An Ontology for Gendered Content Representation of Cultural Heritage Artefacts

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Abstract

The need for organising and digitally processing the vast amount of Cultural Heritage (CH) information has recently led to the development of formal knowledge representation models (ontologies) for the CH domain. Existing models, however, do not capture gender-related concepts. This article presents an effort to fill this gap by developing a new ontology for the representation of gendered concepts in CH resources. The new ontology, named "GenderedCHContents" resulted from combined research in women's studies, gender theory, and computer science. Its primary aim is to draw attention to the presence of women within CH artefacts. The proposed ontology extends the Europeana Data Model (EDM) with twenty-two new classes, sixteen object properties and seven datatype properties. The article presents a demonstration of the "GenderedCHContents" ontology's use in five different representation tasks, which describe five resources related to Pandora's myth. Lastly, the study stresses the benefits of reasoning support (i.e. enabling computers to infer further information from a set of asserted facts) in revealing different gender ideals and inferred relationships between metaphorical concepts, along with the benefits of the Semantic Web in making information about gendered contents more easily retrievable to the users.

Introduction

The "GenderedCHContents" ontology is a formal model for semantically describing gendered aspects of the content of Cultural Heritage (CH) resources. It has been designed by extracting relevant concepts from five different artefacts (two textual resources and three digital images) depicting Pandora. We chose Pandora's myth because it forms a representative sample of ancient beliefs about the creation of the first woman and an example which displays a variety of metaphors regarding women's roles and characteristics. Further, by using resources from different periods (8th-7th and 5th centuries BC, and 16th and 19th centuries AD), which are inspired by the same myth and thus, by representing different implementations of the same myth, the ontology enables users to compare and obtain insights about the historical backgrounds and the gendered ideas that each resource entails. Therefore, this study aims to evoke a critical representation of gender ideals in a historical perspective (see Section Scope and Overview of the Ontology). [1]

With this ontology, we aim to open the way to bridge the gap of querying and accessing semantic data on the Web related to gender concepts (i.e. *GenderRoles*, *GenderIdentity, GenderedTraits*, etc.) through a semantics-based representation of the content of CH artefacts: that is focusing on the description of graphic or literal representation of entities within the CH artefacts. The ontology is extensible so that further gender-related concepts can be added as extensions (e.g. subclasses) to its current structure. [2]

This study is focused on women but at the same time the designed ontology enables the representation of figures of all genders and statuses. The focus on women is justified as an attempt to underline the importance of combining Semantic Web applications and gender studies in order to reduce the gap between online historical representations of women on the Semantic Web. We approach gender as a mode of social construct which represents roles, norms, and meanings that different societies assign to men and women. Thus, we chose to use the term gender in the "GenderedCHContents" ontology, since gender is what societies make of the biological differences between males and females and the things associated with them "on account of their real or imagined sexual characteristics" [Anderson 2015]. As Kirkup notes, gender is seen as "a property of individuals, social structures and symbolic systems. Gender relations are at the same time power relations which lead to unequal access to material resources" [Kirkup 2000, 3]. In this framework, the ontology can be seen as a semantic tool for organising and accessing gender-related concepts, but also as a means to enable semantics-based search over the Web (e.g. such as in http://collection.britishmuseum.org/). This is a more efficient and effective way to retrieve CH artefacts in relation to gender, compared to traditional keyword-based search. [3]

In order to represent the gendered contents of CH artefacts so that this information can be more accessible on the Web, we used technologies from the Semantic Web. To develop the "GenderedCHContents" we extended the Europeana Data Model (EDM), which acts as an integration medium for collecting, connecting and enriching descriptions of Europe's CH data [Europeana 2014, 8]. We took into consideration the restrictions and capabilities of the Web Ontology Language (OWL) and the feminist criticism of ontologies and Artificial intelligence (AI).[1] The main reasons for choosing OWL as the ontology language were its compliance with the Resource Description Framework (RDF), which is the standard metadata model for the Web; its ability to express complex semantic relationships among the objects represented in CH artefacts; and its support for inference, which makes it possible to deduce further ontological knowledge, not explicit in the code. Finally, we used the Protégé ontology editor to implement and validate the ontology.[2] [4]

We first present the theoretical and technical background of our work. We then present the "GenderedCHContents" ontology and a demonstration of its use in five different representation tasks related to Pandora's myth. Finally, we summarise and discuss our plans for further validation of the ontology. [5]

Background and Related Work

Feminism and Computer Science

Feminist theories of gender and technology, as Wajcman points out, have changed perspectives over the years. In the 1960s, early second-wave feminism [6]

generated a fatalism, which focused on the role of technology in reproducing patriarchy. On the other hand, during the 1990s, cyberfeminism approached digital technologies as "inherently liberatory for women" [Wajcman 2007, 287]. Recently, feminist scholars such as Faulkner [Faulker 2001], Oudshoorn et al. [Oudshoorn et al.2004] and Wajcman [Wajcman 2004] have followed a co-construction approach to gender and technology, criticising technological determinism [Wajcman 2007, 287–288]. This determinism, as Björkman discusses, was detected in feminist/gender works regarding computer science (CS), where research focused on gender equality aspects and CS was seen as neutral and objective [Björkman 2005, 179]. Contrary to this belief, our study approaches the relationship between gender and technology as one of mutual shaping, "where neither gender nor technology is taken to be pre-existing, nor is the relationship between them immutable" [Wajcman 2007, 288]. Therefore, we do not approach CS as neutral; on the contrary, we chose a gendered vocabulary when designing the "GenderedCHContents" ontology in order to fill the gap of representing gendered concepts on the Semantic Web (see Section The "GenderedCHContents" Ontology).

We acknowledge that the task of combining feminist theories and computer science is epistemologically challenging. On the one hand, feminists have criticised universal categorical distinctions. On the other hand, ontologies use abstract sets of elements, called classes, to group together specific objects with shared properties to represent a domain. Despite this contradiction, we chose to create a structured representation of gendered information to describe CH contents and demonstrate the socially constructed nature of categorical distinctions. By making this information available and retrievable, we aim to enable users to analyse the historically and socially constructed views on gender as found in CH artefacts. We took into consideration Lorber's call for a feminist de-gendering movement in order to "change the embedded gendered social order" by targeting the "processes and practices of gendering and their outcome – gendered people, practices, and power" [Lorber 2000, 80, 90–91]. Specifically, the study suggests a gendered vocabulary to enable the retrieval of gendered contents. Secondly, it opens the path for a de-gendered methodology in annotating CH objects by firstly acknowledging and representing the gendered norms found within artefacts.

The study takes into account the feminist epistemological approach of the situatedness of knowledge, where "all processes that produce knowledge are situated socially, culturally and historically" [Björkman 2005, 183]. Specifically, we focus on the Content of CH artefacts and attribute situatedness within the class *Entity*, which is a subclass of *Content*. *Entity* (*Person* / *Animal* / *Object* / *Demigod* / *Deity*) represents a figure/character depicted on a CH artefact which has specific emotions, posture, identity, roles, characteristics etc. within a given space, time and activity. Therefore, in this study, *Entity* is perceived as a carrier of gender ideals and the ontology provides the vocabulary to describe *Entity* and its gender connotations.

In order to provide a description of an *Entity* we focus firstly on the information found in the primary source and then on the secondary sources which provide an analysis of the primary sources in terms of content, symbolisms and meanings (e.g. to describe Pandora as found in Rossetti's Victorian oil painting, we consulted Pandora's description from the book *Pandora's box* [Panofsky and Panofsky 1956, 108–110] and the Rossetti Archive website) (see Section Ontology Validation and Demonstration). We are aware that the same content can have multiple subjective "readings". However, we believe that by providing access to different interpretations of the same *Entity*, the user can obtain a more complete and coherent idea of the complexities of the contents of CH artefacts, i.e. Pandora might be seen as a symbol of goodness or evilness, and both interpretations can be represented with the ontology. This may lead to the retrieval of contradictory information, which will enable users to do their own analysis and interpretation of the entities' roles and significations.

Furthermore, we underline the importance of expressing semantic relationships among the objects represented in CH artefacts by using RDF in line with Olson's view of the "web" and "connecting knowing" rather than following a linear and hierarchical structure as practised in catalogues, indexing and databases. In this spec, Olson presents three approaches: "enhancing browsability as compared to linear searching; focusing on nonhierarchical relationships within standards; and increasing the functionality of syntagmatic relationships within surrogates" [Olson 2007, 511–12, 532]. Thus, by focusing on representing relationships between concepts, the current study aims at demonstrating entities' roles and relations with other classes within CH artefacts.

