Generic ontological dependence

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Abstract

We analyze how the notion of generic ontological dependence is used for describing the relationship between information artifacts and their bearers, in the BFO ontology. The conclusion is that the notion of generic ontological dependence is problematic and that the relationship mentioned is better described as a type/token relationship.

Keywords

BFO, ontology, information artifact

1. Introduction

One important theme in the tradition of philosophical ontology is ontological dependence. Some entities can only exist in the presence of other entities. In the UFO foundational ontology, one basic classification of endurants is between substantials, such as a rose, and moments that inhere in other entities, such as the color of the rose. The color cannot exist on its own, just like a Cheshire cat's smile cannot exist without the Cheshire cat. In BFO [1], the former are called continuants, while color is called a quality.

In addition to the notion of ontological dependence, another weaker notion has been raised, of generic ontological dependence which roughly says that X cannot exist (not without some specific Y, but) without any instance of a class Y. A typical example that will be the main topic of this paper is the relationship between some information entity, e.g. Cervantes' novel *Don Quixote*, and some material information bearer, e.g. the *Don Quixote* copy on my shelf. The novel is not existentially dependent on my copy, because there are more copies. Although the notion of generic ontological dependence seems to be well-defined and looks quite appropriate to describe the relationship between novel and copy, in this example, it turns out that on closer inspection this formalization raises several problems.

The goal of this short paper is to review the way generic ontological dependence has been used in the BFO ontology [1] to formalize the relationship between information content entity and information carrier. Based on this review, we recommend avoiding the notion of generic ontological dependence. The relationship in question (information content/bearer) can be analyzed as a type/token relationship.

2. The definition of Information Content Entity in BFO

Grounded in the BFO ontology, the IAO theory provides an ontological analysis of information entities such as novels, documents, software code and other textual artifacts. This part of BFO is called IAO (Information Artifact Ontology). The following text is based on [2,3]. At the heart of the IAO is the term 'Information Content Entity' (ICE), which is defined as follows:

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> INFORMATION CONTENT ENTITY =def. an ENTITY which is (1) GENERICALLY DEPENDENT on (2) some MATERIAL ENTITY and which (3) stands in a relation of ABOUTNESS to some ENTITY.

An ICE is conceived as an entity which is about something in reality and which can migrate or be transmitted (for example through copying) from one entity to another. The relation of generic dependence was used in BFO 1.1 in order to capture the fact that some dependent entities – for example the pattern of ink marks in your copy of a novel) – are able to migrate from one bearer to another (e.g. by means of a photocopier). In this context, generic dependence is defined as follows:

> *a* ***generically depends on*** *b* = def. *a* exists and *b* exists and: for some universal B, *b* ***instance of*** B and necessarily (if *a* exists then some B exists)

In BFO 1.0 (as in UFO, for that matter) the migration of dependent entities from one bearer to another is excluded. Dependence in BFO was restricted to specific dependence, or in other words as a relation which obtains between one entity and another specific entity when the first is of its nature such that it cannot exist unless the second also exists. A smile is dependent in this sense on a certain specific face, a headache on a certain specific head, a belief on a specific person. Generic dependence, in contrast, means that the first entity is dependent, not on some specific second entity, but rather merely on there being some second entity of the appropriate type. A DNA sequence is generically dependent in this sense on some but not on any specific DNA molecule; a pdf file on some but not on any specific memory store; and so on.

A generically dependent entity is in each case concretized in some specifically dependent entity (more specifically in some BFO:quality). For example, this sentence is concretized in this pattern of ink marks on this piece of paper or in this pdf. Note that the term 'pattern' is understood in two senses – as referring either (i) to what is shared or communicated (between original and copy, between sender and receiver), or (ii) to the specific pattern before you when you are reading from your copy of *Don Quixote*.

IAO then continues to define:

> INFORMATION QUALITY ENTITY (IQE) =def. a QUALITY that is the concretization of some INFORMATION CONTENT ENTITY (ICE)

IQEs were called 'information carriers' in the earlier version of IAO. IQE's are ontologically dependent on material i*nformation bearers*. ICEs are not material entities, but they need to be concretized in (IQE qualities of) material entities.

So far, the BFO account for Information Content Entities and its grounding in generic ontological dependence. We observe a couple of problems:

1. First, there is a general and well-known challenge with defining generic dependence in a modal existential way such as above. *Numbers* are entities that necessarily exist. According to this definition, anything then is generically dependent on for instance the number 2. Another problem was raised by Fine [5]. If *a* exists, then so does the set *{a}*; and vice versa. The two would be mutually dependent, which raises several questions (can dependence be symmetric?). One can try to avoid these problems by a longer definition, for instance, excluding the *b* to exist necessarily, but that will make the definition less and less intuitive.
2. The condition on the *b* entity looks incomplete. The definition is such that if the *Don Quixote* depends on this specific pdf file on my laptop, it depends on every file. In other words, the *Don Quixote* also depends on Peter's address book file.

