from the more specific tags. In our case it means that it will be possible using a single query to retrieve the whole set of texts marked as human sacrifices along with the two subsets of the sacrifices of virgins and the sacrifices of other human victims. Figure 2 shows a possible arrangement of some of the relevant classes in a taxonomy. There the class 'Human Sacrifice' is split into two different kinds, 'Virgin Sacrifice' and 'Other Sacrifice'; similarly we have also arranged the potential victims of a sacrifice into a hierarchy. The definition of the different types of human sacrifice is the starting point for more complex queries such as that which we describe below.

As we demonstrated in the annotation example in Section 2, the attitude of the victim is an important trait in the

representation of sacrifices, and it is one of the characteristics of the rite that allows the comparison to be made between human and animal sacrifice. The attitude of the sacrificial victim is expressed by two opposing tags, namely, #victimae_consensus/consent_of_victim and #victimae_dissensus/dissent_of_victim). A simple query on the two tags returns all the occurrences of victims (either human or animal) who either consent to or dissent from the ritual taking place. The tag #victimae_consensus/consent_of_victim, for example, marks the passages of Eur. *IA* where Iphigenia consents to being sacrificed and the passage of Eur. *IT*, 469 where Orestes and Pilades, victims of a fake human sacrifice, are untied so they can go to the ritual of their own volition. Among the occurrences of willing victims there is also Aesch. *Ag.* 1297, cited above, where Cassandra is compared to an ox willing to approach the sacrifice. Among the attestations of the #victimae_dissensus/dissent_of_victim tag there are the passages of Aeschylus' *Agamemnon* cited above, various passages of Eur. *IA* preceding the voluntary sacrifice (for example Eur. *IA* 1243 where Iphigenia is supplicating to her father), and Eur. *Hel.* 1559, where an ox refuses to get in the ship where it will be sacrificed. Both the consent and the dissent of the victim are attitudes that can be adopted by the sacrificial victims, either animal or human.



Figure 5. (a) Hypothesis of fragment of knowledge concerning attitude of victims. (b) pseudocode of SPARQL query that retrieves all the sacrifices of consensual virgins.

The construction of the ontology will also help researchers to retrieve and study so-called perverted sacrifices. As we described previously, in Section 2 and in the example given in Section 3, the tag #homicidium_sicut_sacrificium/homicide_as_sacrifice marks all those passages in which the comparison between homicide and sacrifice is explicitly stated in the text or where it is clear to the annotator. It is possible to say that a homicide is being described in sacrificial terms by a tragic author if the description includes details that are unequivocally associated with rituals. This dramatic mechanism is recognisable (and will have been recognised by an audience), for example, in cases when the ritual slaughter #sphage is mentioned in the description of a homicide, when a murder is carried out on an altar [Durand and Lissarrague 1999] or when it is carried out with ritual objects. The perception of an interference between homicide and sacrifice on the part of the tragic audience should not, however, be taken for granted in all the passages that describe a homicide with ritual features. It would be useful, however, for further research on sacrifice and supplication in Greek tragedy, if it were possible to retrieve the largest possible number of passages where an interference between homicides and rituals may be present, in order to give scholars and experts easy access to important textual evidence. To this end, in our ontology we can create a subclass of *Instruments* called *Ritual Instruments* that covers instruments used in ritual (see Figure 6). We can then define the class of events *Homicide_as_Sacrifice* using a logical axiom (presented below in the diagram in a description logic formalism) as the intersection of all events that are classified as a *Homicide* and where the instrument used belongs to *Ritual Instrument*.

21



Figure 6. Hypothesis of fragment of knowledge concerning the event Homicide as Sacrifice.

