Fictionalism, Realism, and Empiricism

on Scientific Models

Abstract

This paper defends an approach to modeling and models in science that is against model fictionalism of a recent stripe (the “new fictionalism” that takes models to be abstract entities that are analogous to works of fiction). It further argues that there is a version of fictionalism on models to which my approach is neutral and which only makes sense if one adopts a special sort of antirealism (e.g. constructive empiricism). Otherwise, my approach strongly suggests that one stays away from fictionalism and embraces realism directly.

Key words: models, representation, realism, empiricism, fictionalism, maps, and reference

**1. Introduction: the new fictionalism**

 Philosophical discussions on scientific modeling and models have concentrated for some time on their functions in scientific theorizing and their relationships with theories. One approach, a la Cartwright and her defenders (cf. Cartwright 1983, 1999; Morgan & Morrison 1999), takes models to be “mediators” between phenomena and theories but not ontologically different from theories. They differ from theories in the roles they play in the praxis of science. To this approach we might join the ones from the deflationists (cf. Teller 2001; Suarez 2003, 2004, 2010; Callender and Cohen 2006) who take models to be part of scientific theories and yet their uses and meanings are entirely pragmatic, such as tools for inferences (a la Suarez). Another approach, a la van Fraassen and Giere and their defenders (cf. van Fraassen 1980; Giere 1988), is to regard models as the core components of theories (model + empirical hypothesis = theory) or theories as classes of structures/models (the semantic approach to theories), but of a non-linguistic form. With inquiries into the functions of modeling and the structures of theories approaching exhaustion, attentions have recently shifted towards metaphysical issues (cf. Contessa 2009, 2010; Frigg, 2010a,b, 2011; Godfrey-Smith 2006, 2009; Levy 2010, 2012; Rowbottom 2009; Suarez 2009a,b; Toon 2010a,b).

Godfrey-Smith (2006) is undoubtedly correct in pointing out that even though not all disciplines of science resort to modeling and use models, a large number of them do, and so at least with respect to such “model-based” disciplines, it is worth finding out what models are metaphysically and how they represent. One of the results of this intense effort is what I shall call the new fictionalism on models (cf. Contessa 2009, 2010; Frigg, 2010a,b, 2011; Godfrey-Smith 2006, 2009; Levy 2010, 2012; Toon 2010a,b), of which I give a sketch below (more details appear later in the discussion).

The model-based scientific representation, according Frigg (2010a,b, 2011), is an enterprise of a *tripartite structure* (descriptive elements ⇒ models ⇒ real systems), and two salient features stand out among the variety of models and modeling jobs in science: models are *non-truth-apt* (or *non-discursive*) entities and modeling involves an invention of *imaginary systems*. As non-linguistic and a “mediator” between the linguistic and the target system, a model is best seen as either *an abstract artifact* or *a physical artifact* (cf. Keller 2002; Rowbottom 2009 for how even natural objects, such as a fruit fly, can be models). If one chooses the former, as the new fictionalists do, one has the following options for models: Plationism (realism), nominalism, and fictionalism, as they are options for other abstract entities such as numbers and propositions. And given the second salient feature on models, fictionalism becomes an attractive choice. Besides, adopting Platonism for models appears awkward, very much unlike the situation with, say, numbers and propositions, because while adding natural numbers, etc. to reality on top of physical things does not seem too problematic, adding representational vehicles (including models) of physical things to that reality does seem odd. In that case, we would have in reality the physical things, the physical realizations of the models (of some) of those things (such as scale models) and, in addition, the models. Although not an impossible stance, it does not seem a natural or reasonable position to take. And nominalism is not viable if Platonism is not a sensible option. On the other hand, ample examples have been paraded to show similarities between modeling and fiction writing (cf. Frigg 2010a,b, Levy 2012, Toon 2010a,b, Godfrey-Smith 2009). Godfrey-Smith reminds us that *War and Peace* is intended to and does represent Napoleon’s campaign against Russia and *Lord of the Rings* Europe in the Middle Ages. Frigg also argued that the “t-representation” in his account between model systems and their targets is analogous to how fiction teaches us about real life (Frigg 2010a, pp. 103, 121).

