

A GRAPHICAL HUMOR ONTOLOGY FOR CONTEMPORARY CULTURAL HERITAGE ACCESS

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Abstract

Humor is a multifaceted communication phenomenon that has been approached from different perspectives in existing research studies. Such heterogeneity of views poses a challenge to the creation of metadata records for digital humor assets, if rich interpretive and descriptive sentences are desired for the construction of semantic access interfaces. Ontologies in the context of Semantic Web research provide the appropriate flexible representational framework for describing the many aspects and interpretations of digital humor artefacts. This paper reports the initial design of an ontology of humor artefacts engineered as part of a project that deals with semantic access to contemporary Spanish graphical humor. The main ontological commitments adopted – semantic frames and humor technique applications - are described, along with the annotation technique used and some illustrative examples of the richness that the approach provides to browsing interfaces.

Keywords: Contemporary cultural heritage, graphical humor, theories of humor, ontologies, Semantic Web.

1 INTRODUCTION

Humor and laughter are human communication phenomena that represent a multidisciplinary and fertile research field, as evidenced in the extensive review provided in Shibles' *Humor Reference Guide*¹. Nonetheless, there is not a commonly accepted theory for humor. Even though recent studies have begun to delineate theories of humor that provide an evolutionary interpretation to the diverse social, psychological and aesthetical facets of humor (Caron, 2002), the field has still not reached a level of maturity and consistency, as stated, for example, by Lefcourt (2001): "The subject matter is more in its early stages than at maturity". This represents a challenge for cultural heritage access applications in which the exploitation of humor interpretations is a requirement or a desirable property. This is due to the fact that the description of a given humor piece may be approached from a variety of perspectives. For example, the same piece of humor can be interpreted from the psychological perspectives of incongruity, tension relief or superiority, as described by Lynch (2002). As a consequence, the creation of comprehensive metadata records for digital humor assets should reflect the variety of aspects that are dealt with in humor studies, if interpretive statements are desired. In addition, a machine-understandable description of a humor piece requires the encoding of subtle and many times highly culture-specific knowledge. Moreover, contemporary humor pieces are often tied to understandings or critiques of social or political situations, which represents a challenge from the perspective of knowledge engineering.

Such heterogeneity requires a representational framework rich enough to specify metadata with (a) detailed interpretive and descriptive sentences for humor artefacts, and (b) enough flexibility to accommodate disparate views and facets of humor as a communication phenomenon, and to evolve in the future to integrate new perspectives originated in research about the subject. Ontologies as used in *Semantic Web* research (Berners-Lee, Hendler and Lassila, 2001) provide the required machinery for such needs. On the one hand, their underlying description logics formalism (Baader et al., 2003) allow for defining complex relationships and axioms that are useful in the description of the *frames* associated with the semantics of humorous communication (Rojo-López, 2002). And on the other hand, the widespread availability of open source software and specifications for Web-oriented ontology description languages (Klein et al., 2003) makes possible architecting access interfaces that exploit ontological definitions and are able to accommodate without changes extended versions of domain ontologies (García and Sicilia, 2003).

In this paper, we describe the first results in the process of engineering an ontology of humor (more specifically, of humor in the form of drawings, comics and other 'graphical' artefacts), as part of the efforts of an ongoing research project on contemporary cultural heritage access using *Semantic Web* technologies (García, 2004). The ontology described here is not intended to provide a definitive and comprehensive account of the many aspects of humor and humor research, but it aims at serving as a foundation for further specification efforts. In addition, the ontology is somewhat biased by the specifics of the database of humor resources that have been used in the *OntoVisual* project that motivated this work, but the overall ontological commitments are of a general applicability irrespective of the communication mean or support.

The rest of this paper is structured as follows. In Section 2, the main ontology elements and decisions are described (ontology terms and properties are typed in Courier font), providing illustrative examples of the descriptive possibilities provided by the ontological approach. Then, Section 3 sketches the concrete metadata annotation practice adopted. Finally, conclusions and future research directions are provided in Section 4.