A query on all the events in the class *Homicide as Sacrifice* will return the list of the tragic passages where a homicide is carried out by means of a ritual instrument and where the mechanism of the so-called perverted sacrifice may be involved. The resulting list of passages would be extremely interesting for the domain expert, who will be able to study the dramatic function of the tragic passages and to compare them with the ritual practices that can be reconstructed from other, different kinds of sources. In doing this, however, the domain expert will have to take into account the plasticity of the ancient Greek ritual norm: in the actual ritual practices as well as in their representations we can observe variations from the norm which do not always result in a perversion of the ritual process. The case of the ritual instruments used in violent context is exemplary: as a matter of fact, the set of ritual objects that can be used as weapons in murders is hard to define, and it is an interesting starting point for the further development of our ontology. The texts of Greek tragedy are rarely accurate as far as the technical lexicon of sacrificial instruments is concerned. The

22

word μάχαϊρα, denoting the sacrificial knife, is used only twice in the corpus of extant tragedies (Aesch. *Pers.* 56 and Eur. *Supp.* 1206) and twice in Euripides' *Cyclops*. In Euripides *Electra*, where the ritual competence of Orestes in the sacrificial butchery of the victim is at stake, the two technical terms σφαγίς and κοπίς are employed to indicate two different types of knives, the second of which is specifically chosen to kill Aegisthus. The terms generally used to indicate the sacrificial knife are the two unmarked terms indicating swords, ξίφος and φάσγανον [Bruit-Zaidman 2014]. These types of knives can be used as ritual instruments, and they are actually used for slaughtering victims in various tragic human sacrifices. At the same time, however, they should not be considered as instruments exclusively for use in rituals since they are used as instruments in battle and in other contexts. Some similar observations can be made concerning the axe used by Clytaemestra in the killing of Agamemnon (see Section 2). The double-axe (πέλεκυς) is not part of the hoplite armour, and it was not used as a weapon in Classical Greece. Being primarily an instrument for felling trees, it was not a ritual object per se. At the same time, its use in animal killings can be interpreted as a sacrificial use: various sources attest the presence of the double-axe in sacrificial contexts, and it is used in Homer to stun sacrificial victims of large size. A query on the intersection between the two keywords #ascia/axe and #homicidium/homicide returns various mentions of Agamemnon's killing by his wife (e.g. Soph. *El.* 486, Eur. *El.* 170, 279, 1160).

A further development of our ontology may include the distinction between objects that are unequivocally ritual instruments, objects that are not ritual instruments but may be used in rites and finally objects that are to be considered ritual instruments when used in a certain way. The insertion of the “killer-axe” and of the technical terms denoting ritual knives in a set of ritual instruments to be retrieved in the context of murders and violent actions could help interpreters of Greek tragedy to cast new light on various aspects of the so-called perverted sacrifice. A search on murders that present ritual features (e. g. that are accomplished with ritual instruments) will return a series of passages that are not explicitly characterized as perverted rituals, but that may be insisting on the tragic ambiguity between homicide and sacrifice.

23

Conclusion

In this paper we have discussed a system for the annotation of a corpus of Greek tragic texts that focuses on the ritualistic and religious aspects of those texts. The annotation system adopts a bottom-up approach, three different phases of which have been described in this paper: first there was the annotation stage proper, with the possibility of registering different textual and interpretive variants, then there was the design of a search engine that allows the database to be tested, and finally the on-going construction of an ontology of the tags. The system was designed to answer a specific research question, described in the introductory section of this paper, and therefore finds its first application in the retrieval of tragic passages in support of this research. As we have shown in Section 3, the search engine allows the domain expert to perform multiple-searches that return all those portions of the text which attest to the annotated phenomena. The passages which are retrieved as a result have of course to be studied in their textual and dramatic context (the list of hashtags shown in the search results is extremely useful for a quick look at the context of the passage). At the same time, since the construction of the ontology is based on the ritual norms reconstructed both from tragic texts themselves and from historical sources (as was described in Section 4), the system offers users the possibility of performing queries on various aspects of Greek ritual such as the consenting of the sacrificial victim to the ritual or the so-called perverted sacrifice. This research on sacrifice and supplication in Greek tragedy is based on the idea that, in the tragic representations of rituals, variations from the norm could be recognized and understood by the audience. From this perspective, the lists of passages resulting from the queries illustrated above will help the domain expert to broaden the corpus of his/her sources, and to question his/her sources in a different way. The annotation combines textual variants as well as modern interpretations on the tragic texts and theories on ancient ritual based on different sources, and it strongly depends on the needs and the choices of the annotator. Therefore, the search results should not be taken to be certain attestations of given phenomena, but they can be read as signs of possible ambiguities resulting from a comparison between the actual ritual norm and its tragic representation. For instance, the list of passages resulting from the query pertaining the murders accomplished with ritual instruments discussed at the end of Section 6, is not to be taken as a list of all the attestations of the so-called “perverted sacrifice” in the corpus of Greek tragic texts, but as a list of all the tragic passages where the public could have perceived a ritualistic connotation in the description of a violent action. Analysing the passages in their context, the domain expert will be able to verify if

24

the tragic text actually refers to the ritual and relies on the ritual skills of the audience.