The next question is whether such a fictionalist turn is compatible with scientific realism. While some of the new fictionalists (e.g. Frigg 2010a, b, 2011) suggest that we shelve the issue, others (e.g. Levy 2012) confront and explore it, short of making a commitment. Contessa (2010, pp. 219-20) rightly warns us against a confusion between the new fictionalism and the more traditional view á la Fine (1993) and Cartwight (1983, 1999). While the traditional fictionalism is about theoretical/unobservable objects being unreal or fictional, being necessary only to save phenomena, and it is therefore only an option for antirealism, the new fictionalism is said to be compatible with realism if not conducive to it.

In fact, one can be a scientific realist and still believe that the models that we use to represent atoms or quarks are fictional entities even if the atoms and quarks themselves are actual concrete entities just like tables and chairs. (Contessa, 2010, p. 220)

Levy (2010, 2012) fully confronts the compatibility issue between fictionalism and realism and explores two packages of fictionalism towards reconciliation: the ‘whole-cloth’-fiction (Levy 2012) package and the worldly-fiction package. In the former approach, whole systems are imagined or fabricated and treated as targets (or as if they were real systems), while in the latter approach modeling is seen as abstracting aspects of real systems, forming statements about the abstracted aspects, and forming an idealized or abstracted theory of the real system. In the earlier paper (Levy 2010) a version of the former is called *de novo* modeling and a version of the latter *de re* modeling. *Prima face*, the worldly-fiction package is more amenable to realism than the world-cloth version.

Whichever version of new ficionalism one is inclined to embrace, whether it is compatible with scientific realism is undoubtedly treated as a serious issue in the recent literature.

This paper defends an approach to modeling and models in science that is against the new fictionalism. It further argues that there is a version of fictionalism on models to which my approach is neutral, and that it only makes sense to adopt it if one adopts a special sort of antirealism (e.g. constructive empiricism). The other option is to stay away from fictionalism and embrace realism directly.

**2. A hybrid approach to modeling**

I shall begin my approach to modeling with a look at how maps work. The map metaphor for modeling is quite common and goes a long way back, and Frigg (2010b) gives perhaps its latest detailed study (he uses maps to show how his t-representation relation may work (p. 125)). My account differs from his, as I shall explain later.

When we look at, for instance, a map of Beijing (in English) and see a thick straight line-segment in the middle bearing the name “E. Chang an Ave,” we know that the line-segment represents in the map the East Chang an Avenue in Beijing. Other streets and buildings in Beijing and their geological relations are represented in the map the same way: a line segment or a dot and a name or a numeral attached to it (with numerals, a key is provided at a corner). The names denote the objects they refer to, and then the geometrical figures the line segments refer to tell us how those objects in the city of Beijing are represented, or *what they are like*, *in the map*.[[1]](#footnote-1) The geometric figures (picked out by the line segments) are abstract objects and they appear in other places and fulfill other purposes just like any other geometric figures do. They serve a special purpose in this map because the line segments and the dots are *attached with* the appropriate names. However, the names do not refer to or denote the geometric figures, even though it has the appearance of doing that, because, for instance, the name “University of Florida” on a plague at the entrance of the university refers to the university (and its campus). The thick line-segment in the middle of the map of Beijing does not by itself represent East Chuang an Avenue. It represents what that avenue should look in relation to other figures represented in the map. The whole map is usually called “The Map of Beijing,” which is the name of the map, not of the city; but all the names, including “Beijing” in “the Map of Beijing,” in the map are names of parts of the city, not of the figures in the map. By the direct reference of the names and symbols, the map is made to represent a complex city as Beijing in a simple geometrical image. And the image is *shown* by the lines and dots that refer to pure geometrical figures of difference types and sizes. Is the map like (= good representation) the city? Yes, if it represents the *geometrical features* of the city correctly; otherwise, it is not like the city (= bad representation). Does the map resemble the city? No, not by a long stretch; but that is beside the point for representations of this sort. Our map of Beijing necessarily distorts the actual features of the city for the sake of accenting those features that map users want, and there are good distortions and bad distortions, but good or bad, once the names are attached correctly or nearly correctly, it is a map that represents Beijing.

I suggest that the sort of scientific models the recent literature has been covering (the models understood in the new fictionalism) can and should be understood in essentially the same way.