¹ <http://facstaff.uww.edu/shiblesw/humorbook/>

2 OVERALL ONTOLOGICAL COMMITMENTS

The very notion of humor is elusive, and as a consequence, existing definitions are either not useful in practical terms, or partial in the sense that they do not cover aspects considered by other researchers. The recent work of Lynch (2002) has connected several psychological and sociological aspects of humor under a communication model: “At its most basic level, humor is an intended or unintended message interpreted as funny”, but it still lacks a consideration of other definitions, e.g. the consideration of humor as an emotion, and it does not consider explicitly that a humor artefact may have not ever been communicated, and it is still a resource intended as humor by its author. From the viewpoint of our task of creating metadata for digital humor assets, the actual object of study is the `HumorArtefact`, which can be defined both as an “information bearing thing” (IBT) subject to being interpreted as funny in communication acts, and as a “conceptual work”, depending on the intended usage.

The notion of IBT follows that of the class of the same name in the *OpenCyc* knowledge base², i.e. “A collection of spatially-localized individuals, including various actions and events as well as physical objects. Each instance of *InformationBearingThing* (or "IBT") is an item that contains information (for an agent who knows how to interpret it)”. This approach leaves open the definition of humor to the surrounding concepts and descriptions around humor artefacts. Even though not every humor manifestation is eventually codified, the domain of digital cultural heritage access deals only with information artefacts. In the CIDOC model, a similar concept is that of *Information Carrier*, a kind of *Man-Made Object*. This characterization is useful for describing the digital version of the humor artefact. In addition, it has the associated benefit of fitting the concept of learning object as described by Sicilia *et al.* (2004), which allows for selection and usage of digital humor pieces (*ComputerFileCopies* in *OpenCyc*) inside learning designs.

Another way of considering humor artefacts is describing them as *ConceptualWorks*. This concept in *OpenCyc* refers to creations that have informational structures. As such, a novel is a conceptual work, and the copies of the novel are the IBTs that realize that conceptual work. This view enables the separation of the digital artefact from the intellectual work of humor pieces, and enables the possibility of describing different instances of the same humor piece, let’s say, for example, for a humor piece that was published in two different magazines. CIDOC provides a similar concept *InformationObject*. Then, the annotations referring to the conceptual work in itself are attached to instances of `ConceptualHumorWork`, leaving the format and location details to information associated to concrete `HumorArtefacts` connected with the former through `instantiationOfWork` relationships.

Humor artefacts can be classified according to several dimensions, including date, format, narrative structure, intention and cultural constraints. Many of them are captured in current metadata standards oriented to e-learning, cultural heritage or basic description. For example, the Dublin Core³ describes basic identification, creators and contributors, coverage, description and format, and the IEEE LOM standard⁴ takes the viewpoint of creating learning resources and adds information regarding educational uses. The CIDOC Conceptual reference model can be used also to provide detailed identification and lifecycle information along with descriptions of the contents of the artefacts. Since here we are interested only in describing the characteristics that differentiate humor pieces from other informational artefacts, so that we will only describe distinguishing features, namely, semantic frames and the description of humor technique applications.

One important consideration in humor ontologies is the representation of *frames* in the sense provided by Rojo-López (2002). Based upon the work of Fillmore (1976), “frame semantics” allows the