Semantic Web

Overview

Semantic Web [Berners-Lee et al. 2001] advocates the representation of information on the Web in a structured, machine-interpretable format, thereby allowing automated reasoning, i.e. enabling computers to detect inconsistencies or infer new information from a set of asserted facts, and advanced added-value services on the uploaded data. The Semantic Web and related semantic technologies build on ontologies, which provide a means to formally define the basic terms and relations that comprise the vocabulary of a certain domain of interest. As such, they essentially represent the schema that the associated data descriptions should follow. To be usable in the uncontrolled Web environment, ontologies, as well as their associated data, need to be represented in a uniform, platform-independent, machine-interpretable and semantically-enriched format, using a generic language. This need is covered by the standard data model for representing information in the Semantic Web, RDF, which models data using triples (s, p, o), denoting that a *subject* (s) is associated with an *object* (o) via a *property* (p). The RDF Vocabulary Description Language, RDFS,[3] is an extension of RDF that enables defining domain-specific semantics, using simple constructs (classes, properties and individuals) and relationships (class and property subsumption). RDFS also supports some basic types of reasoning, via the transitivity of the subsumption hierarchies, and its propagation to the classification of individuals into classes/properties. For even more sophisticated semantics and reasoning, OWL and its more recent version, OWL2,[4] have become dominant. These allow more expressive semantics, such as the specification of custom properties for relations (e.g. transitivity or symmetry), existential or universal quantifiers, operations among classes (union, intersection, complement) and others. These languages have been widely used to model information in different domains, including health, law, culture, media, geography, e-governance, life sciences and cultural heritage (e.g. such as the ReDD-Observatory project; the Linked Jazz research project; GoodRelations ontology; the BBC Web; the Research Space project and the Open Government Data).[5]

Cultural Heritage and Gendered Artefacts

Doerr describes CH "as the material evidence of human activities of social relevance in the past" and he explores the characterisations of the discourse in CH as reflected in data structures and ontologies [Doerr 2009, 464]. Doerr also underlines that, in order to handle information about all the different kinds of CH artefacts, the use of rich terminology is needed. He notes that formal ontologies deal not only with technical problems, but also with "intellectual challenges in the approximation of intuitive or traditional concepts by logical definitions, such as the possible narrower and wider meanings of the same

term, objective declaration of discriminating features or fuzzy transitions of instances from one class to another" [Doerr 2009, 465]. Moreover, he notes that there is not an adequate formalisation of the major terminological systems in the sector of CH, but as he suggests "this may be overcome by a gradual transfer of know-how and better appreciation of the specifics of cultural conceptualization by ontology engineers" [Doerr 2009, 465]. These observations were taken into consideration to decide which terms to use in the ontology in order to represent classes and properties. Specifically, we referred to the *Encyclopedia of Gender and Society* [O'Brien 2009] for choosing the gendered vocabulary and the definitions of terms (see Section The "GenderedCHContents" Ontology).

Oudshoorn et al. used two different approaches to theorising the gendering of CH artefacts: the genderscript approach, which captures "all the work involved in the inscription and de-inscription of representations of masculinities and femininities in technological artefacts" [Oudshoorn et al.2002, 473] and the domestication approach, which emphasises the role of people in attributing gender to objects [Oudshoorn et al.2002, 471]. They see artefacts as embodiments and a materialisation of social relations [Oudshoorn et al.2002, 471]. In addition, they criticise the fact that in contemporary culture, material objects are not perceived as social agents but on the contrary, they are perceived as socially neutral, and thus, they empower and maintain their embodied social relations [Oudshoorn et al.2002, 471]. Oudshoorn et al. also note that feminists have shown how "gender is further imprinted onto objects through instructions, advertisements, associations with gendered divisions of labor, and associations with gender symbols and myths" [Oudshoorn et al.2002, 472–473]. Further, they emphasise the importance of studying the inscription of gender into artefacts, as this helps understand the ways in which technologies enable or not specific performances of gender identities and relations. In other words, technologies can influence the ways in which hegemonic representations of gender are perceived [Oudshoorn et al.2002, 473].

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These considerations made, the current study aims to identify and semantically annotate gendered entities, symbols, myths and metaphors within CH objects by suggesting a specific gendered vocabulary. We acknowledge that there are some issues with regard to simplistic "identification" of such relations, i.e. assuming transparency of these relations within objects. The study aims to avoid simplifications by consulting secondary sources and their analysis of CH objects when describing the contents of these artefacts in order to provide access to different interpretations of gender relations etc. within artefacts.

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Further, as Bath underlines, the view of gender as inscribed in artefacts raises the danger of social determinism, leading us to assume, for example, that the social determines the technological [Bath n.d.]. Bath's work on de-gendering information technologies focuses on artefacts and their design aiming not at "a gender-neutral technology (or at creating a technological space where gender does not matter)" but at preventing technology design from gendering processes [Bath n.d.]. Bath mentions that a contextual analysis of the specific technology must be made in order to identify gendering processes and find design methodologies that enable the modelling of the de-gendered technology [Bath n.d.]. The study takes the above into account, but rather than de-gendering technology, the proposed gendered vocabulary in the "GenderedCHContents" ontology is intended to open the way of identifying gendering processes in CH artefacts. It does so by making gendered contents accessible in order to enable users to gain insights into inscribed cultural norms and gender beliefs in different historical periods.

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Moreover, our study aligns with Mulvey's view on representations of women in art, as presented in the *Encyclopedia of Gender and Society*. Specifically, Mulvey, as cited in O'Brien [O'Brien 2009], pointed out that, since art and virtual culture "are not merely reflections but also sites of construction of gender identities, they make an apt site for feminist and queer interventions through the production of alternative representations" [O'Brien 2009, 44]. Thus, by acknowledging that CH artefacts are reflections of views of different societies, the focus of the ontology on metaphors aims to reveal these social reflections. It is also acknowledged that "woman" is not a solid and unchanged concept but is connected to ideas of specific periods, places and societies.

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Ontologies for Cultural Heritage and Narrative Representation

The international standard for the representation and exchange of CH information is the Documentation of the International Council of Museums (CIDOC) Conceptual Reference Model (CRM). This ontology facilitates "the integration, mediation and interchange of heterogeneous cultural heritage information" [Le Boeuf et al. 2015, 1]. The "GenderedCHContents" ontology builds upon the EDM, which collects, connects and enriches the descriptions provided by Europeana content providers. EDM is aligned to CIDOC-CRM in its definition of an event-centric model. In order to implement its tasks, the EDM uses two main categories. Firstly, it re-uses elements from other namespaces; specifically, from the RDF and the RDFS namespaces, the Open Archives Initiative Object Reuse and Exchange (OAI-ORE) namespace, the Simple Knowledge Organization System (SKOS) namespace, the Dublin Core namespaces for properties from the elements, terms and types namespaces, the W3C Data Catalog Vocabulary (DCAT) namespace, and the Creative Commons (CC) namespace.[6] Secondly, it uses the elements introduced by EDM [Europeana 2014, 8].

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Despite the development of these ontologies, as Doerr comments, museums do not show an interest in using discrete schema elements to analyse iconographic representations [Doerr 2009, 474]. Similarly, Damiano and Lieto underline that there is a contradiction between the huge quantity of resources published on the Web in recent years, and the inadequate way that these resources are described. As they note:

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> the way they are described is far from meeting the requirements of content-based access required by the general public: neither their description in terms of editorial metadata nor the tags added by users seem adequate to describe the content of media resources, and fall short of providing an effective access to digital media. [Damiano and Lieto 2013, 76]

By developing the "GenderedCHContents" ontology, we suggest that a content-based description of artefacts is essential, especially in the field of CH, in order to facilitate the retrieval of gender-related concepts and encourage different interpretations of CH artefacts. As Damiano and Lieto further mention, media studies show that users, when tagging artworks, tend to describe the content of the artworks [Damiano and Lieto 2013, 76]. Therefore, a description of the content of CH artefacts could be useful to users in order for them to obtain a more holistic idea of the represented artworks or even question and rethink represented gender norms and beliefs.

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Different story ontologies have also been developed recently, aiming to model narrative concepts. For example, the BBC's "News Storyline" Ontology is a generic model that describes and organises the stories that news organisations present, but it is focused on the representation of news rather than on CH artwork stories.[7] On the other hand, the Contextus Project aims "to allow people to explore and analyse narratives [in heterogeneous media] through the

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annotation of those works with semantic descriptions" [Describing Narrative in the Digital World n.d.]. Further, the "Stories ontology" was developed in collaboration with the BBC, "to create an ontology for narrative representation that could be applied across a diverse set of cases" [Linked Open Vocabularies n.d.]. Moreover, within the same project, the "OntoMedia" ontology was developed in order to represent heterogeneous media by semantically describing their content. Thus, its scope is to enable users "to have easy access to the type of details that previously would have been impractical to search for due to the sheer effort it would have taken to collect and correlate" [OntoMedia n.d.].