3. The previous point applies also when we consider the material information bearer to be the *b* entity. One could argue that this article needs to be on some memory store to exist, but it is odd that this article generically depends on Peter's laptop.
4. According to the textual description, one goal of the definition of ICE in terms of generic dependence is to account for the potential of ICEs to be copied. However, the concept of copying and migrating is ill-defined. The point is that a specific file cannot migrate to another location. "The pattern of ink marks in your copy of a novel" is unique to your copy. Perhaps the photocopier left a small ink dot or printed only half of the t, but even when the printing was done perfectly, the ink pattern in your copy is a *moment* that ontologically depends on your copy. This unique moment cannot migrate or exist in two copies. The term copying/migrating can also not be applied to the ICE, as the ICE *Don Quixote* the novel is and remains unique, no matter how many copies exist.

In 2020, a new version of BFO was published [1] in which the definitions of ICE and generic dependence were adapted. Generic ontological dependence is defined here as:

> continuant *a* **g-depends** on continuant *b* at *t* iff there inheres in *b* an s-dependent continuant which concretizes *a* at *t*

This definition is definitely an improvement. It avoids the modal extensional formula, and so the problems mentioned under (1) above. What about the information content entity *Don Quixote*? According to the definition of carrier, my copy being a carrier of the novel means that the novel g-depends on my copy. So the novel is a continuant, and there is something inhering in my copy that concretizes the novel. In this way, the novel g-depends on my copy and also on any other copy. However, it does not g-depend on Peter's address book, as there is nothing in this address book that concretizes the novel.

The definition avoids talking about universals. In UFO terms, the inhering continuant is a moment, and the *a* that is concretized in this moment (like *Don Quichote*) would be a moment universal, not a continuant. BFO avoids the universal by introducing the notion of concretization. In [1-2.53], *concretizes* is defined in terms of sharing: x concretizes y when y is "the pattern or content that x shares with actual or potential copies". Concretization seems to be introduced specifically for the purpose of modeling information content entities. Is it a basic ontological category, if it is only used for this case?

Alleged examples of shared patterns are not only the novel, but also the chessboard pattern on a chessboard, a morse code on a piece of paper, DNA information in molecules and data items on a hard disk. These are all in the information domain, in a broad sense. As generic dependence is defined in terms of concretization, it means that generic dependence is taken in a much narrower sense than it is traditionally. However, it is not clear why the idea of sharing could not be applied to other qualities, for instance a color. The color of his red rose shares something with the color of the other red rose: redness. In this case, BFO talks about the color red as a class with multiple instances and not as a continuant, concretized in different roses. Why does it not treat these similar cases in the same way?

Another point is that the notion of "pattern" raises questions. When it is said that different copies share "the same pattern", is the pattern a g-dependent continuant or an s-dependent continuant? In [1-2.53] it is said that the "sum of patterns of ink on the pages of this copy" concretizes the novel, strongly suggesting that the patterns are at the concretizing side, in other words, that the patterns of ink are s-dependent continuants. But as we remarked earlier, s-dependent continuants are unique. In the above description taken from [3], it is acknowledged that the word pattern is used both for the g-depending entity (ICE, the shared pattern) and some quality of the carrier (the ink pattern), which is rather confusing. It is better to avoid an ambiguous word in the first place, and if pattern is a key concept, it should be given an ontological account.

We note that the BFO definition also uses the word *content*, but that does not bring us much further. We started by trying to define the relationship between Information Content and carrier in terms of generic dependence, then it does not help much if we define generic dependence in terms of content. The only gain, if you want, is the claim that two information carriers can have the same content, and that there is no content without a content holder. The question remains how to account for that ontologically.

Talking about patterns of ink, it should be added that these ink patterns typically take the form of characters in a certain font, and that these characters are composed into words. An ontology should specify the ontological categories of these entities and cannot leave this concept of pattern ambiguous. However, this more precise characterization of patterns is probably not the direction IAO wants to go into, as it also talks about the "pattern of neuronal connections in the brain of the subject who reads [the sentence]" as being the same as the ink pattern of the sentence on paper.

3. Other alleged examples of generic dependence

There are more situations that are sometimes analyzed as generic dependence.