² <http://www.opencyc.org/>

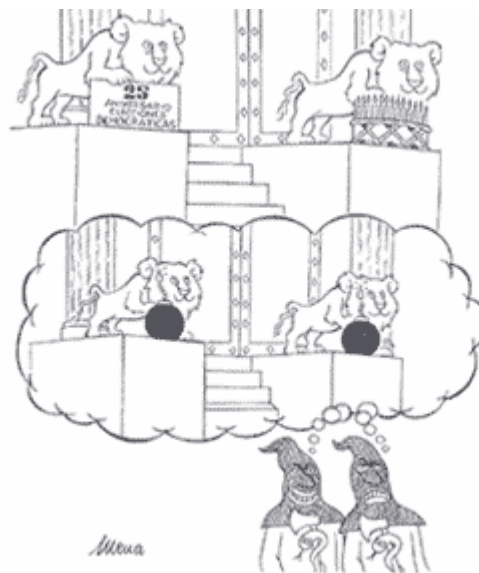
³ <http://dublincore.org/>

⁴ <http://ltsc.ieee.org/wg12/>

description of the mental structures that provide the common ground required to understand a concrete piece of humor. The Berkeley *FrameNet* project has currently codified hundreds of frames related to lexical units, which provides an interesting ground to start the codification of humor artefacts. A semantic frame can be defined as “schematic representations of situations involving various participants, props, and other conceptual roles, each of which is a frame element”. Although frames are tied to lexical structures, the overall philosophy is also applicable to graphical humor, since the situation described in the humor piece can be described in terms of frames. From a technical viewpoint, a frame inside a formal ontology can be any term or property that refers to a concrete domain. Then, we will consider that frames are ontology elements that are used as descriptions for humor pieces, which in terms of a `isFrameOf` property (inverse of `framedIn`) can be expressed by the following fragment of description logics (Baader et al., 2003):

$$\text{Frame} \equiv \exists \text{isFrameOf} . \text{HumorArtefact}$$

This definition enables re-using existing ontological definitions as frames without changing them. It should be noted that the use of frames has an intrinsic value in browsing and search interfaces based on ontology navigation (García & Sicilia, 2003), since frames serve “automatically” as search affordances. To illustrate the richness and complexity of the semantic frame concept for humor description, let’s analyze a concrete piece of contemporary graphical humor that is profoundly rooted in Spanish culture. The piece of the popular humorist José Luis Martín Mena (*Mena*) is available at the Web that celebrates the 25th Anniversary of the Spanish Constitution⁵.



The humor piece puts in contrast two semantic frames that refer to recent Spanish history. In the above part, the front of the “Congress of the Deputies” is showed, with the two popular statues representing lions that were cast from the bronze of guns captured by Spanish troops in 1859 at the beginning of the wars with Morocco. The balls of the lions are replaced by a birthday cake and a label remembering the 25th anniversary. This is the connection point with first associated `Frame` of the piece, which is an allegory of the success of contemporary democratic institutions in Spain. Here we have the two principal elements of the frame descriptions:

- The frame-connecting element, in this case, the “Congress of the Deputies” building as a representation of democracy.
- The frame itself, which can be rooted in an instance of `GovernmentSystem` representing Spanish democracy. Such instance will be connected to other ontological structures

⁵ <http://www.constitucion.es/>

describing the main institutions of the Spanish government system, including the Spanish parliament, which has the building of the “Congress of the Deputies” as house. It is required that the frame-connecting element be related to the frame-defining element in some way to preserve consistency. In this case, the connection is established through a chain of semantic connections: the SpanishParliament (one of the politicalInstitutions of the SpanishGovernmentSystem) is housedIn the CongressofTheDeputies.

The second frame involved in the graphical piece is that of BasqueTerrorism, which is represented in the drawing by the presence of two individuals wearing hoods, in which the symbol of the Basque terrorist organization ETA (snake and axe) is clearly identifiable. Here the frame-connecting element can be considered the ETA-Terrorist instance representation, which could be represented as a member of ETA, which in turn is a TerroristOrganization that is activeIn the BasqueTerrorism phenomenon. This closes the connection of the “head” frame element with the pictorial representation.

It should be noted from this example that the selection of the frame-defining element inside the ontology is subject to some subjectivity in the selection of a degree of generality. For example, the frames described above could be substituted to more general categories, let’s say, “Democracy and Terrorism”, which represent a more general description, not tied to the case of Spain. This degree of generality could be later “refactored” by searching for similar cases inside the concrete Collection of humor pieces that is being considered.