As we have described above, the peculiarity of the annotation system lies in the fact that it was designed to study religious aspects of ancient Greek civilisation on the basis of a well-defined corpus of literary texts. In future work we plan to make the tagset available (both in TEI format and as Linked Open Data) along with the ontology in order to allow these resources to be reused in other projects. We can imagine at least two axes of possible interchanges: projects for the annotation of themes and motifs in ancient Greek texts, and projects aiming to study ritual and religion as they are attested in other corpuses of ancient Greek sources (e.g. Greek epic and historical texts).

Notes

[1] On the history and epistemology of Historical Anthropology of the Ancient World see Didonato (1990) and Didonato (2013).

[2] On the religious context of Ancient Drama see Pickard (1968); Didonato (2002); Sourvinouinwood (2003).

[3] The ritual dimension of Greek tragedy has been widely discussed by Winklerzeitlin (1990); Seaford (1998); Scullion (2002); Calame (2013); Calame (2017).

[4] The works by Robert Parker [Parker 1996]; [Parker 2005]; [Parker 2011]; offer a complete discussion of the religious life of fifth century Athens. On the public of Greek tragedy see Csaposlater (1994); Sommerstein (1997); Loscalzo (2008).

[5] See Taddei (2009) and Taddei (2014); in general, on the competence of the tragic public see Revermann (2006).

[6] The annotation system and the DSL are described in Mugelli (2016). The current version of our DSL grammar is available at (last access: 15/07/2019).

[7] In the annotation, the three dots (...) indicate continuity and the tilde (~) indicates discontinuity.

[8] For the sake of readability in this paper the tags are cited in the form `#hashtag/english_translation`.

[9] Zeitlin (1965) was the first to introduce, for the *Oresteia*, the notion of *perverted sacrifice*. On the history of the notion of perverted ritual and its applicability to Greek tragedy, see Henrichs (2004). See also Viadnaquet (1972) on the metaphorical use of sacrifice and hunting in the *Oresteia*.

[10] The texts of Aeschylus' *Oresteia* are cited in the translation by Sommerstein (2008).

[11] All the tags in the form `X_as_Y` marks explicit metaphors or comparisons, e. g. in Eur. *Hel.* we used the tag `#tumulus_sicut_altaria/tomb_as_altar` to mark that a tomb is used as an altar in supplication.

[12] On the lifting of the sacrificial victim see [Van Straten 1995, 109–111] and [Parker 2005, 180, 330]. Cfr. the Attic black-figured amphora from Vulci, 550 ca BCE, Museo Nazionale Archeologico, Rocca Alborno, Viterbo <http://www.beazley.ox.ac.uk/record/6F03DCDE-FEBD-4317-9490-2C84BE43618B>.

[13] Our annotation registers only the variants or interpretations that involve changes in the description of the ritual, see Mugelli (2016). On a similar selection process for textual variants see the project *Musisque Deoque*, [Mastandrea 2009] <http://mizar.unive.it/mqdq/public/>.

[14] The concept of "victim" as it is conceived in modern languages was absent from the Ancient Greek language [Brulé and Touzé 2008].

[15] The nodding of the victim was theorized by Burkert (1972). For a list of all the sources *pro et contra* the theory of the willing victim see Naiden (2007). On the history of the different modern interpretations of Ancient Greek animal sacrifice see Parker (2011) and Naiden (2013).

[16] Terra-cotta bowl, II century bce, BerlinStaatl.Mus.3161= LIMC 3.2 s.v. *Iphigenia*, 9.

[17] The concept of ritual norm has recently been investigated, see [Brulé 2009]. In particular relating to the corpus of the so-called Greek Sacred Laws, see Parker (2004), Chaniotis (2009), Carbon Pirenne del Forge (2012). A digital collection of Greek Ritual Norms is under construction at the University of Liège (<http://web.philo.ulg.ac.be/thiasos/cgrn-collection-of-greek-ritual-norms/>).