1. **Material Dependence**: A statue depends on the marble it is made from. The statue cannot exist without the marble, illustrating how one entity can depend on another for its material composition.
2. **Social Constructs**: A corporation exists as a legal entity, depending on the laws and societal agreements that define it. Without the legal framework and social recognition, the corporation would not exist.
3. **Properties and Objects**: The color red depends on objects that can exhibit that color. The property of being red cannot exist without something that possesses that property.
4. **Conceptual Dependence**: The concept of a "father" depends on the existence of a "child." The relationship inherently requires both parties for the concept to have meaning.
5. **Events and Conditions**: A sporting event depends on the presence of players, rules, and an audience. The event cannot occur without these components.

We briefly consider these cases.

- The statue/marble case is a special case of the form/matter duality about which much has been written (cf. [8]). Important here is that the statue is a product of design. Generic dependence is not appropriate here. UFO would use a variable/rigid embodiment pattern, as in [6].
- The social examples mentioned are probably all grounded in relators [7]. A corporation in the legal sense is based on recognition (registration relator) by the government, and the presence of an owner. Father and son are correlative roles in a relator.
- There seems to be an assumption in example 3 that a universal only exists when it has some existing instance. This makes some sense, although it is not undisputed. But if so, should that not be an axiom on its own? It is possible to say a bit more about this, see the music case below.
- Example 5 is actually a case of specific dependence, not generic dependence. A football game instance with different players would be a different game.

Considering the formal difficulties of defining generic dependence and observing that the alleged cases are all disputable, we tend to conclude that the whole notion of generic dependence may be better avoided, not only for information entities.

4. The alternative: type/token relationships

When talking about information entities, we see a parallel with the case of music. Is the *5th of Beethoven* an instance or a universal, and how does it relate to its repeated performances? According to Dodd [4], it is best understood as a type/token relationship. There are alternative approaches that want to see the piece of music as a continuant (a particular) and the performance as its embodiment. Although this seems to make some sense at first sight, these approaches run into problems when trying to describe the relationship between this continuant particular and the performances in some concrete form of generic dependence. Citing Dodd:

> It may be granted that an entity that generically depends for its existence upon other items is repeatable. The problem is that the kinds of things that are generically dependent upon other objects are themselves *generic* entities rather than continuants. It is significant that, when pressed to provide examples of such generic dependence, we can only come up with examples such as the following (Fine 1995: 287–9): the ontological dependence of a set on its members; the (putative) ontological dependence of a property upon its instances; or (still more controversially) the ontological dependence of a type upon its tokens (a thesis which, in my view, is false). The crucial point about these cases, however, is that in each such example the ontologically dependent entity is something that fits the instantiable–instance ontological pattern. Consequently, such examples of generic ontological dependence cannot provide support for the thesis that a work of music's repeatability consists in its being a genuine *continuant*—that is, a particular rather than an instantiable item—that generically depends for its existence upon its embodiments. Generic dependence seems to be limited to instantiables.

Note that Dodd does not believe that a type requires a token (instance) to exist. However, he is also not a Platonist believing in eternally existing ideas. He prefers the requirement that a type must be instantiable to exist. Pieces of music can be performed at least as long as scores exist. Artefacts (universals) need not have an instance to exist, as long as there is a design on the basis of which new instances could be generated. At this point it would become important to define what it means for a universal to exist or not exist (which is not the same thing as defining a dependency). Anyway, Dodd's point is that it is hard to support the claim that the dependent entity must be a continuant, as the embodiment (realization, concretization, or whatever label is given) can also be described as an instantiable/instance relationship.

5. Conclusion

Describing the relationship between an information entity such as the novel *Don Quixote* and its copies is a challenge for all ontological theories as information entities are deviant with respect to the standard objects of study, material entities and their properties. In many cases, ontologists introduce a special ontological relationship. In BFO, this special relationship is called concretization and it is defined as – in fact identified with – generic ontological dependence. In this paper, we have shown that the original formalization had severe problems. The latest definition avoids most problems, but still raises questions. It seems better to forget about generic ontological dependence and analyze the alleged cases in another way. The relationship between an information entity, or a piece of music, and its copies or performances, respectively, can be described as a type/token relationship and does not require the introduction of a special relationship. In UFO, types are instantiable but can have other types as instances, as it supports multiple type levels [2]. In the DSR artifact ontology, an information entity is modeled as a universal [5], in the same ways as other artifacts. The relationship between the copy/instance and its design is a normative one (cf. [9]). The design specifies how an object should look like to be considered an instance and this can be demonstrated by testing.

Declaration on Generative AI

During the preparation of this work, the author used ChatGPT in order to suggest content on a specific question. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the publication's content.

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