Another example, the Labyrinth system, which is targeted at CH dissemination and digital publishing, focuses on the notion of "cultural archetype" and is based on the "Archetype ontology" [Damiano and Lieto 2013, 77]. This ontology has been designed to support reasoning "on the relations among characters, actions and stories, while abstracting from different genres and media types" [Damiano and Lieto 2013, 77]. Its role-based schema is closer to the aims of this study, since the focus of the "GenderedCHContents" ontology is centred on the concept *Entity* (*Person* / *Animal* / *Object* / *Demigod* / *Deity*). The current study, therefore, was influenced by Archetype's aim but did not follow the same developing strategies in defining the basic concepts and properties because the central role here is found within entities and their gender relations rather than on the stories.

The GenderedCHContents Ontology

Scope and Overview of the Ontology

The "GenderedCHContents" ontology (see Figure 1) was developed as an extension of the EDM to semantically describe gendered CH contents. Since EDM does not provide the capability for representing gendered concepts, we focused on filling this gap. EDM uses Dublin Core's property, *dc:description*, which "may include but is not limited to: an abstract, a table of contents, a graphical representation, or a free-text account of the resource" [DCMI Metadata Terms n.d.]. Since EDM specifies that it is mandatory to supply either a *dc:description* or a *dc:title* [Europeana 2014, 51] for a resource, it is evident that limited information about the content of the resource is provided to the user, and, when provided, it is in a free-text form. Currently, users can search the Europeana website using keywords (search terms); they can also browse its material using facets for collections, media, terms of use, providing country, language, aggregator and institution. There is no facet, however, related to the content of artefacts (see Figure 2).
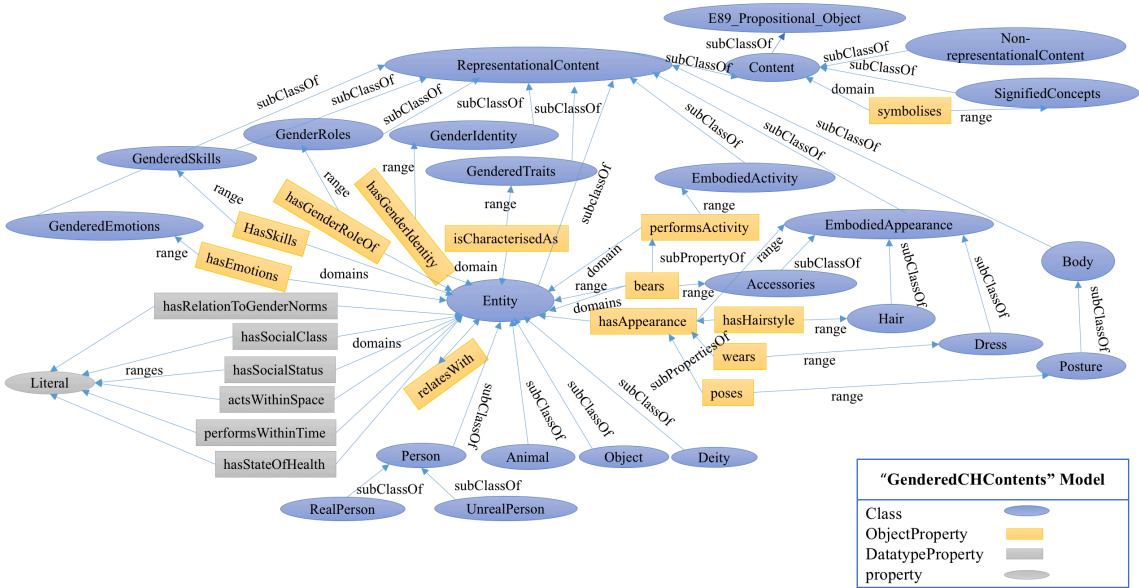
Figure 1. Graphical Representation of the "GenderedCHContents" Ontology. The code of the ontology is available at: https://github.com/ucldis/dh/blob/master/GenderedCHContents.owl [Accessed 5 Dec. 2016].

Moreover, the description of a resource is represented (by the underlying ontology) via an annotation property, and therefore has the form of "flat text". As a result, to retrieve a resource based on the description of its content, the user has to use the exact keywords from the description of the resource, which makes the task even more difficult. This is because annotation properties do not carry any meaning under the direct semantics of the ontology language [Antoniou et al. 2012, 104]. In the "GenderedCHContents" ontology we represent gendered concepts and their relationships using classes, object and datatype rather than annotation properties, enabling a semantics-based description of gendered contents.
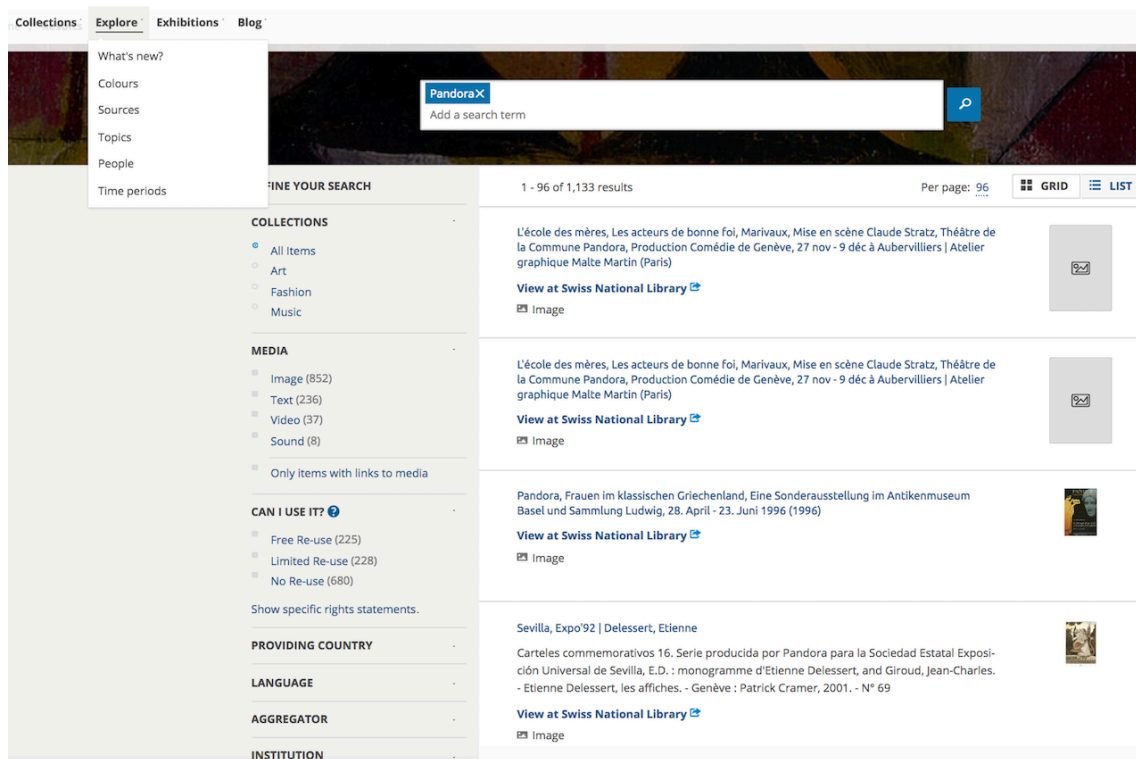
Figure 2. Screen shot of the Europeana website displaying the search results when entering the word "Pandora" [Accessed 30 Jan. 2017].

Procedure

The general steps we followed for the creation of the ontology were the following: first, we represented the relevant concepts as ontology classes by choosing the gendered vocabulary and its definitions as found in the *Encyclopedia of Gender and Society* [O'Brien 2009] while investigating and extracting relevant concepts from the textual and pictorial representations of Pandora in five resources. Specifically, we used information from two textual resources: Hesiod's *Theogony* and *Work and Days* (8th–7th century BC). We also used three digital images of Pandora, from respectively the red-figured wine bowl (calyx-krater) vase of the classical period attributed to the Niobid Painter, the 16th century Pieter Serwouter's engraving, and Rossetti's Victorian oil painting (1871) (see Figures 3a, b, c). By semantically describing the figure of Pandora as expressed in resources from different periods, we aimed to explore the different implementations of the myth and enable a comparative representation of the notion of woman over place and time. The "GenderedCHContents" ontology provides abstract classes to describe individual objects, as found in the resources. Even if we use universal/abstract terms to describe a set of elements (i.e. *Content*, *Entity*, *Person*), we focus on the individual, partial and locatable information that each artefact entails.

Figure 3. Image of the red –figured calyx-krater displaying the creation of Pandora[8]. Figure 3b: Image of Serwouter's engraving (nl) Pandora en Epimetheus[9]. Figure 3c: Image of Rossetti's Victorian oil painting of Pandora[10].

