

Exuviae: an Ontology for Conceptual Epistemic Comparison

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1 Introduction

In this work we address the long and still unresolved epistemological debate known as the “demarcation problem”, involving distinguishing alternative theories on a similar set of phenomena.

Science, technology, engineering, and mathematics (STEM) disciplines concentrate on causal explanation as a primary criterion for theory preference and evolution (modulo the social and political dynamics studied e.g. by Fleck (1994), Kuhn (1962) and Feyerabend (2018)). However, social sciences and humanities (SSH) often host alternative theories about phenomena not easily coerced to causal explainability, like emotional spectrum theories, motivation of personal beliefs, moral foundation value theories, framing of historical or argumentative perspectives, etc., which are trending topics in the social information semiosphere that pervades “onlife” (Floridi (2015)) in the so called post-truth era.

This has also created difficulty in comparing alternative theories, in the absence of causal criteria. As a consequence, SSH concepts and their relations’ semantics are often unstable. In addition, lacking a causal foundation, semantic instability becomes a primary concern for comparison and selection across alternative theories.

We call these theories “floating theory fragments” that categorise, explain, or even generate an empirical spectrum of phenomena.

2 Theoretical Implant and Context of Use

Exuviae (“In biology, exuviae are the remains of an exoskeleton and related structures that are left after ecdyso-zoans - including insects, crustaceans and arachnids - have moulted.”¹) is a formal computational ontology used to represent and explain epistemic choices done while modeling and comparing elements of the same or different theories. It is intended as a pragmatic logical framework, which provides a conceptual “exoskeleton” to formally compare sets of floating fragments.

Exuviae ontology is not meant in the first place to determine the superiority of one theory over another, nor to discredit theories developed in a less formal way, but rather

¹ <https://en.wikipedia.org/wiki/Exuviae>

aims to do exactly the opposite, in agreement with Habermas (1988) conception of SSH:

Whereas the natural and the cultural or hermeneutic sciences are capable of living in mutually indifferent, albeit more hostile than peaceful coexistence, the social sciences must bear the tension of divergent approaches under one roof.

Exuviae lets us build an ontological container to jointly analyse floating fragments, test their soundness, and possibly integrate them in a larger theory.

2.1 Exuviae Methodology

Exuviae ontology is applied through three main phases, which correspond, *mutatis mutandis*, to Hegelian tripartition Thesis, Antithesis and Synthesis :

1) explicit formal representation of a floating fragment: a theory, perspective or interpretation is modeled in OWL language. Entities described in the concepts and relations are distinguished, and related by means of logical axioms or vector spaces.

2) where possible, concepts and relations are aligned to foundational theories (e.g. ontological dimensionality such as 2D or 3D entities, topology, mereology, identity, process models, participation, scalar models, common sense or specific frames, etc.), or ad hoc reference domain frameworks ("core ontologies").

3) formal comparison, resolution and selection: alignment facilitates a formal comparison by using correspondences as a backbone. It is now possible to determine "what a fragment is talking about" e.g. the different types of entities, frames, focus etc. Similarity and clusters may now emerge, and possible equivalences, conflicts, and mutual completions may arise, facilitating the integration of multiple floating fragments. Also, the criteria emerge, for which a fragment is relevant, and possibly more relevant than another, as well as fragments competing for the same role in a theory, eventual overlap, differences that can be made more explicit etc.

2.2 Horizon of Understanding

Exuviae is an ontology realized with the awareness that data are a vast and impenetrable - at least in a univocal interpretative way - domain, but this should not drive to cheap relativism. The whole ontology, but in particular all object, data and annotation properties, are meant to fight a postmodern deconstructionist view which could question the framing of data. In this sense Exuviae is an attempt to allow knowledge reasoning from a data-driven approach, keeping explicit track of all the rationale, appraisals, methodologies, references and evaluations applied in the epistemic comparison process, in order to deal, in a satisfying way, with the philosophical hermeneutics position, stated in particular by Gadamer (2004), of the limit of a certain horizon of understanding.

Furthermore, Exuviae aims to deal with phenomena like "Conceptual Drift" as presented in Kuukkanen (2008) and Wang et al. (2011) via representing in ontological form specifications of extensional change corresponding to intensional modification of the concept itself.

Finally, Exuviae embraces Betti and Van Den Berg (2014) position about conceptual modeling and interpretations and it aims to operationalize it via ontological structure:

Making an interpretive framework explicit in fact provides the best defence against the risks of interpretative biases in the writing of intellectual history, and furthers the comprehension of texts.

3 Ontology Structure

Here we list the main classes, object, data and annotation properties. This list is not intended to be concluded but open to the introduction of new entities, especially properties, on the basis of the use case.

3.1 Classes

The main classes, as shown in Figure 1, are related to and axiomatise the `:EpistemicComparison` class, which is the hub for the comparison.