[18] The structure of our ontology is described in Mugelli (2017), where we also discuss the use of the ontology itself within a system for querying the annotated corpus.

Works Cited

- Baader et al. 2005** Baader, F., Horrocks, I., Sattler, U. "Description logics as ontology languages for the semantic web." *Mechanizing Mathematical Reasoning*. Springer Berlin Heidelberg (2005): 228-248.
- Berthiaume 1982** Berthiaume, G. *Les rôles du mâgeiros: étude sur la boucherie, la cuisine et le sacrifice dans la Grèce ancienne.*, E. J. Brill les Presses de l'Université de Montréal, Leiden Montréal (1982).
- Bonanno 2006** Bonanno, M. "Assenza, più acuta presenza. Ifigenia nell'*Agamennone* di Eschilo." *LEXIS*, 24 (2006): 199–210.
- Bonnechere 1994** Bonnechere, P. *Le sacrifice humain en Grèce ancienne* Kernos Suppléments 3, Presses universitaires de Liège, Athènes-Liège (1994).
- Bonnechere 1999** Bonnechere, P. "La μάχαιρα était dissimulée dans le κavoῦν?", *REA*, 101 (1999): 21–35.
- Bonnechere 2009** Bonnechere, P. "Le sacrifice humain grec entre norme et anormalité" In P. Brulé (ed), *La Norme En Matière Religieuse En Grèce Ancienne: Actes Du Xlle Colloque International Du CIERGA* (Rennes, Septembre 2007), Kernos Suppléments 21. Presses universitaires de Liège, Liège, (2009): 189–212.
- Bonnechere and Gagné 2013** Bonnechere, P. and Gagné, R. *Sacrifices humains. Perspectives croisées et représentations*. Presses universitaires de Liège, Liège (2013).
- Boschetti 2007** Boschetti, F. "Alignment of variant readings for linkage of multiple annotations." In P. Zemanek (ed), *Proceedings of the ECAL 2007: electronic corpora of ancient languages*, Praha (2008), pp. 11-24.
- Boschetti 2013** Boschetti, F. "Annotations in collaborative environments." *Studia Graeco Arabica* 3 (2013): 185-194.
- Bruit-Zaidman 2014** Bruit Zaidman, L. "Objets rituels tragiques chez Euripide." *Revue de l'histoire des religions* (2014): 581–598.
- Brulé 2009** Brulé, P. *La norme en matière religieuse en Grèce ancienne: Actes du Xlle colloque international du CIERGA* (Rennes, septembre 2007). Presses universitaires de Liège, Liège (2009).
- Brulé and Touzé 2008** Brulé, P. and Touzé, R. "Le hierieion: phusis et psuchè d'un medium." In Mehl, V. (ed) *Le sacrifice antique: vestiges, procédures et stratégies*, Presses universitaires de Rennes, Rennes (2008): 111–138.
- Burkert 1972** Burkert, W. *Homo necans: Interpretationen altgriechischer Opferriten und Mythen*. W. de Gruyter, Berlin-New York (1972).
- Calame 2013** Calame, C. "De la pratique culturelle dominante à la philologie classique: le rôle du chœur dans la tragédie attique" *LEXIS*, 31 (2013): 16–28.
- Calame 2017** Calame, C. *La tragédie chorale. Poésie grecque et rituel musical* Les Belles Lettres, Paris (2017).
- Carbon and Pirenne-Delforge 2012** Carbon, J.-M. and Pirenne-Delforge, V. "Beyond Greek Sacred Laws." *Kernos*, 25 (2012): 163–182.
- Chaniotis 2009** Chaniotis, A. "The Dynamics of Ritual Norms in Greek Cult". In P. Brulé (ed), *La Norme En Matière Religieuse En Grèce Ancienne: Actes Du Xlle Colloque International Du CIERGA* (Rennes, Septembre 2007), Kernos Suppléments 21. Presses universitaires de Liège, Liège, (2009): 91–105.
- Csapo and Slater 1994** Csapo, E. and Slater, W. *The Context of Ancient Drama*. The University of Michigan Press, Ann Arbor (1994).
- Detienne and Vernant 1979** Detienne, M. and Vernant, J.P. *La cuisine du sacrifice en pays grec*. Maspero, Paris (1979).
- Di Donato 1990** Di Donato, R. *Per una antropologia storica del mondo antico*. La nuova Italia, Firenze (1990).
- Di Donato 2002** Di Donato, R. "A Dioniso nulla? Tragedia ateniese e politica". In P. Vidal-Naquet, *Lo Specchio Infranto*. Donzelli Editore, Pisa (2002).
- Di Donato 2010** Di Donato, R. "Ritualità e Teatro nei Persiani di Eschilo". *Lexis*, 28 (2010): 59–66.
- Di Donato 2013** Di Donato, R. *Per una storia culturale dell'antico: contributi a una antropologia storica*. ETS, Pisa (2013).
- Durand 1986** Durand, J.-L. *Sacrifice et labour en Grèce ancienne, essai d'anthropologie religieuse*. La Découverte, Parigi-Roma (1986).