Hesiod's *Theogony* and *Work and Days* are the first to narrate Pandora's creation, and the other sources are representatives of the myth in different historical periods: the red-figured wine bowl (calyx-krater) vase of the classical period, Pieter Serwouter's engraving of the early modern period, and

Rossetti's oil painting for Victorian period. We based our semantic description of the red-figured wine bowl vase (see Figure 3a) on the investigation of the digital image of the vase in the British Museum's Collection online database, and on its online description.[11] Similarly, for Serwouter's engraving of Pandora (see Figure 3b), we considered the online digital description available on the Europeana website [Europeana 2014] and that from the book *Pandora's box* [Panofsky and Panofsky 1956, 80–82]. We used the same book as a source of information for Rossetti's Victorian oil painting of Pandora [Panofsky and Panofsky 1956, 108–110] (see Figure 3c); for this painting we also considered relevant information from the Rossetti Archive website.[12] For *Theogony* and *Work and Days*, we used their English translations, which we found in the Perseus website.[13]

The second step consisted of defining the ontology properties that relate the ontology classes, specifying the property characteristics and constraints over the elements of the ontology. We then instantiated the ontology with individuals (or instances of the classes), which are the basic, "ground level" components of an ontology, and with property assertions (statements) to describe Pandora in the five resources.

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The benefit of providing a structure of abstract classes and their relationships with the classes to which the individual objects belong, is that it enables the formation of semantic annotations and, as a result, the semantics-based retrieval and access to that specific information. For example, Pandora is an instance of the class *Person* and is also related to other classes in that it has specific *GenderRoles*, *GenderIdentity*, *GenderedTraits* (see Section Main Classes). By semantically annotating her description in different CH artefacts, the user can obtain insights about her depiction and her roles within a primary source and compare that representation with other sources of different periods. Thus, the ontology provides the schema to represent gendered descriptions of CH artefacts. This, however, does not mean that all classes or properties need to be used when describing an artefact, since for each individual artefact this description may vary (i.e. correspond to multiple classes and relationships) or some classes and properties might not always be applicable for certain instances.

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Main Classes

The "GenderedCHContents" ontology contains twenty-two classes which form the conceptual representations of the CH artefacts' gendered content (see Figure 4). These extend the EDM by adding twenty-two new classes, defined as subclasses of *E89_Propositional_Object*, which EDM reuses from CIDOC CRM and it is equivalent to *edm:InformationResource*.
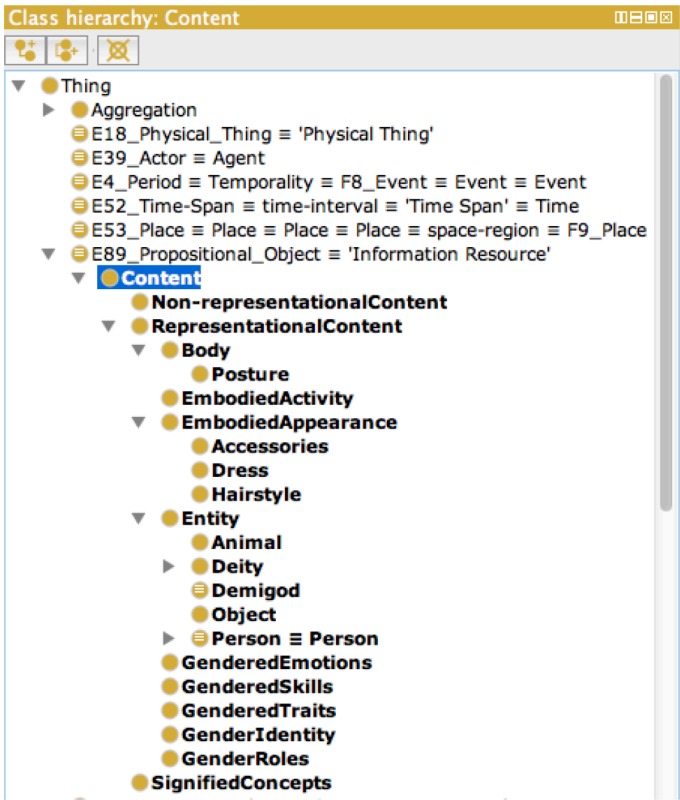
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Figure 4. Classes and subclasses of the ontology (Screen shot of Protégé)

The class *E89_Propositional_Object*, as defined by CIDOC CRM, comprises "immaterial items" like "stories, plots, procedural prescriptions, algorithms, laws of physics or images that are, or represent in some sense, sets of propositions about real or imaginary things and that are documented as single units or serve as topic of discourse". Moreover, it "comprises items that are 'about' something in the sense of a subject" [Le Boeuf et al. 2015, 33–34]. Similarly, *edm:InformationResource* "is a resource whose essential characteristics can be conveyed in a single message" and it has a URI and a representation [Europeana 2014, 14].

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We extended the EDM with a new class named *Content* (see Figure 4), which we defined as a subclass of *E89_Propositional_Object*, for it provides a description of the content of CH artefacts. This new class represents the thematic topics that each resource is related with. In the case of literary resources *Content* refers to "what is said in a literary work, as opposed to how it is said" [Baldick 2008]; and in the case of visual resources, to describe what is depicted on them. The thematic topics are usually the results of an interpretation of the meaning of CH artefacts, which takes into account their historical

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and cultural context.

Although each content consists of a narrative, we decided not to include the term "narrative" in the class *Content* in order to emphasise that content contains a narrative which is expressed through some medium, in this case an image or a text. Thus, by using the term *Content*, we applied the more general concept, which denotes the connection with the form and context of CH artefacts.

We added three new classes, *Non-representationalContent*, *RepresentationalContent* and *SignifiedConcepts*, as subclasses of *Content* (see Figure 4). The first two are used to distinguish artefacts based on the structure of their contents. *Non-representationalContent* refers to abstract and non-figurative art or literary description which does not aim to reference reality, whereas *RepresentationalContent* refers to depictions of figures, etc. This distinction is not absolute, in the sense that an artefact may be associated to more than one of the subtypes of content.

The class *SignifiedConcepts* borrows the "term" signified from Semiotics [Saussure et al. 1986] and is used to connote meanings that entities may carry and, in this case, meanings related to gender symbolisms. We defined this class as a subclass of *Content* to show that every *Entity*, which is a subclass of *Content*, can potentially refer or stand for something other than itself (see Figure 5). This class enables the representation of metaphors related to women and, thus, an illustration of these symbolisms through the meanings that the concepts convey. For example, *HesiodsTheogonyPandora* isAssociatedWith *Laziness* (see Section Ontology Validation and Demonstration, Metaphors). We declared all other classes of our ontology (e.g. *Entity*, *Body*, *EmbodiedActivity* etc.) as subclasses of *RepresentationalContent*, since this superclass contains all the representational entities which convey descriptive characteristics about gender.
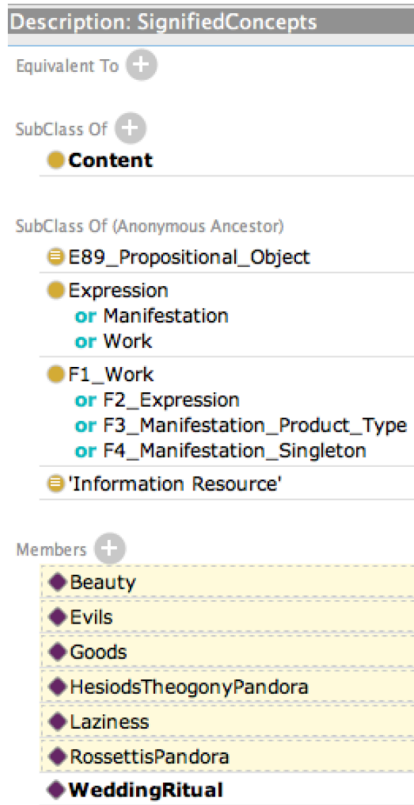
Figure 5. Description of the class SignifiedConcepts

The core concept of this ontology is the class *Entity*, which is the "starting point" for detecting, describing and accessing figures of women within a content. *Entity* includes the subclass *Person*, which represents all women's figures. *Entity* contains all entities that have distinct and independent existence, being and form. Therefore, *Animal*, *Object*, *Deity* and *Demigod* are also subclasses of this class. We declared *Person* as equivalent to *foaf:Person* that EDM reuses from Friend of a Friend (FOAF): "the Person class represents people. Something is a Person if it is a person. We don't nitpic about whether they're alive, dead, real, or imaginary" [FOAF Vocabulary Specification n.d.].[14]

Unlike FOAF, our ontology differentiates between real and imaginary people by using two subclasses of *Person: RealPerson* and *UnrealPerson*. The first refers to people who lived in real life – there is historical evidence of their existence – whereas *UnrealPerson* refers to all characters and figures that are fictional, mythological and imaginary. With this grouping we aim to reveal different ideas about characteristics and roles that historical and imaginary entities represent in specific contents. The ontology can be further extended in the future by adding properties which can demonstrate similarities and differences between the two classes. We acknowledge that the categorisation of CH artefacts can be a complex process, in that for example, it is not historically clear if the ancient Greeks believed in their myths [Veyne 1988] and if Pandora was seen as a historical or as a mythological figure in Hesiod's period, or even, whether she was perceived as a mythological figure in the classical period. The ontology offers the flexibility to support all these different presumptions by enabling an individual (e.g. Pandora) to belong to one of or both subclasses of *Person* (*RealPerson* and *UnrealPerson*), demonstrating the complexity of interpreting the content of CH resources.