- `:TheoreticalFragment` : a `TheoreticalFragment` is a collection of related ontology elements from one or multiple theories. The fragment is the hub useful to compare different theories and derive some element by applying epistemological choices made based on some criterion, eventually leading to a selection result.
- `:EpistemicComparison` : the hub for epistemic operations on theory fragments with the purpose to compare and select one.
- `:CriterionMeasurement` : the Measurement of the Criterion chosen to compare a Fragment against another. e.g. better literature grounding, more soundness, better resources at disposal, more operationalizable structure etc.;
- `:ReframingModus` : the way in which some entity is conceptually derived from a theory but with some modifications.
- `:SelectionCriterion` : if the final purpose is a Selection, the Criterion based on which the Selection is made.
- `:SelectionResult` : if Selection is the final purpose, the result of the Selection based on some SelectionCriterion.

3.2 Object Properties

The properties focus on conceptual derivation of some entity from another, and aims at specifying the type of conceptual dependence:

- `:conceptuallyDerivedFrom` : Property to state the intellectual debt of some entity towards another e.g. a concept was elaborated starting from some clue, intuition, concept, rule or theory that gave the input in a more or less decisively way to a cognizer for its cognition of the concept. It's the super-property of all the followings.
- `:contradicts` : Some Entity or part of it is derived and then contradicted or negated, totally or partially.
- `:explicitates` : A way to express some logical or formal conclusion explicitly declared by the conceptually derived entity and implied, but not declared explicitly by the source.

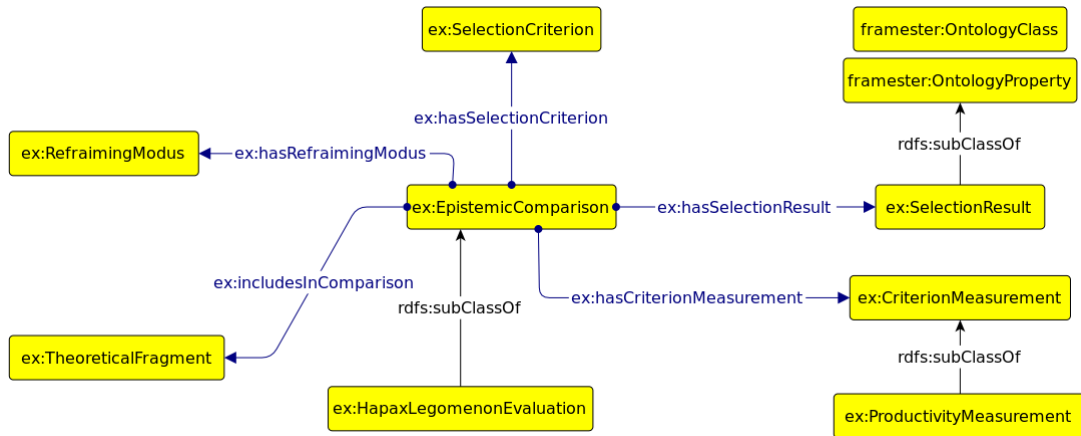


Figure 1: Exuviae Epistemic Comparison Hub.

- **:generalizes** : The derived entity corresponds to a broader extension than the source, this property is similar to the `skos:broadMatch` property, but referred to conceptual objects.
- **:reframes** : The derived entity is `:conceptuallyDerivedFrom` some source but reframed in some way. It could be a more strict formalization, a different range or domain declaration or anything else. In case of need it is highly recommended to create subproperties which specify the type of reframing, if not already covered by other properties.
- **:reuses** : The derived entity is copied and reused (cloned), with possible minimal and not substantial nuanced distinctions e.g. re-labeling without new semantic commitment.
- **:specifies** : The derived entity corresponds to a narrower extension than the source, this property is similar to the `skos:narrowMatch` property, but referred to conceptual objects.

3.3 Data Properties

- **:explanation** : The explanation in natural language of some conceptual derivation declaration. It is meant to be used to e.g. specify the dimension of conceptual reframing, conflictuality etc. It is purely to allow humans to better understand modeling choices.

3.4 Annotation Properties

- **:bibRef** : Annotation of the bibliographical reference of some fragment, concept or even whole theory including the original definition, detailed occurrences reference location record and year of publication. It is meant to track back the original definition of each entity modeled, in order to allow users to understand and retrieve original information about the entity.

4 Ontology Soundness

The ontological transposition of theories, which preludes to the Exuvia exoskeleton conceptual analysis should be realized according to good modeling practices, as in Gangemi et al. (2005), Djedidi and Aaufaure (2010), Duque-Ramos et al. (2011), Rico et al. (2014) and Zhu et al. (2017).

5 Conclusion

As in the old Persian tale of the three brothers and 17 camels in Ageron (2013), where a wise man introduces an 18th camel to permit the distribution of the herd to each brother, a floating fragmentation problem in SSH is unsolvable unless we introduce some external element, without actually changing the phenomena. Exuvia ontology-based method aims at being the 18th camel, acting as an exoskeleton for the floating fragments. Its very existence could allow us seeing things from a different perspective, and eventually integrating or selecting the best fragments, either for the advancement of a discipline, or to apply them to a specific task.

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