Another important dimension in the ontology of humor is that of the typology of humor pieces. Since a commonly accepted typology does not currently exist, a flexible way of implicit classification has been integrated in terms of *humor techniques*. A HumorTechnique is a representation of a resource used by the humor author or present in a humor piece that contributes to producing the humorous interpretation. Many of these techniques have been identified in the literature, for example, a comprehensive list of them with examples is provided in Shibles’ Humor Reference Guide. For the sake of clarity, we have departed from the study of Buijzen and Valkenburg (2004), which in turn adapts Berger’s typology (1993) to the specifics of audio-visual media. Although graphical humor does not share all of the characteristics of audiovisuals, their narrative is in most cases similar. The identification of a humor technique is by itself a valuable metadata asset, but the combination of semantic frame definitions with techniques allows for the definition of details of the application of the technique. The decisions adopted to represent humor techniques differentiate HumorTechnique instances (e.g. absurdity, exaggeration, irony, irreverent behaviour, etc.) from HumorTechniqueApplications (HTA), which can be expressed by the following description logics sentence:

$$HTA \equiv \forall appliedIn.ConceptualHumorWork \cap \exists instOf.HumorTechnique$$

The rationale for such differentiation is that each kind of technique requires different descriptive details. For example, in the above example about terrorism, the principal technique appears to be Transformation (i.e. “someone or something takes another form or undergoes a metamorphosis”), more concretely, the humorous contrast is realized by showing bombs below the lions of the Spanish parliament instead of the birthday cake. This represents the desire of prototypical terrorists to destroy Spanish democracy, metaphorically represented by the facade of the parliament. In formal terms, this entails defining subclasses of HTA with specialized properties. For example, the described transformation can be represented by two properties with domain in TransformationApplication (subclass of HTA): originalElement linked to the representation of the balls of the parliament lion statues, and finalElement linked to an instance of TerroristBomb. Other techniques may entail different properties. For example, Absurdity could be considered as a secondary technique in the same situation, which should be linked to the fact that changing a fixed part of a public sculpture is not plausible.

From the perspective of historiography, making explicit the techniques used has the advantage of being able to inductively analyze the styles of Humorists, creating rough categories like those that rely mostly on language absurdity or those that develop irony as the main humor tool (as a concrete example, *Mena* is known for rarely using written descriptions or dialogues in his drawings). Such characterizations can be defined in terms of approximate, flexible queries to the ontology and its instances, serving as a research tool on stylistic considerations. In addition, the sub-graph of concepts and properties serving as frame allows the retrieval of humor pieces that explain or discourse about them.

In addition to the above discussed frames and techniques, it is of course necessary to represent in ontological terms the actual, objective contents of the graphical humor piece. This combined with the frame could – at least in simple cases of the use of incongruity as a humorous technique – be used to automatically elicit the dissonant element that is the source of humorous interpretation. For example, from a structural perspective, the above graphical piece of *Mena* is divided in two vertically-divided parts; each of them could be modelled through a `dividedIn` property linked to generic `Sections`. Then, a separate description could be provided for each of the sections. The upper one could be described by linking it to the “Congress of the Deputies” instance, with a `deviation` pointing out to the birthday cake, while the lower one could be represented in a similar way, but changing the `deviation` to connect to instances of `TerroristBomb`. In addition, the below section should be described with the `thinkingOf` property connected to `BasqueTerrorist` instance. With such formal definitions, a tool could automatically derive the points that differentiate the two sections and that are at the source of the humorous technique.

