On the Adequacy of Requirements for Foundational Ontologies

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Abstract

In this very issue, Augusto (2022) formulates two requirements upon which to evaluate the adequacy of a foundational ontology. Specifically, the ontological categories: (i) should be understood as the most general kinds of things and (ii) are organized in a non-overlapping finite hierarchy. On the basis of such constraints, he claims that most existing foundational ontologies engineered in the context of Applied Ontology, including the UFO-B ontology, are inadequate. In this article, first we show that his objection against UFO-B can be dissipated by pointing to a trivial terminological confusion. We then argue that his two constraints are not plausible. Then, we show that the disagreement between our point of view and Augusto's framework is not restricted to those two constraints but extends over the notion of conceptualization of reality.

Key words: Foundational Ontology; Ontological Category; Conceptualization of Reality

1 Introduction

In an article published in this very issue, L. M. Augusto argues that the ontological categories constituting most foundational ontologies are inadequate with respect to the following principles: (i) they should be understood as the most general kinds of things; (ii) they should be organized in a non-overlapping finite hierarchy. The first goal of our article is to show that Augusto's principles are not well-supported, they are semantically indeterminate, and implausible. As a consequence, they are

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inadequate as general adequacy requirements for what foundational ontology should be like. However, our disagreement with Augusto's view does not stop at these two principles. Indeed, we show that it is more fundamental, since it extends over the notions of conceptualization of reality in the context of the Applied Ontology project.

This article is structured as follows. In Section 2, we briefly introduce Augusto's framework, his two principles, and his criticism of specific foundational ontologies and, in particular, UFO-B (Benevides et al., 2019). In Section 3, after briefly arguing that his objection against UFO-B is a mere terminological misreading of the literature on the topic, we formulate our objections to his two principles, and we argue that his notion of ontological category does not have a clearly defined meaning.

2 Augusto's Argument

The main notions in Augusto's account are the notions of *foundational ontology*, *conceptualization of reality*, and *ontological category*. In particular, he defends his notion of foundational ontology as follows (Augusto, 2022, p. 1):

> ***Foundational ontology:*** "A central topic in ontology is that of identifying the *basic*, or *foundational*, *ontological categories* (henceforth often just *categories*), or the ur-elements from which the whole of reality is believed to be composed: If one manages to carry out such an exclusive and exhaustive ur-segregation–i.e. *only*, and *all*, the basic categories are identified–then one has what is called a *foundational ontology*."

According to Augusto, a foundational ontology and the ontological categories constituting it are built upon a conceptualization of reality, the latter being characterized as follows (*ibid.*, pp. 2-3):

> ***Conceptualization:*** "A fundamental component of human cognition as an integrated system or architecture is the *shared conceptualization* of the entities that compose reality and of the relations among them [...] Like many other components of cognition, this mental activity is largely, or mostly, unconscious or implicit [...] When these implicitly shared conceptualizations become *explicit* we speak of *ontology (doing)* and the resulting distinctions are now often called *ontological categories*".

Finally, the notion of ontological category is characterized by reference to the aforementioned principles (i) and (ii) (*ibid.*, pp. 4-5):

> ***Ontological Category:*** "It is largely agreed that the ontological categories, taken in the sense of the most basic categories from which the whole of reality can be derived [...], (i) should be understood as the most general kinds of things and (ii) are organized in a non-overlapping finite hierarchy. This establishes *generality* and *well-foundedness* as two of the main requirements of a categorial ontological account that aims at being a foundational ontology".

Now, with his notion of ontological category at hand, and supported by his notions of foundational ontology and conceptualization of reality, he seems to launch an attack

on a number of well-known domain-independent ontologies in the area of Applied Ontology. In his own words:

> In the current context of upper-ontology engineering, we are often confronted with projects that are seen as foundational ontologies when in fact they do not satisfy these conditions. [...] More flagrantly, UFO-B is presented as a foundational ontology for events (Guizzardi et al., 2013), which appears to obliterate *tout court* condition (i).

The ontologies targeted by Augusto include proposals that have been successfully used in a myriad of projects in different domains and over decades with very concrete measurable results (Guizzardi et al., 2015; Verdonck et al., 2019). Augusto, however, does not directly attack these ontologies on their quality or merit and, in a sense, his argument could be interpreted as having a purely terminological nature. In other words, he could just be saying that whatever the merits of these projects may be, they should not be called by the name "foundational ontology" unless satisfying requirements (i) and (ii). Under this interpretation, we would be less inclined to respond to his article. However, intentionally or not, his argument has the potential of eliciting in readers an interpretation in line with a qualitative criticism. This can be seen in the criticism of Keet & Khan (2022; this issue):

> "[s]ince they [i.e., these foundational ontologies (FOs)] are being used, they would not be so bad, would they? Or: is that "badness" only bad in theory or also in practice and their use has led to defective applications? Second, there is one empirical evaluation on the effectiveness of FO/no-FO in domain ontology development and one regarding FOs in conceptual data model development for database and software application design and they both concluded that the quality of the resultant ontologies and models are better thanks to using a FO compared to not using one. Different FOs were used in those experiments (BFO and UFO). If those defects in FOs are non- negligible, then, to substantiate the claim of inadequate FOs, should they not have been either fixed or substituted with a better-designed FO, the experiments re-run, and determined that the quality of the ontologies and models is even better?" (Citations were removed.)