Figure 1 shows a model for atoms in an experiment (Rutherford’s), and “The Rutherford model” is a name of the model, not the actual experiment, but of in model, we have “atoms,” “electron,” “α particle,” “nucleus,” etc.



Figure 1: The Rutherford Model of atoms (and experiment)

These are terms referring to the objects in reality, not the components in the model. It is not difficult to see that most other models, differences in details notwithstanding, can and should be viewed essentially in this manner[[2]](#footnote-2). The names, (natural) kind terms, or any other sorts of symbols used in such a model all refer to the specific components of the target systems that the model represents. They do not refer to or denote components in the model. The components are in most cases abstract objects that may serve in a great variety of models and bear a great variety of terms (or symbols). If we strip all the *referring devices* (RD) from a model, what is left is an abstract object of a certain structure,[[3]](#footnote-3) which may or may not resemble something real.

I shall henceforth call such things “models sans RD,” (where RD refers to all symbolic devices, not just words and labels, though they are the most often used,) and they are generic abstract entities (or physical objects if you will). Note: the point is not that abstract model components, such as geometric figures, cannot serve as notational vehicles. They can, of course, just as a realistically drawn portrait of Obama can serve (without any labels) the double duty of denoting and showing the likeness of Obama (but what if Obama had an identical twin brother? cf. Goodman 1976)[[4]](#footnote-4). The point is that in most cases, and more importantly by the nature of scientific modeling, the duties of denoting and showing likeness in selected aspects are distinct and separate. What modeling does is to show us what the denoted components are like and how they are related. The referring job is done by devices that already perform the same duty in other occasions in our language, and the showing job is done by the abstract objects as model components (again, if you reject abstract entities, the job is done by the physical components or drawn geometric figures). This conception of modeling as a combination of abstract (or concrete) objects as modelistic elements and RDs as symbolic elements is, I argue, the right conception; and it provides a simple explanation for a well known fact in the literature on models: why resemblance, isomorphism, or any other intrinsic relationship between the structure of a model and its target is neither necessary nor sufficient for representation *per se* (cf. Goodman 1976, Suarez 2003, 2004, Callender and Cohen 2006, among others). Such a relationship between the modelistic elements and the target in terms of structural resemblances of some sort is not needed for the sake of denotation/reference. The job is done essentially by RDs or their equivalence. In my approach, modelistic elements (elements without RDs) are not supposed to *also* tell the inventors and users of models what they represent because whenever necessary, there are always attached RDs to rely on.

Let me now provide more arguments for this approach to modeling, which one may call a *hybrid view* of modeling, because it says that a model involves symbolic as well as modelistic devices, where the former denote and the latter show. And one essential feature of most modeling jobs is a sort of division of labor.

First, the quote above from Contessa (see p. 4) suggests that there are atoms and quarks in models, call them “schmatoms” and “schwarks,” and there are atoms and quarks in reality (like tables and chairs). Schwarks, etc. are fictional objects, but Contessa claims that one can still be a realist in the sense of believing that quarks, etc. exist and are represented, through some magical ways, by schwarks, etc. (“magical” because it connects quarks, the real, with schwarks, the fictional). Contessa and the other new fictionalists do not talk about this arrangement in this transparent manner; they think the same terms such as “atoms” and “quarks” can be used to denote modelistic elements in some contexts and the real objects in other contexts. Therefore, in models, we have idealized or abstracted objects that are also called “atoms” and “quarks.” This is obviously the wrong way of looking at modeling and models, because terms, such as “atom” and “quark” do not shed their normal meaning when combined with modelistic elements (or more general with pictorial elements) and become “schmatom” and “schwark,” that denote those elements.

Why can’t terms function differently in different situations? They do and can but not in this case because we also use the same terms, such as “quark,” in sentences that talk about quarks. Don’t tell me that scientists have to constantly disambiguate the term as meaning quark or meaning schwark when they read high-energy physics papers. (There are special terms referring to model components that do not include the word “model”, such as “Bohr’s atoms” and “lattice gas,” but they are just like “schmatom” and “schwark” and they are never ambiguous.)