Deity class refers to supernatural beings and conveys ideas about the sacred. Since "images of deities reflect and shape understandings of sexual

difference and the cultural meanings attached to biological sex", this class is used here as a resource that can illustrate beliefs and cultural visions, providing insights into social behaviour [O'Brien 2009, 191]. Moreover, *Demigod* is defined as a class that has partially divine and partially human characteristics. The *Object* class refers to all material things and the *Animal* class to all living organisms which feed on organic matter.

Further, we added the class *Body* and its subclass *Posture*. This refers to the position of the body, to gestures and to bodily attitudes, to represent "norms and ideals about standard body shapes [that] are culturally expressed in intentional and unintentional ways" [O'Brien 2009, 82]. *Body* refers to the physical structure of a living entity. Also, since "cultural, economic and political factors are literally visible on the bodies of society members" [O'Brien 2009, 86] we added the classes *EmbodiedAppearance* and *EmbodiedActivity* to examine and analyse bodily representations of entities and their actions.

<div style="text-align:right">37</div>

EmbodiedAppearance, which refers to the way a body looks, has three subclasses: *Accessories*, *Hairstyle*, and *Dress* (see Figure 4). It designates "gender-differentiated body conceptions", which reflect a "conception of men and women as essentially different" [O'Brien 2009, 86]. This class aims to represent different appearances in order to demonstrate how human bodies can vary, aiming to question the "absolutist classifications of dominant sex/gender understandings" [O'Brien 2009, 86–87]. *Accessory* refers to all things that complement a person's appearance, *Hairstyle* to the way in which an entity's hair is cut and arranged, and *Dress* to the clothing that entities wear. To describe any type of appearance that does not fall under one of the three subclasses (e.g. body painting), one can either directly associate it to the main class (*EmbodiedAppearance*), or extend the ontology by adding another relevant subclass.

<div style="text-align:right">38</div>

EmbodiedActivity refers to the performance of an entity, "engaging in a set of behaviours that display an individual's gender identity as female or male and that cause the individual to be so perceived during social interaction" [O'Brien 2009, 366]. *GenderedTraits* pertains to the characteristics ascribed in the sources to a specific entity. It aims to represent these traits and relate them with an entity's identities. *GenderIdentity* represents gender identities as described by or as performed in the resources. By creating the class *GenderIdentity* we aimed to include all categorisations that have been historically made and, based on these, to represent all the different relations between identities, roles, emotions and embodied activities. Further, the *GenderRoles* class refers to the distinct social roles assigned to men and women. "Gender role" is understood as a set of expected actions and dispositions ascribed to an individual on the basis of her or his assumed biological sex [O'Brien 2009, 371]. *GenderedSkills* refers to stereotypically gendered activities that genders may perform (such as cooking being female, fighting being male). Finally, the class *GenderedEmotions* represents the feelings that derive from an entity, which "might be symbolically gendered even if men and women do not manifest it differently" [Anderson 2015].

<div style="text-align:right">39</div>

Properties

The second step in developing the ontology was to determine the relationships within the ontology. For this purpose, we created sixteen object properties (see Figure 6).
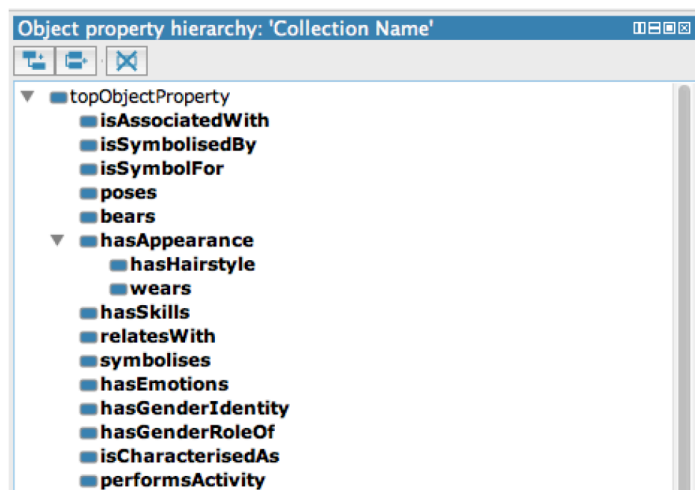
<div style="text-align:right">40</div>

Figure 6. The Object Properties of the Ontology

All properties except *isAssociatedWith*, *isSymbolFor* and *symbolises*, have *Entity* as their domain. This choice underlines the focus on the *Entity* class to represent the gendered characteristics, roles, emotions, etc., which this class relates with. In order to represent the appearance of an entity, we added the *hasAppearance* property with *EmbodiedAppearance* as range. The *hasAppearance* has two subproperties: *hasHairstyle* and *wears*, with ranges *Hairstyle* and *Dress* respectively, to demonstrate the physical characteristics and appearance of the figure. The *bears* property also contributes to the descriptive representation of the entity, since it has *Accessory* or *Entity* as range, describing any accessories (e.g. bags) or living beings (e.g. babies) that someone may *bear*. The *poses* property, with *Posture* as range denotes movements of the body, gestures, body position and attitudes connected to the body. To describe an activity that an entity is engaged in, we added the property *performsActivity* with *EmbodiedActivity* as range. We also added the *hasGenderRoleOf* property, with *GenderRoles* as range, to describe an entity's social role. To demonstrate the different *GenderedSkills*, *GenderedEmotions*, *GenderedTraits* and *GenderIdentity* of an entity we added the four following properties (which respectively have the above classes as their ranges): *HasSkills*, *hasEmotions*, *isCharacterisedAs*, *hasGenderIdentity*. The relation between different entities can be described using the *relatesWith* property, which we defined as symmetric since it is equivalent to its inverse [Antoniou et al. 2012, 106].

<div style="text-align:right">41</div>

In order to represent the symbolisms that concepts entail, we created the *symbolises* property with *Content* as domain and *SignifiedConcepts* as range. This means that each entity that is part of a content potentially denotes a specific meaning. Further, in order to connect the symbol/signifier to the signified idea/meaning, we added two more properties which are inverse to each other: *isSymbolFor* and *isSymbolisedBy*. The latter has *Entity* as domain and

<div style="text-align:right">42</div>

Content as range (and vice versa for *isSymbolFor*). With this model, entities that have the role of symbols in specific contents and entities that are described by symbols are equally represented. In order to connect an entity that has a symbolic/metaphorical meaning with a concept that is related with the same meaning, we defined the *isAssociatedWith* property with *SignifiedConcepts* as domain and *Entity* as range. The ontology also reuses some of EDM's object properties in order to demonstrate the subject of the resource and to relate it with other similar resources.

In addition to the object properties, we also added seven datatype properties (see Figure 7) that associate instances of the class *Entity* to certain data values (e.g. numbers, strings, or dates). The domain of all these properties is, therefore, *Entity* and the range is rdfs:Literal, which is a built-in RDF class.
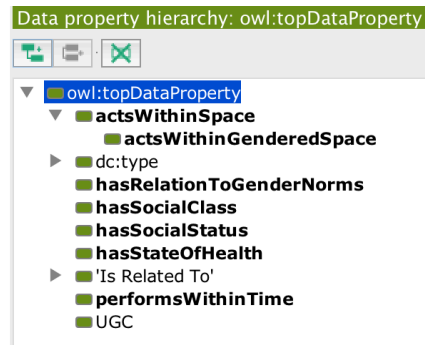
Figure 7. The Data Properties of the Ontology

Specifically, *hasRelationToGenderNorms* denotes whether a certain entity, through its embodied activity, appearance and role, complies with the gender norms ascribed to the individual's gender within its historical framework. This categorisation can be made by consulting secondary sources which analyse stereotypical behaviours and gender norms in the period in which an entity is presented (e.g. for women's roles in the ancient world, James and Dillon's [James and Dillon 2015] and Cohen's [Cohen 1994] works can be consulted). This property enables a representation of women's figures that repudiate specific norms and roles. It takes either "complied" or "not complied" as its value. In this way, the ontology can be seen as a research resource for identifying the changes between following or changing the ascribed gender norms in different CH artefacts.

Another important aspect that we attempt to implement with this ontology is the association of a figure with its social circumstances in order to show the link between social, economical and political factors that may influence and partially determine a figure. For this reason, we added the properties *hasSocialStatus* and *hasSocialClass*, which describe an individual's social position and reflect the roles, activities and identities that an individual holds within a social system. The acceptable values for *hasSocialStatus* are: "has status", "no status". This simplified model aims to be as inclusive as possible. Therefore, by denoting whether an entity has a status or not, we can group entities based on this characteristic. We acknowledge that in some situations this is not applicable or may be seen as an absolute classification. However, as a first step it would be interesting to gather figures that apply to this model and, as a second step, reconsider the use and naming of the specified values. The same applies to the property *hasSocialClass* since the only values it accepts are: "lower", "middle", "upper", and "not applicable". The limitation of this design is that these values classify an individual with values that represent social systems from the eighteenth century onwards, reflecting capitalist societies, whereas structures of earlier societies are not represented.[15] For this reason, we included "not applicable" as an acceptable value, to demonstrate that this is not the only hierarchical classification, and that it cannot be universally applied.