- Durand and Lissarrague 1999** Durand, J.-L. and Lissarrague, F. "Mourir à l'autel. Remarques sur l'imagerie du «sacrifice humain» dans la céramique attique". *Archiv für Religionsgeschichte* (1999): 83–106.
- Foley 1982** Foley, H.P. "Marriage and Sacrifice in Euripides' Iphigeneia in Aulis". *Arethusa* 15 (1982): 159–180.
- Foley 1985** Foley, H.P. *Ritual irony. Poetry and Sacrifice in Euripides*. Cornell University Press, Ithaca London (1985).
- Fraenkel 1950** Fraenkel, E. *Aeschylus, Agamemnon*. Clarendon press, Oxford (1950).
- Georgoudi 1999** Georgoudi, S. "À propos du sacrifice humain en Grèce ancienne: remarques critiques" *Archiv für Religionsgeschichte*, 1 (1999): 61–82.
- Georgoudi 2005** Georgoudi, S. "L'occultation de la violence dans le sacrifice grec: données anciennes, discours modernes". In S. Georgoudi, R. Koch Piettre, F. Schmidt (eds), *La cuisine et l'autel. Les sacrifices en questions dans les sociétés de la Méditerranée Ancienne*. Turnhout, Brepols (2005).
- Georgoudi 2008** Georgoudi, S. "Le consentement de la victime sacrificielle : une question ouverte". In V. Mehl, P. Brulé, R. Parker (eds), *Le sacrifice antique. Vestiges, procédures et stratégies*. Presses universitaires de Rennes, Rennes (2008).
- Georgoudi 2015** Georgoudi, S. "Le Sacrifice humain dans tous ses états" *Kernos*, 28 (2015): 255-273.
- Gibbs and Owens 2012** Gibbs, F. and Owens, T. "Building Better Digital Humanities Tools: Toward broader audiences and user-centered designs", *Digital Humanities Quarterly*, 6, 2 (2012).
- Hanson 1993** Hanson, V. D. *Hoplites: The Classical Greek Battle Experience*. Routledge, London-New York (1993).
- Heflin 2007** Heflin, J. "An Introduction to the OWL Web Ontology Language." Lehigh University. National Science Foundation (NSF) (2007).
- Hemminger 2009** Hemminger, B. "NeoNote. Suggestions for a Global Shared Scholarly Annotation System", *D-Lib Magazine* 15 (May/June 2009) (5/6).
- Henrichs 2004** Henrichs, A. "Let the Good Prevail: Perversions of the Ritual Process in Greek Tragedy". In D. Yatromanolakis, R. Panagiotis (eds), *Greek Ritual Poetics*. Harvard University Press, Cambridge (Mass.) (2004): 189-198.
- Khan 2016** Khan, F., Arrigoni, S., Boschetti, F., Frontini, F. "Restructuring a Taxonomy of Literary Themes and Motifs for More Efficient Querying." *Estudios Literarios Digitales*, 2, 4, (2016): 11–27.
- Lamé 2015** Lamé, M., Sarullo, G. et al. "Technology & Tradition: A Synergic Approach to Deciphering, Analyzing and Annotating Epigraphic Writings", *LEXIS* 33 (2015): 9-30.
- Lloyd-Jones 1990** Lloyd-Jones, H. *Greek Epic, Lyric, and Tragedy: The Academic Papers of Sir Hugh Lloyd-Jones*. Clarendon Press, Oxford (1990).
- Lorimer 1950** Lorimer, H.L. *Homer and the monuments*. MacMillan, London (1950).
- Loscalzo 2008** Loscalzo, D. *Il pubblico a teatro nella Grecia antica*. Bulzoni Editore, Roma (2008).
- Maas 1951** Maas, P. "Aeschylus, *Agamemnon* 231 ff. illustrated", *Classical Quarterly* (1951): 94.
- Marrucci 2004** Marrucci, L. "Il buono (e il cattivo) uso della makhaira", *LEXIS* 22 (2004): 397–414.
- Mastandrea 2009** Mastandrea, P. "Gli archivi elettronici di Musisque deoque. Ricerca intertestuale e cernita fra varianti antiche (con qualche ripensamento sulla tradizione indiretta dei poeti latini)". In P. Mastandrea, L. Zurli (eds), *Poesia latina. Nuova e-filologia. Opportunità per l'editore e per l'interprete: atti del convegno internazionale, Perugia, 13-15 settembre 2007*. Herder, Roma (2009) pp. 41–72.
- Medda 2012** Medda, E. "Ifigenia all'altare. Il sacrificio di Aulide tra testo e iconografia". *EIKASMOS*, XXIII (2012): 87–114.
- Medda 2017** Medda, E. *Eschilo. Agamennone. Edizione critica, traduzione e commento*. Accademia nazionale dei Lincei, Roma (2017).
- Mehl 2006** Mehl, V. "Caresser, conduire, contraindre : les gestes entre les hommes et les animaux dans l'iconographie sacrificielle". In L. Bodiou, D. Frère, V. Mehl, A. Tourraix (eds), *L'expression des corps: gestes, attitudes, regards dans l'iconographie antique*, Presses universitaires de Rennes, Rennes (2006), pp. 347-360.