Second, this hybrid approach bears some resemblance to Frigg’s view (2010a,b, 2011), but it is different. I have no problem agreeing with the framework of the tripartite conception of modeling, where abstract systems are imagined even “whole-cloth” (to borrow a term from Levy (2012)). In Frigg’s version (2010a,b, 2011), we see a structure that may be simply rendered this way: Model Descriptions =(p-represent)=> Model Systems =(t-represent)=> Real Systems, where the first two parts are related by the “p-representation” and the last two parts by a different and separate representational relation he calls “t-representation.” Given our analysis above regarding the nature and functions of RDs, it is simply not correct to think of the model-description part of the enterprise as only about the models systems in the middle part. The RDs in the sentences and equations in that first part refer to the objects in the third part where real systems reside that are the targets of modeling. Frigg (2010b) has tried to deal with the problem of how his t-representation may work, and for delivering a “First-Stab” he enlisted the map metaphor (p. 125) as I mentioned earlier. No doubt his effort in making this connection between map and modeling continues and enriches a long tradition of exploring that metaphor for representation, but by separating the p-representation and the t-representation, he fails to see that RDs function independently or free from these two separate stages of modeling. RDs in most cases of modeling do not refer to modelistic elements in the middle part, but are transferred from the first part to these elements so that the original referential relation is kept intact. In this way, when we consider the t-representation (if we opt to follow Frigg’s structure), the referential relation that is transferred from the p-representation (always pointing to the components of real systems) is used to secure the connection between the modelistic and the real systems.

The RDs do the job I interpret them to do in a model the same way they do in other contexts; and this is a merit of my hybrid view of modeling. Symbolic vehicles of representation, which include terms and labels, function, and should function, the same way whether they appear in a sentence, a picture, or a more elaborate scientific model. They refer to the objects they are used to refer to in accordance with the convention that connects them to their referents and secure that connection. Unless special circumstances, as the ones we shall soon turn to, require the terms to work differently (but also by agreement among users for the special usage), there is no good reason to believe that when combined with modelistic elements, they change their function and refer to those elements instead. (The special cases include, e.g. that the terms “hawk” and “dove” don’t really refer to hawks and doves in such models as the Hawk-Dove Model in evolutionary game theory.)

Not only is this the right way to resolve Frigg’s “t-representation” problem, it also explains why modeling in science can be so imaginatively creative and not be bound by any apparent constraints on whether or how much the model (sans RDs) resembles the target. When the target of a model is securely anchored by its RDs, we can create whatever we want to show what it and its parts are like in the aspects we choose as long as there is a collective agreement. We may be bad modelers, but no one can accuse us of modeling the wrong thing. On the other hand, we can be said bad modelers precisely because the RDs in our models hold us accountable. Otherwise, we can acquit ourselves by saying we are talking about schmatoms and schwarks, and they are what we say they are; and unless we are inconsistent, we are therefore good modelers of atoms and quarks. This consequence, which may be reasonably attributed to new fictionalism, is clearly unacceptable.

Third, what about the point in favor of new fictionalism that models are often studied for their own sake, apart from what and how they represent? This happens only for models sans RDs and they are inevitably studied not as models of x and y, but rather as *proto-models*, something generic and can be used to model x and y and many other things when RDs are introduced. They may be mathematical objects or more substantial but still abstract artifacts (or they are just physical artifacts), and they may have special terms for their parts (such as “lattice gas” or “auxiliary loops”); but a study of them is not to be confused with studying the full-fledged model. That is a study of the target (through the model), which is chiefly the aim of science. We may study how non-interacting points operate in a confined space with rigid walls as a study of what modeling job this combination of abstract objects can do. But when we study ideal gas in which gas molecules behave like the abstract system, we are studying the behavior of molecules, not that of schwolecules! This is not so different from how differential equations are studied for their own sake. It is quite different from how Maxwell’s equations are studied to understand electromagnetism. In parallel, the RDs for the variables in Maxwell’s equations are exactly analogous to the RDs in, say, Rutherford’s model. For instance, the vectors **E** and **B** are variable (symbols) for the intensity of electric field and magnetic field, not for their stand-in’s in any model of electromagnetic field.