Another aspect captured by the ontology is the way that an entity is associated with health. We made this design choice because there is a broad literature referring to women and health, and how women are connected to mental disorders like hysteria, etc. in different historical periods (see, e.g. [Annandale 2008], [Tasca et al. 2012], [Gilman et al. 1993], [King 1998], and [King 2009]). The property *hasStateOfHealth* with acceptable values "healthy", "mentioned illness", "not mentioned" and "unhealthy", aims to classify each individual according to a specific state of health as represented within the resource. Therefore, it enables the retrieval of cases where mentioned/recognisable illness or representations of women in unhealthy states are displayed. This will make it possible for researchers to identify the kind of illness that a figure is illustrated with and reflect on ideas about health and body.

The study takes into account the concept of "the space–time fixity constraint that binds activities or series of acts to a specific place and moment in chronological time" [Schwanen et al. 2008, 2109]. It also takes into consideration attempts to deconstruct "dominant understanding(s) of time through, for example, drawing our attention to "women's time" as embodied in daily life" [Odih 1999, 10]. The term "relational time" was introduced in feminist discourse to describe "an experience of time that 'exists' in relation to an embeddedness in embodied social relations". Also, since it is "mediated through significant others", as Odih notes, "relational time is shared rather than personal and thus sensitive to the contextuality and particularity of interpersonal relations" [Odih 1999, 10]. In order to represent the space-time in which a character/entity exists, as presented in the sources, we added two datatype properties: *actsWithinSpace* and *performsWithinTime*. The former enables the semantic annotation of space and has rdfs:Literal as its range. It, therefore, accepts any used-defined values that denote space. Some possible values are: "abstract", to represent a non-representational space/place; "indoors" or "outdoors"; "private" or "public"; and "specified" or "non-specified" to denote whether there is a recognisable named place. The use of terms "public" and "private" aims to incorporate gendering theories of spaces[16] – when this information is transparent – and map the spaces where entities are presented. This is not an exhaustive list; depending of the content, new values can be added to describe space efficiently. Moreover, *actsWithinSpace* has *actsWithinGenderedSpace* as a subproperty to allow the semantic annotation of gendered spaces (i.e. women's quarters in households, gender-specific restrictions in baths and temples, etc.) where this information is transparent within the artefact. Currently, *performsWithinTime* accepts the following values: "abstract", when time is not specified; "ancient period" (3600 BC – 500 AD), "medieval period" (500 – 1500), "early modern period" (1500 – 1750) and "modern period" (1500 – present) to specify the historical time period in which an entity is presented; "day" and "night"; "narrative past", "narrative present" and "narrative future" to represent cases where an entity is clearly presented within a narrative and her/his actions, descriptions etc. refer to an explicit past, present or future of narrative time. The ontology provides the flexibility to add new values for representing more fine-grained dates.

Property and Class Axioms

The third step of ontology development was to define restrictions on the classes and properties of the ontology. Aiming to develop a generic ontology, which enables the representation of as many different resources as possible, we only added a small number of restrictions. For example, although declaring *RealPerson* and *UnrealPerson* as disjointed or as complementary to each other seemed to be a reasonable choice, we decided not to declare the distinction, considering that some resources may represent figures of uncertain historical status.

48

We defined one pair of inverse properties: *isSymbolisedBy* and *isSymbolFor*, as mentioned in the previous section, to underline the reciprocal relationship between signifier and signified.

49

We also defined a property chain, as shown below (see Figure 8).

50

SuperProperty Of (Chain) +
■ **isSymbolisedBy** o **symbolises** **SubPropertyOf** **isAssociatedWith**

Figure 8. Property Chain

We defined *isAssociatedWith* as a property chain of *isSymbolisedBy* and *symbolises*. This means that if an individual of *Entity* class *isSymbolisedBy* a specific content, and the content *symbolises* an individual of *SignifiedConcepts* class, then it is inferred that the same *Entity isAssociatedwith* the individual of *SignifiedConcepts*.

51

We added a class equivalence axiom to denote that *Person* is equivalent to *foaf:Person*, which EDM reuses, since both classes contain exactly the same set of individuals.

52

We defined *Demigod* as the intersection of *Deity* and *UnrealPerson*. This means that every member of *Demigod* is also a member of the *Deity* and *UnrealPerson*.

53

Ontology Verification and Validation

Overview

The verification and validation of the ontology has two goals [Vrandecic 2009, 295]: to verify its correctness with respect to the syntax and semantics of the ontology language – OWL in our case – and to assess its representational capabilities for modelling the domain it was designed for – in our case, the gendered concepts in the CH domain. To achieve the first goal, we used the HermiT OWL Reasoner,[17] which is pre-installed in Protégé. HermiT can check the logical consistency of an ontology; but it can also make inferences, e.g. deduce subsumption relationships between classes, based on the semantics of OWL. We conducted the verification while we were developing the ontology, so that we could identify and correct errors early in the development process.

54

For our second goal, we instantiated the ontology with RDF descriptions of the five resources, related to the myth of Pandora (see Section Procedure).

55

Description of Pandora in GenderedCHContents

Figure 9 depicts the RDF statements that describe Niobid's Pandora. She (*performsActivity*) stands in the centre of an abstract space and time (*actsWithinSpace/performsWithinTime*) holding two wreaths; her appearance is represented by means of the clothes she *wears* and her hairstyle. Individuals like "LongHairWithADottedFillet", "Apoptygma" and "DoricChiton" – which we added as values of the *hasAppearance* subproperties: *wears* and *hasHairstyle* – are also directly associated to the *hasAppearance* property through inference (the inferred relationships are in yellow in Figure 9).

56

Figure 9. Example of Niobid's Pandora Property Assertions

Metaphors

An important feature of the proposed ontology is the representation of metaphors related to gendered contents. Examples of metaphors can be detected in Hesiod's *Theogony* (see Figure 10) in *Works and Days* (see Figure 11) and in Rossetti's Pandora (see Figure 15). In these cases, inferences can be made in terms of symbolic concepts. Specifically, Figure 10 depicts the inference that *Theogony's* Pandora *isAssociatedWith* "Laziness"; Figure 11 that Pandora *isAssociatedWith* "PlagueToMen"; and Figure 15 that she *isAssociatedWith* "Evils". This is achieved by the application of the property chain discussed in the previous section.

```
Property assertions: HesiodsTheogonyPandora

Object property assertions ⊕
    ■isCharacterisedAs  BeautifulEvil
    ■wears  Garlands
    ■isCharacterisedAs  FirstWoman
    ■wears  EmbroideredVeil
    ■wears  SilveryRaiment
    ■'Is Similar To'  SerwoutersPandora
    ■hasGenderRoleOf  CreatorOfTheRaceOfWomenAndFemaleKind
    ■hasGenderIdentity  Woman
    ■wears  Crown
    ■isSymbolisedBy  Drone
    ■'Is Similar To'  NiobidsPandora
    ■hasGenderRoleOf  Wife
    ■'Is Similar To'  RossettisPandora
    ■isAssociatedWith  Laziness
    ■hasAppearance  Garlands
    ■hasAppearance  EmbroideredVeil
    ■hasAppearance  Crown
    ■hasAppearance  SilveryRaiment
    ■dc:relation  RossettisPandora
    ■dc:relation  NiobidsPandora
    ■dc:relation  SerwoutersPandora

Data property assertions ⊕
    ■actsWithinSpace  "specified"
    ■performsWithinTime  "ancient period"
    ■dc:type  "text"
```

Figure 10. Example of Hesiod's Theogony Pandora Property Assertions

```
Property assertions: HesiodsWorksAndDaysPandora

Object property assertions ⊕
    ■isCharacterisedAs  Graceful
    ■bears  Necklace
    ■poses  Longing
    ■hasSkills  Speech
    ■hasGenderIdentity  Woman
    ■poses  ShamelessMind
    ■wears  Belt
    ■poses  Voice
    ■hasSkills  Needlework
    ■performsActivity  CausedSorrowAndMischiefToMen
    ■bears  Wreath
    ■poses  Strength
    ■performsActivity  tookOfftheGreatLidOfTheJar
    ■hasSkills  Weaving
    ■relatesWith  Epimetheus
    ■hasGenderRoleOf  ModestMaid
    ■hasGenderRoleOf  Wife
    ■isCharacterisedAs  Deceitful
    ■isSymbolisedBy  Gift
    ■isAssociatedWith  PlagueToMen
    ■hasAppearance  Belt

Data property assertions ⊕
    ■dc:type  "text"
    ■actsWithinSpace  "specified"
    ■performsWithinTime  "ancient period"
```