Both frames and humor technique applications and descriptions require the use of domain ontologies specific to the content of the frames referenced by each particular humor piece. For example, the above humor piece requires a description of current contemporary Spanish institutions and recent history that is still not available publicly, and that would require a separate ontological engineering effort. In addition, descriptions could be arbitrarily complex, since some drawings are crowded of elements and characters, and others describe situations that combine several elements in particular ways. Even though it is virtually impossible to anticipate such diversity, there are recurrent patterns that can be represented inside the general ontology of humor. The following humor piece of Manuel Summers, also published in the Spanish Constitution Anniversary Web site shows a typical dialogue between characters that is easily describable.



The dialogue `SpeechActs` represented follows the typical comic narrative ordering from the upper part to the lower, and each `Character` is easily identifiable. Those dialogue acts can be represented as structure, concretely as specialized `Sections`. This piece of humor uses `Repartee` (i.e. verbal banter) as the essential technique, in this case playing with the senses of the Spanish word “labor” which means both “task” and also “the result of knitting clothes or textiles”, the usage of each of the

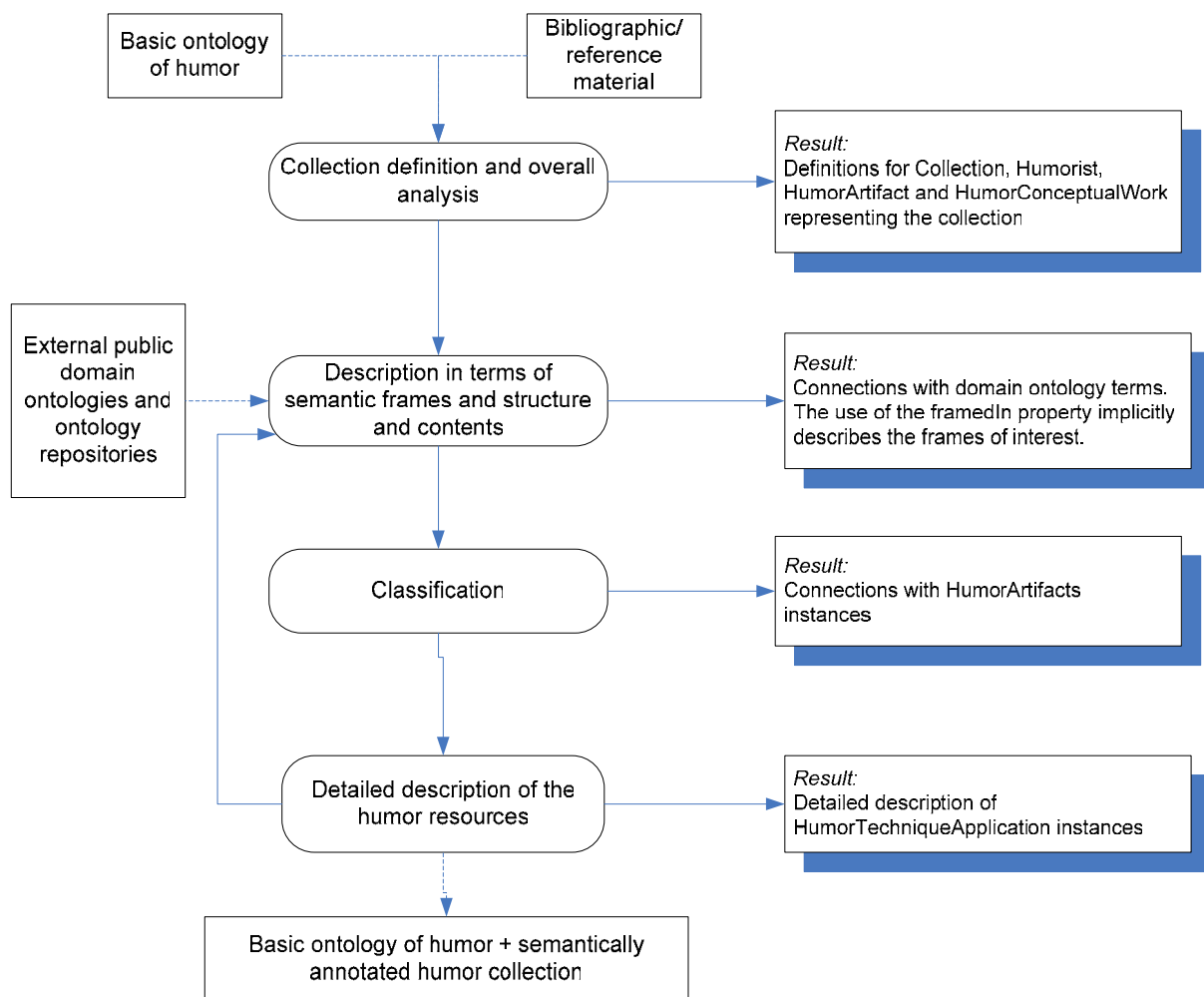
senses can be represented by connecting them to speech acts #1 and #2 respectively. Verbal banter is complemented with the Absurdity of a woman knitting a pullover inside the parliament.