- Meuli 1946** Meuli, K. "Griechische Opferbräuche". In *Phyllobolia für P. von der Mühl zum 60. Geburtstag am 1. August 1945*. Basel (1946). Reprinted in *Gesammelte Schriften*. Vol. 2. Basel (1975): 907–1021.
- Mugelli 2018a** Mugelli, G. "Eracle e il sacrificio interrotto: immagini tragiche di sacrificio nelle Trachinie di Sofocle e nell'Eracle di Euripide." *Scienze dell'Antichità*, 23, 3 (2018): 123-139.
- Mugelli 2018b** Mugelli, G. *Pratiche rituali e spazi drammatici: forma e funzionamento dei riti nella tragedia attica*. Ph.D. Thesis, Università di Pisa; École des Hautes Études en Sciences Sociales, Paris Sciences et Lettres (2018).
- Mugelli 2019** Mugelli, G. "« La flamme dévoratrice d'offrandes »: feu et agentivité rituelle dans la tragédie grecque." *Cahiers Mondes Anciens 12: En action! Lectures anthropologiques de l'agir dans l'Antiquité* (2019), <http://journals.openedition.org/mondessanciens/2406>.
- Mugelli et al. 2016** Mugelli, G., Boschetti, F., Del Gratta, R., Del Grosso, A.M., Kahn, F., Taddei, A. "A user-centred design to annotate ritual facts in ancient greek tragedies". *BICS*, 59 (2016): 103-120.
- Mugelli et al. 2017** Mugelli, G., Kahn, F., Bellandi, A., Boschetti, F. "Designing an Ontology for the Study of Ritual in Ancient Greek Tragedy" *Proceedings of Language, Ontology, Terminology and Knowledge Structures Workshop (LOTKS 2017)*. Association of Computational Linguistics, Montpellier (2017) <http://aclweb.org/anthology/W17-7011>.
- Nagy and Prescendi 2013** Nagy, A.A., Prescendi, F. *Sacrifices humains : dossiers, discours, comparaisons actes du colloque tenu à l'Université de Genève, 19-20 mai 2011*, Bibliothèque de l'École des hautes études. Brepols, Turnhout (2013).
- Naiden 2007** Naiden, F. S. "The Fallacy of the Willing Victim", *Journal of Hellenic Studies*, 127 (2007): 61-73.
- Naiden 2013** Naiden, F. S. *Smoke signals for the gods : ancient Greek sacrifice from the Archaic through Roman periods*. Oxford University Press, Oxford (2013).
- Parker 1996** Parker, R. *Athenian Religion. A History*. Clarendon Press, Oxford (1996).
- Parker 2004** Parker, R. "What Are Greek Sacred Laws?". In E. M. Harris, L. Rubinstein (eds), *The Law and the Courts in Ancient Greece*, Duckworth, London (2004), pp. 57–70.
- Parker 2005** Parker, R. *Polytheism and Society at Athens*. Oxford University Press, Oxford (2005).
- Parker 2011** Parker, R. *On greek religion*. Cornell University Press, London Ithaca (2011).
- Parr 2010** Parr, T. *Language implementation patterns: create your own domain-specific and general programming languages*, Raleigh NC, (2010).