Figure 11. Example of Hesiod's Works and Days Pandora Property Assertions

"Drone" is connected to Hesiod's *Theogony* Pandora, "Gift" with Hesiod's *Works and Days* Pandora and "Box" with Rossetti's Pandora through the property *isSymbolisedBy*. Since these individuals *symbolise*, respectively, "Laziness", "PlagueToMen" and "Evils", which are all instances of *SignifiedConcepts*, it is inferred that each Pandora *isAssociatedwith* these concepts (see Figure 12).
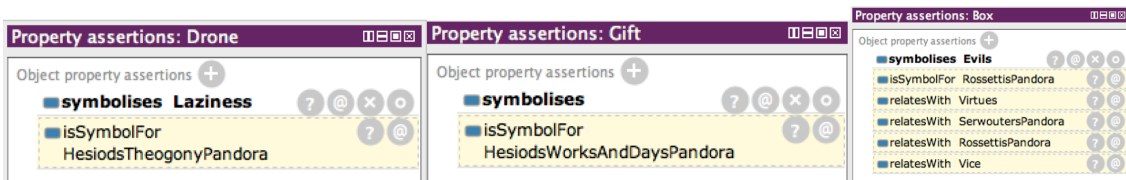
Figure 12. Property Assertions of the "symbols" Drone, Gift and Box

We also attempted to represent the mythological figures of Vice and Virtues, which are referred to in Serwouter's accompanying poem and in the engraving (see Figures 3b,13). According to the poem, Jupiter filled Pandora's box with good and evil to ensure a balanced state of affairs [Panofsky and Panofsky 1956, 82].
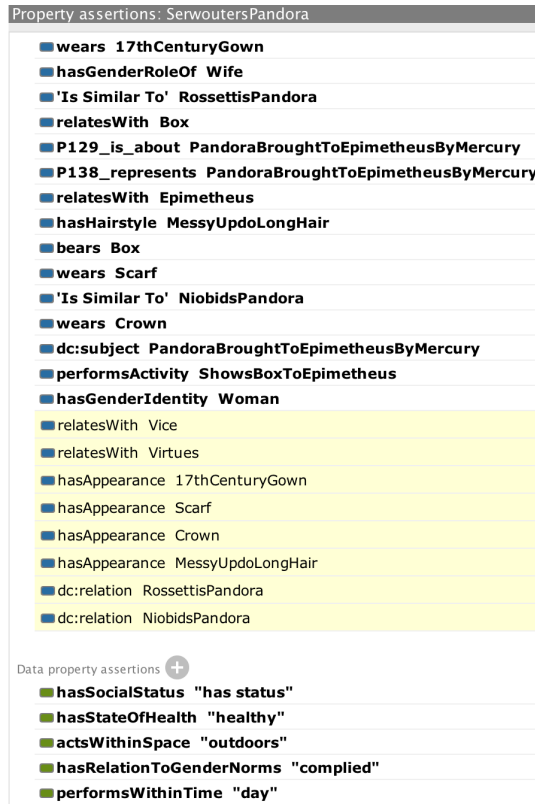
Figure 13. Example of Serwouter's Pandora Property Assertions

When Pandora opens the box, the Virtues, that symbolise "good", escape into the air and Vice spreads all over the earth. Thus, as depicted in Figure 14, "Vice" and "Virtues" are connected to the box through the *relatesWith* property, and the concepts that they symbolise appear as values of the property *symbolises*. It is, therefore, inferred that "Evils" are associated with Vice and the signified concept of evil. Also, Rossetti's Pandora (see Figure 15) associates with the evils that come out of the box, but in this case "Evils" have the form of smoke and not an anthropomorphic form, which is stated as follows: Pandora *poses* "EnvelopedBySmokeOfEvils".
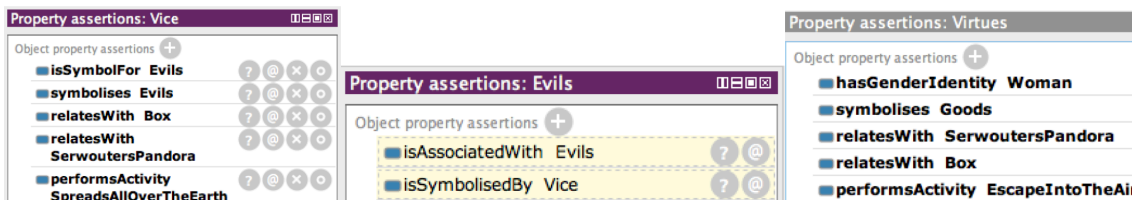
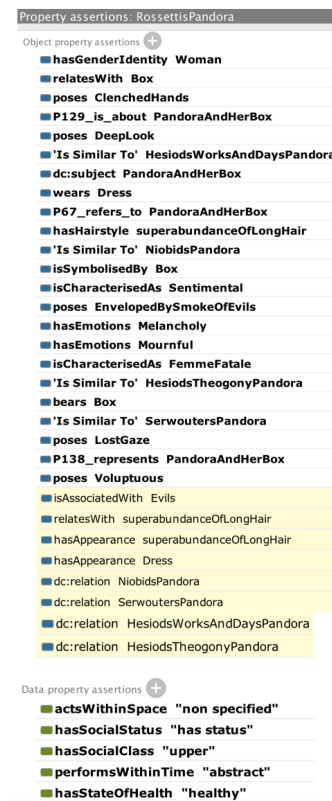**Figure 14.** Property Assertions of Vice, Evils and Virtues

Figure 15. Example of Rossetti's Pandora Property Assertions

In the above examples, we also demonstrate the symmetry of *relatesWith*. Another example, which demonstrates this feature, is this: Pandora in Serwouter's engraving *relatesWith* Epimetheus since she is his future wife, and therefore it is inferred that Epimetheus relates to Pandora (see Figure 16).
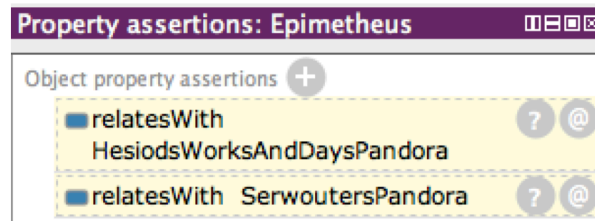

Figure 16. Example of the symmetric characteristic of the object property *relatesWith*

We classified "Virtues" using a specific gender identification (see Figure 14). We decided to represent them as "women" to enable the description of their anthropomorphic characteristics, but also to capture gendered notions related to women, for example the notions of good and evil, as traits inherited in woman's "nature". However, although "Virtues" may appear to have a female bodily figure (see Figure 3b), they still have non-human characteristics such as the ability to fly. Therefore, we additionally classified them as *UnrealPerson*. Thus, by simultaneously representing "Virtues" as *RealPerson* and *UnrealPerson*, the ontology enables the description of this instance using characteristics of both classes.

Lastly, similarities in appearance like long dress, wreath/crown and beauty, as expressed in different periods, are aspects that our ontology can also capture. Accordingly, by using, for example, the *edm:isSimilarTo* property to connect Niobid's Pandora to the other two digital artworks of Pandora, and considering that this property is a subproperty of *dc:relation*, it can be inferred that Niobid's Pandora is related to those artworks. The benefit of extending the EDM is evident in the last example, where our ontology enables us to interrelate all resources that share the same or relevant topic and contents (see Figure 17).

```
<!-- http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#NiobidsPandora -->

<owl:NamedIndividual rdf:about="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#NiobidsPandora">
    <rdf:type rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#UnrealPerson"/>
    <performsWithinTime>abstract</performsWithinTime>
    <actsWithinGenderedSpace>non specified</actsWithinGenderedSpace>
    <hasRelationToGenderNorms>complied</hasRelationToGenderNorms>
    <hasStateOfHealth>healthy</hasStateOfHealth>
    <actsWithinGenderedSpace>abstract</actsWithinGenderedSpace>
    <hasSocialClass>not applicable</hasSocialClass>
    <hasSocialStatus>has status</hasSocialStatus>
    <wears rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#Apoptygma"/>
    <poses rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#FeetCloseTogether"/>
    <poses rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#HandsAtSides"/>
    <performsActivity rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#HoldingAWreath"/>
    <hasHairstyle rdf:resource="http://www.semanticweb.
org/ioanna/ontologies/2015/6/gender#LongHairWithADottedFillet"/>
    <bears rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#Pin"/>
    <edm:isSimilarTo rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#RossettisPandora"/
>
    <edm:isSimilarTo rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#SerwoutersPandora"
/>
    <performsActivity rdf:resource="http://www.semanticweb.
org/ioanna/ontologies/2015/6/gender#StandsEnFaceInTheCentre"/>
    <dc:subject rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#TheCreationOfPandora"/>
    <cidoc-crm:P67_refers_to rdf:resource="http://www.semanticweb.
org/ioanna/ontologies/2015/6/gender#TheMythOfPandora"/>
    <cidoc-crm:P138_represents rdf:resource="http://www.semanticweb.
org/ioanna/ontologies/2015/6/gender#TheMythOfPandora"/>
    <cidoc-crm:P129_is_about rdf:resource="http://www.semanticweb.
org/ioanna/ontologies/2015/6/gender#TheMythOfPandora"/>
    <hasGenderRoleOf rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#Wife"/>
    <hasGenderIdentity rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#Woman"/>
    <hasEmotions rdf:resource="http://www.semanticweb.org/ioanna/ontologies/2015/6/gender#emotionless"/>
</owl:NamedIndividual>
```

Figure 17. RDF Description of Niobid's Pandora in the "GenderedCHContents" Ontology

We conclude that interpretations about the box and the goods and evils that Pandora and the box as gifts to men entail, are represented differently in the five examples. The emotions, activities, skills and postures are also depicted differently: from an emotionless Niobid's Pandora represented as a wooden statue to Rossetti's Pandora where the first woman is transformed to a femme fatale figure [Panofsky and Panofsky 1956, 109] (see Figure 15).