The following Table serves as a summary of the required ontological dimensions that should be present in the ontology of humor, providing some illustrative instance descriptions in natural language.

Dimension	Example metadata elements	Example instance metadata
Identification and basic lifecycle data	For <i>HumorArtefacts</i> : CIDOC Appellations for creation, creators and dimensions. CIDOC Documents in which the pieces were published. For <i>ConceptualHumorWorks</i> : IEE LOM Description and coverage.	“length: 3.9-4.1 cm” “published in Quevedos magazine, 10, p. 21.” “situated in Spanish civil war, Madrid”
Format	MIME type of a HumorArtifact	“image/jpeg”
Frame	Ontology element describing the frame and concrete element connecting the graphical representation with the frame.	“framedIn Teleadicction” “frameElement BasqueTerrorist”
Content	Structure (division in sections of comic frames) and general description for each section.	“a ConceptualHumorWork is dividedIn frameA, frameB and frameC” “frameC represents SpanishPrimeMinister”
Techniques used	HumorTechniqueApplications connected to HumorTechnique instances.	“aTransformation appliedIn aConceptualHumorWork”

3 SEMANTIC ANNOTATION OF GRAPHICAL HUMOR ASSETS

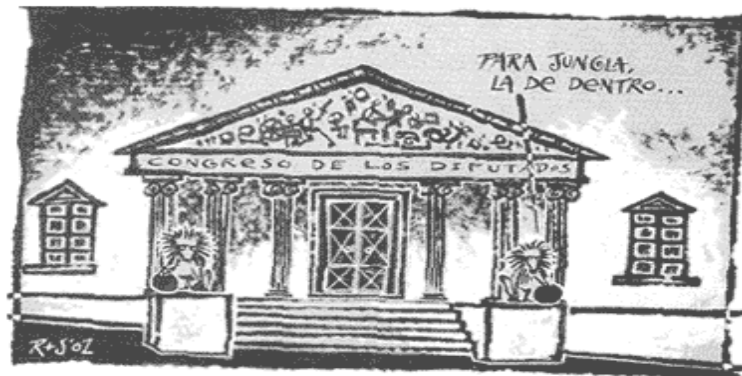
Graphical humor assets are typical pieces in newspapers and magazines, and serve as a visual communication tool for diverse purposes. The semantic annotation of a piece of humor is thus a process that requires providing details about all the aspects described above. Nonetheless, the identification of humor techniques, descriptions and frames are the three key dimensions that require expertise, both in terms of interpretation of the humor piece, and also in terms of ontological engineering technical skills. This has led us to define a process for the annotation that may serve as a method for teamwork in cultural heritage settings. The following Figure depicts the principal steps in that process.



The process starts with the representation of the components of the collection in terms of humor pieces and

and
Such iterative process allows for the incremental description of a collection, in which typically the first iteration would be highly time-consuming due to the overhead in selecting and/or defining the required domain knowledge.