- Pickard-Cambridge 1968** Pickard-Cambridge, A. *The Dramatic Festivals of Athens*. Clarendon Press, Oxford (1968).
- Revermann 2006** Revermann, M. "The Competence of Theatre Audiences in Fifth- and Fourth-Century Athens." *Journal of Hellenic Studies*, 126 (2006): 99-124.
- Scullion 2002** Scullion, S. "«Nothing to do with Dionysus»: tragedy misconceived as ritual". *Classical Quarterly New Series*, 52 (2002): 102–137.
- Seaford 1998** Seaford, R. "Something to Do with Dionysos - Tragedy and the Dionysiac: Response to Friedrich". In M. S. Silk (ed), *Tragedy and the Tragic: Greek Theatre and beyond*, Clarendon press, Oxford (1998): 284-294.
- Snodgrass 1964** Snodgrass, A. M. *Early Greek armour and weapons from the of Bronze Age to 600 b. C.*, Edinburgh University Press, Edinburgh (1964).
- Sommerstein 1997** Sommerstein, A. H. "The Theatre audience, the demos, and the Suppliants of Aeschylus". In C. Pelling (ed), *Greek Tragedy and the Historian*. Clarendon Press, Oxford (1997) pp. 63–80.
- Sommerstein 2008** Sommerstein, A. H. *Oresteia : Agamemnon, Libation-bearers, Eumenides*. Harvard University Press, Cambridge, Mass (2008).
- Sourvinou-Inwood 2003** Sourvinou-Inwood, C. *Tragedy And Athenian Religion*, Lexington Books, Lanham, MD (2003).
- Taddei 2009** Taddei, A. "Inno e pratiche rituali in Euripide: il caso dell'*Ifigenia tra i Tauri*". *Paideia* (2009): 235–252.
- Taddei 2014** Taddei, A. "Le Panatenee nel terzo stasimo degli *Eraclidi* (Eur. *Heracl.* 748-783)". *LEXIS*, 32 (2014): 213–228.
- Taddei 2015** Taddei, A. "Ifigenia e il Coro nella *Ifigenia tra i Tauri*. Destini rituali incrociati", *LEXIS*, 33 (2015): 150–167.

- Taddei 2016** Taddei, A. "Vergognarsi davanti al proprio dio: il coro nel terzo stasimo dello Ione di Euripide". *Quaderni Urbinati di Cultura Classica*, 142 (2016) 47-64.
- Van Straten 1995** Van Straten, F. *Hiera Kalà: Images of Animal Sacrifice in Archaic and Classical Greece*. Brill, Leiden (1995).
- Vidal-Naquet 1972** Vidal-Naquet, P. "Chasse et sacrifice dans l'*Orestie* d'Eschyle". In J.-P. Vernant, P. Vidal-Naquet (eds) *Mythe et tragédie en Grèce ancienne*, Maspero, Paris (1972).
- Winkler and Zeitlin 1990** Winkler, J. J., Zeitlin, F. I. *Nothing to do with Dionysos: Athenian drama in its social context*, Princeton University Press, Princeton, N.J (1990).
- Zeitlin 1965** Zeitlin, F. I. "The Motif of the Corrupted Sacrifice in Aeschylus' *Oresteia*", *Transaction and Proceedings of the American Philological Association*, 96 (1965): 463-508.