64

Further Validation

We acknowledge that the specific instantiation of the ontology was only a first step towards its validation. As Vrandecic notes, "most validation approaches require the close cooperation of domain and ontology engineering experts. Validation often cannot be performed automatically" [Vrandecic 2009, 295]. Therefore, as a further step, we suggest a more concrete and complete validation in collaboration with experts from the CH domain, who will evaluate different aspects of the ontology such as its vocabulary and semantics.[18]

65

Simultaneously, in order to evaluate the effectiveness of the ontology in the context of its application, we propose as a next step, a task-based approach to ontology evaluation. That is to tag ontological relations from a broader range of artefacts, including Psyche's, Persephone's, Atalanta's and Helen's representations in CH artefacts. More specifically, we suggest using a larger subset of study, including these myths, in order to test further how the ontology can be applied to semantically represent women and their relation to symbolic objects, such as the box in Psyche's myth [Apuleius et al. 1922], and the symbolic role of the golden apple in Atalanta's and Helen's myths.

66

This task-based evaluation can follow the same procedure we used to represent Pandora in the five CH artefacts (see Section Procedure) and will describe Psyche's description in Apuleius' *The golden ass: being the metamorphoses of Lucius Apuleius* [Apuleius et al. 1922], and in artworks of different historical periods, including: *Amor and Psyche* (1589) by Jacopo Zucchi, *Psyche Revived by Cupid's Kiss* (1793) by Antonio Canova, *Psyché aux enfers* (1865) by Eugène Ernest Hillemacher and *Psyche Opening the Golden Box* (1903) by John William Waterhouse.[19]

67

Moreover, the works of Colluthus' *Rape of Helen* and Ovidius' *Metamorphoses* 10.560 ff [20] will be used to represent the judgement of Paris and Atalanta's race with Hippomenes respectively. Paintings of these scenes will also be used to semantically annotate relevant contents, such us the Athenian red figure vase painting on the Judgement of Paris (C5th B.C.), Botticelli's *Judgement of Paris* (1485), Rubens' *Judgement of Paris* (1636), Crispijn van de Passe (I), after Maerten de Vos' *Atalanta en Hippomenes* (1602-1607), Reni's *Hippomenes and Atalanta* (circa 1620-1622), Colombel's *Race between Atalanta and Hippomenes* (1644-1717) and Hallé's Race between Hippomenes and Atalanta (1762-65).[21]

68

This task-based evaluation aims to measure the ontology's performance in representing a range of different descriptions of women and the symbols related to them as found in the CH artefacts.

69

Summary and Future Work

In this article we propose the "GenderedCHContents" ontology as an attempt to investigate ways in which different historical artefacts, when interpreted today, can create a gendered conceptual map of women's representations. The development of the ontology is a first step in bringing closer gender studies and Semantic Web technologies, aiming to represent semantically gendered contents on the Web. We are aware of the possible objections, epistemological debate or controversy inherent in any attempt to combine feminism and ontology engineering. Nevertheless, we consider it vital to pursue

70

and find a way to reconcile – even if via compromise – these fields in order to semantically represent gendered concepts within CH artefacts.

Taking into account the expressive power of OWL, the proposed ontology captures different types of relationships between gendered concepts and their contexts. For example, object and datatype properties provide a means to describe certain attributes of CH artefacts and their contents, as well as ways in which they may relate to each other. The subsumption relation of OWL enables a taxonomic representation of the relevant concepts and their relationships; property characteristics (e.g. symmetry) and axioms (e.g. inverse properties and property chains) enable inferring further relationships among the individuals; and restrictions on the classes and properties (e.g. value restrictions) were used to impose constraints on the range of semantic descriptions that one can create with the ontology. Our aim was to create a model which is generic enough to capture most relevant concepts and their relationships, concise so that it is easy for users to understand and create their own semantic descriptions, but also extensible to further types of information, which are not currently captured.

71

Finally, we suggest a further validation of the ontology by applying a task-based evaluation, in which the ontology will be tested with other sources.

72

Acknowledgements

Notes

[1] For further information related to feminist critiques of logic, languages and organisation of information see Olson [Olson 2007] who examines traditional/Aristotelian logic and its feminist critiques; and Bath's remarks on formalisation [Bath 2009].

[2] http://protege.stanford.edu

[3] http://www.w3.org/TR/rdf-primer/; http://www.w3.org/TR/2014/REC-rdf-schema-20140225/, respectively.

[4] http://www.w3.org/TR/owl-ref/; http://www.w3.org/TR/owl2-overview/; respectively.

[5] http://aksw.org/Projects/ReDDObservatory.html; https://linkedjazz.org/; http://www.heppnetz.de/projects/goodrelations/; http://www.bbc.co.uk/academy/technology/software-engineering/semantic-web; http://www.researchspace.org/; http://opengovernmentdata.org/; respectively.

[6] http://www.openarchives.org/ore/1.0/vocabulary; https://www.w3.org/2009/08/skos-reference/skos.html; http://dublincore.org/documents/dcmi-namespace/; https://www.w3.org/TR/vocab-dcat/; https://creativecommons.org/ns; respectively.

[7] http://www.bbc.co.uk/ontologies/storyline

[8] © Trustees of the British Museum. Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) license. British Museum Collection Database. (2015). calyx-krater "GR 1856,1213.1".

[9] http://europeana.eu/portal/record/90402/RP_P_1886_A_10526.html. RM0001.PEOPLE.1223. Rijksmuseum - http://www.rijksmuseum.nl/collectie/RP-P-1886-A-10526. Public Domain - http://creativecommons.org/publicdomain/mark/1.0/.

[10] http://www.the-athenaeum.org/art/by_artist.php?id=3, Public Domain - http://creativecommons.org/publicdomain/mark/1.0/.

[11] https://goo.gl/ZNbfZd

[12] http://www.rossettiarchive.org/docs/s224.rap.html

[13] http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.01.0130%3Acard%3D545; http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.01.0132%3Acard%3D59, respectively.

[14] http://xmlns.com/foaf/spec/#term_Person

[15] See Delle et al. [Delle et al. 2000] for a presentation of material culture as an active agent in the negotiation of social difference.

[16] See [Gieseking et al. 2014] for the ways in which space and place are produced through large- and small-scale social, political, and economic practices.

[17] http://hermit-reasoner.com

[18] See [Vrandecic 2009] for a description of different evaluation approaches.

[19] https://commons.wikimedia.org/wiki/File:Jacopo_Zucchi_-_Amor_and_Psyche.jpg; https://commons.wikimedia.org/wiki/File:Psych%C3%A9.jpg; https://commons.wikimedia.org/wiki/File:Psyche_aux_enfers.jpg; https://commons.wikimedia.org/wiki/File:Psyche-Waterhouse.jpg; respectively.

[20] http://www.theoi.com/Text/Colluthus.html#16; http://data.perseus.org/citations/urn:cts:latinLit:phi0959.phi006.perseus-eng1:10.560-10.651; respectively.

[21] http://www.theoi.com/Gallery/K4.6.html; https://commons.wikimedia.org/wiki/File:Botticelli-Juicio-de-Paris.jpg; https://commons.wikimedia.org/wiki/File:Rubens_-_Judgement_of_Paris.jpg; http://hdl.handle.net/10934/RM0001.COLLECT.322160; https://commons.wikimedia.org/wiki/File:Guido_Reni_-_Atalanta_e_Ippomene_(Napoli).jpg; https://commons.wikimedia.org/wiki/File:Nicolas_Colombel_002.jpg; https://es.wikipedia.org/wiki/Archivo:No%C3%ABl_Hall%C3%A9_-_The_Race_between_Hippomenes_and_Atalanta_-_WGA11034.jpg; respectively.

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