Let's illustrate the metadata produced in each of the steps by means of an example. The following humor piece by Reboredo & Sañudo is also included in the collection provided in the Web site of the 25th Anniversary of the Spanish constitution.



The results of the first definitional phase will result in definitions as the following which define the humorist team, the conceptual work, humor artefact and the computer file copy representing the drawing:

```

Individual(Javier_Lopez_Reboredo type(a:Humorist))
Individual(Rafael_Sañudo type(a:Humorist))

Individual(Reboredo_Sañudo type(a:HumoristTeam) value(a:component
Rafael_Sañudo) value(a:component Javier_Lopez_Reboredo))

Individual(Rebor_SC_4 type(a:ConceptualHumorWork))
Individual(SC_25th_Anniversary type(a:HumorCollection) value(a:contains
SC_anniversary_4))

Individual(SC_anniversary_4 type(a:HumorArtefact)
value(a:instantiationOfWork Rebor_SC_4))
Individual(SC_anniversary_4_file type(a:ComputerFileCopy) value(a:url
"SC_anniversary_4.jpg"^^http://www.w3.org/2001/XMLSchema#string))
SameIndividual(SC_anniversary_4 SC_anniversary_4_file)

```

Then, the second phase would add the connections to the semantic frame and description of the contents (only the connecting properties and concepts are showed):

```

Individual(Spanish_Congress_Deputies type(a:InstitutionalBuilding)
value(a:facadeArchitecturalElement Spanish_Congress_Lion))
Individual(Spanish_Congress_Lion type(a:Statue))
Individual(Spanish_Democracy type(a:GovernmentSystem))
Individual(Spanish Parliament Struggle type(Political_Practice)
value(a:takesPlaceIn Spanish_Congress_Deputies)
value(a:isFrameOf Rebor_SC_4))
Individual(Rebor_SC_4 type(a:ConceptualHumorWork)
value(a:hasFrameConnectingElement Spanish_Congress_Deputies)
value(a:framedIn Spanish_Parliament_Struggle))

```

As shown in the OWL abstract syntax generated by the Protégé tool⁶ (directly translatable to OWL RDF-based markup), there are two connected instances that represent the frame (the archetypical parliament struggling of the deputies), and the element representing it (the façade of the Spanish Congress of the Deputies institutional building). After this, the main elements that help in the understanding of the humor piece are yet described. The following phase will add the connections with the main interpreted humor techniques. In this case, the main technique is verbal banter (Repartee),

⁶ <http://protege.stanford.edu/>

since there is a play with the senses of the Spanish word “jungla” (jungle) that refers both to the habitat of lions and to struggling in human social situations. Nonetheless, the fact that a lion is talking can be considered as an application of Anthropomorphism, and also Absurdity is present, since a statue is talking. This would result in definitions as the following:

```
Individual(a:Repatee type(a:HumorTechnique))
Individual(Repatee_App_1 type(a:RepateeApplication) value(a:appliedIn
Rebor_SC_4) value(a:instanceOf a:Repatee))
```

The annotation approach through the `appliedIn` should be further extended to differentiate primary or more important techniques from those that could be considered “secondary”.

The last phase is devoted to improve the level of detail of the description that at this point determines the basic frame elements and the humorous resources used. Following with the example, the verbal banter is described specifically by referring to the word senses that are played with, e.g.:

```
Individual(a:Jungla type(a:Word) value(a:hasSense a:Struggle)
value(a:hasSense Animal_Habitat))

Individual(Repatee_App_1 type(a:RepateeApplication)
value(a:wordSensePlay a:Struggle) value(a:wordSensePlay Animal_Habitat)
value(a:appliedIn Rebor_SC_4) value(a:instanceOf a:Repatee))
```

In addition, the concrete description of the situation can be described by describing that one of the lions is producing a speech act. Such description complicates the annotation, since instances of `CharacterAppearance` are required describing the lions, to be connected to the speech acts. The usefulness of further describing such details is left to the expert interpreting the artefact, and depends on the level of detail required or feasible within the schedule of the project. Nonetheless, it should be noted that this would in many cases entail a further description of the semantic frame.