Of course, we agree with Keet and Kahn but, once more, this qualitative criticism reading, if intended, is not even this explicit in Augusto's argument.

3 The Inadequacy of Augusto's Principles

Let us start by observing that Augusto's objection to UFO-B can be completely dismissed as a misreading of the literature on the topic. As stated in several articles, UFO-B is a fragment (or a module) of a more comprehensive foundational ontology termed "UFO" (*Unified Foundational Ontology*). So, the statement that UFO-B is a foundational ontology must be understood only within the broader context to which it belongs. So, from this point of view, and given the complete context of UFO, it is false that UFO-B "obliterate[s] *tout court* condition (i)" (Augusto, 2022). Even if one, ignoring this contextualization made explicit in all UFO-B articles, would

argue that the sentence "a foundational ontology of events" should be rephrased for precision and context-independence as "a module of events that is a proper part of a foundational ontology", the argument then can be easily addressed and solved at a terminological level. Now, looking beyond terminological issues, Augusto's objections to the existing foundational ontologies in the Applied Ontology discipline succeeds only if his principles (i) and (ii) are plausible. We argue that this case has not been made.

Firstly, principles (i) and (ii) seem to be satisfied by trivial models. For instance, consider an ontology that admits only one ontological category: the category *Entity* (or *Thing*). This model would trivially satisfy both principles. However, would Augusto be willing to defend such a mono-categorical ontology as adequate? For instance, it completely obliterates, e.g., the distinction between dependent and independent entities (e.g., John versus John's weight). A possible way out of this challenge would be to reply that such a model does not satisfy a third constraint that specifies the meaning of "ontological category". Indeed, he stresses "ontological categories, taken in the sense of the most basic categories from which the whole of reality can be derived" (*ibid.*, p. 4). Now, the problem with this possible reply is that it is not clear what Augusto means with "from which the whole of reality can be derived". Taken literally, such an expression means that a foundational ontology has to allow one to derive also the notion of, e.g., *car*. However, such a consequence raises a tension within Augusto's account. Either one has to admit that the category *Entity* allows for classifying all things, including cars, or, more appropriately, one would require such as system to be able to account for *principles of identity*, *individuation*, *unity*, *persistence*, etc. (Guizzardi, 2005), which would be necessary for distinguishing cars from people, computers and cows, not to mention from car colors, marriages and hurricanes. Indeed, a foundational ontology that can allow one to properly derive the notion of *car* in the latter sense must contain specific ontological categories, and this consequence is in tension with principle (i), according to which a foundational ontology should countenance only the most general ontological categories. The problem is where to draw the line of ontological specificity.

To make things worse, principle (i) is semantically indeterminate. According to Augusto, principles (i) and (ii), and the notion of ontological category are based on his notion of conceptualization (see, *Conceptualization* in section 2). According to Augusto, there is exactly one shared conceptualization of reality, and this conceptualization is largely unconscious. Now, we simply register that there isn't just one conceptualization of reality. For example, there is a conceptualization of reality as it appears to us from our commonsense point of view, and as it appears to us given our aims of modeling phenomena in information sciences, and there is a conceptualization of reality provided by theoretical physics. All these conceptualizations can be warranted the title of "a conceptualization of reality". So, there isn't *the* conceptualization of reality. Even worse, even within a certain layer (e.g., a mesoscopic account), there can be different conceptualizations of reality. Suppose, for instance, that a human user has a conceptualization of reality according to which the concept *student* just counts students as people enrolled in a given institution. Such a conceptualization is different from one's conceptualization of reality according to which the concept *student* includes self-taught individuals (autodidacts). So, a conceptualization need not to be *shared* by all the users–contrary to Augusto's thesis.

Hence, since a conceptualization of reality is always relative to a class of problems, the sentence "the ontological categories [...] (i) should be understood as the most general kinds of things" is semantically indeterminate. Indeed, this sentence should be relativized to a specific conceptualization of reality that is adopted, and the reasons why such a conceptualization is adopted.

Let us now show that, given plausible assumptions, principle (ii) is false. This principle asks that the ontological categories should be organized in a non-overlapping finite hierarchy. Now, we have that categories can be specialized into multiple orthogonal dimensions while maintaining that each dimension is organized in non-overlapping specialization sub-categories (Guizzardi et al., 2021). For example, in one dimension, we can distinguish categories (a) that merely supply a principle of application to their instances (*characterizing categories*) from those categories (b) that, besides a principle of application, also supply principles of identity, individuation and persistence for their instances (*sortal categories*). On another dimension, we distinguish categories (c) whose instances can exist independently of other entities from categories (d) whose instances only exist by being existentially dependent on other entities. If we take, e.g., the categories *Person*, *Marriage*, *Physical Object* and *Legal Relationship*, these are instances of the following meta-categories: (b) and (c), (b) and (d), (a) and (c), and (a) and (d), respectively. Ontological categories organized in terms of these orthogonal distinctions have been used to model in profitable ways phenomena and to solve concrete and measurable problems (cf. *ibid.*). Thus, given plausible assumptions, it is false that the ontological categories should be organized in a non-overlapping finite hierarchy.

As a conclusion, Augusto's principles are not well-supported, and they are semantically indeterminate. In turn, this conclusion means that also his notion of ontological category is semantically indeterminate. Moreover, given plausible assumptions, principle (ii) is false. Thus, such principles are inadequate grounds upon which to evaluate the adequacy of a foundational ontology.

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