4 CONCLUSIONS AND FUTURE DIRECTIONS

This paper has described the first version of an ontology of humor aimed at providing *Semantic Web* tools for contemporary cultural heritage access and interpretation. The ontology covers the basic identification, lifecycle and format descriptions, but also enables the representation of interpretations of the humor piece. Concretely, it allows the description of the literal contents of the graphical piece, the semantic frame that are required to correctly interpret it, and the techniques present in the piece that provide the humorous aspect. The interplay of frame specifications and humor techniques is particularly interesting for researchers since it conveys detailed analysis information in logical form valuable both as a research tool and also as a learning asset or search hook.

In the context of the *OntoVisual* project, the detailed annotation of a collection of Spanish contemporary humor assets is currently being carried out, and a specialized ontology-based search interface based on previous work (García & Sicilia, 2003) will be used to provide flexible access to the graphical humor artefacts. Hopefully, such annotation effort will result in an improved version of the ontology described in this paper. The ontological approach described should not only be considered as a way to encode existing knowledge, but as the crafting of a genuine tool about cultural artefacts, since the detailed frame descriptions would likely end up in findings derived from the connections between the structure, techniques and contents of large collection of humor assets. Such kind of analysis will be subject to further study.

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References

- Baader, F., Calvanese, D., McGuinness, D., Nardi, D., Patel-Schneider, P. (eds.). (2003). *The Description Logic Handbook. Theory, Implementation and Applications*, Cambridge.
- Berger, A.A. (1993). *An anatomy of humor*. New Brunswick, NJ: Transaction Publishers.
- Berners-Lee, T., Hendler, J., Lassila, O. (2001). The Semantic Web. *Scientific American*, 284(5), pp. 34–43.
- Buijzen, M. and Valkenburg, P.M. (2004). Developing a typology of humor in audiovisual media. *Media Psychology* 6, 147-167.
- Caron, J.E. (2002). From ethology to aesthetics: Evolution as a theoretical paradigm for research on laughter, humor, and other comic phenomena. *International Journal of Humor Research* 15(3), 245-281.
- Fillmore, C.J. (1976). Frame semantics and the nature of language. In *Annals of the New York Academy of Sciences: Conference on the Origin and Development of Language and Speech*, Vol. 280.20-32.
- García, E. (2004). Humor and Rumors in Contemporary Cultural Heritage Access through Ontologies. *AIS SIGSEMIS Newsletter*, 3, available at <http://www.sigsemis.org>.
- García, E. & Sicilia, M.A. (2003). User Interface Tactics in Ontology-Based Information Seeking . *Psychology e-journal* 1(3):243-256.
- Klein, M., Broekstra, J., Fensel, D., van Harmelen, F., Horrocks, I. (2003). Ontologies and Schema Languages on the Web. In *Proceedings of the Spinning the Semantic Web Seminar, 2003*, MIT Press, pp. 95-139
- Lefcourt, H. (2001). *Humor: The Psychology of Living Buoyantly*. NY: Kluwer/Plenum.
- Lynch, O. (2002). Humorous communication: Finding a place for humor in communication research. *Communication Theory*, 12(2), 423-445.
- Rojo-López, A.M. (2002). Frame semantics and the translation of humour. *Babel* 48(1), 34-77.
- Sicilia, M. A., García, E., Sánchez-Alonso, S. and Rodriguez, E. (2004). On integrating learning object metadata inside the OpenCyc knowledge base. In *Proceedings of the 4th IEEE International Conference on Advanced Learning Technologies - ICAALT 2004*, pp. 900-901. Joensuu, Finland.

⁷ <http://www.fgua.es/>