Models sans RDs are not models for they do not represent anything (yet). Metaphysically, there is an option for taking all such objects as fictional objects, just as there is such an option for numbers and propositions (cf. Field 1989; Yablo 1998, 2010). When attached with RDs, they become models, and the devices refer as they do in other appropriate contexts, and the referred real systems are represented and displayed by the models. In the next section I shall discuss in a more systematic manner (though mentioned earlier in passing as in the “Hawk-Dove Model”) how there are fictional models in science (which the modelers themselves recognize as such), and they are not such models as Rutherford’s model or the model for phlogiston or for luminiferous aether.

What is not plausible at all is the conception of new fictionalism that there is a realm that is populated with objects that are different, i.e. idealized or distorted or abstracted, from the real systems that they are supposed to represent; nevertheless, they wear the same “clothes” as the real systems do. So, a sizeless thing in an ideal gas model should still be referred to as a molecule although it only stands in for the real thing. And this realm somehow resembles the imaginary world of fiction, where similar things appear to be happening. There we have people and buildings that bear names real people and buildings have or might well have, and such “models” of society somehow can be used to represent our lives, but they don’t represent them in any straightforward manner because the names in those stories do not refer to real people. From what we have argued so far, we can see that is emphatically never how models in science or in daily life work to represent reality.

**3. Realism, empiricism, and fictionalism**

There are no special challenges to scientific realism when we understand models according to the hybrid view. Realists can argue for the position as they have always done, namely, to show that science can and does aim at a truthful representation of the referred systems, such as electrons and economies, via model systems (be they abstract entities or scaled physical objects). I take it that to the extent that scientific realists have any success in arguing for their position, the fact that real systems are often represented in scientific theories as systems of selected aspects with idealization (and approximation) is no special challenge to their position. Fictionalism only becomes an attractive option when one is convinced of antirealism but needs to deal with the ontological problem for theoretical entities.[[5]](#footnote-5) However, it may not be an attractive option, if one is also an instrumentalist. For instrumentalism, theoretical models, such as the Rutherford Model, contain non-referring terms, and therefore they are not *literally about* anything beyond itself (not fully representational). Claims about electrons, etc. in a model are neither true nor false in the standard way (when they are treated as external claims). They may be trivially/analytically true or false if they are taken to be internal claims about model components or, more plausibly, they are empirically testable if they are taken to be reducible to claims of observational results. Historically, naïve instrumentalism has never been an attractive philosophical position.

Not all empiricists are instrumentalists, and van Fraassen is clearly a non-instrumentalist empiricist. It turns out that fictionalism makes the most sense for van Fraassen’s constructive empiricism (CE) (van Fraassen 1980). In a subtle and illuminating paper, Rosen (1994) argues that the only sense one could make of van Fraassen’s CE is to see it as a piece of fiction in social science, namely, the aim of science as accepting empirically adequate theories despite the demand for their literal construal is best seen as a piece of fiction among fictional communities of scientists. As a side point, but not an unimportant one, he argues that it is also best to think of van Fraassen as taking a fictionalist stance on theories that must be literally construed (although empirical adequacy is the only criterion for accepting them) (see especially, pp. 148-154). Let me flesh out this point of Rosen’s and show why fictionalism can help us make good sense of van Fraassen’s demand on theories for the unobservable.

Van Fraassen takes scientific realism to be committed to two claims regarding theories (or models): the terms in them genuinely refer and to accept them is to believe that they are true with good reasons. In coming up with CE, van Fraassen explicitly keeps the first claim but rejects the second, replacing it with the criterion of empirical adequacy. But what does it mean for the terms in a theoretical model to “genuinely refer”(cf. van Fraassen 1980, chapter 2) while suspending beliefs about claims made by using them? Let’s see how a map works in a fictional setting. Figure 2 is a map of Thomas Hardy’s Wessex.



Figure 2: Map of Wessex

What do terms in it such as “Upper Wessex” and “Wintoncester” mean? As in the case of the map of Beijing, neither the former refers to the enclosed space (containing the words) nor the latter refers to the dot beside “Wintoncester.” No, they refer to the territory, Upper Wessex, and the town of Wintoncester. The only difference here is while “E. Chang an Ave” refers to the Avenue in Beijing, an actual avenue, “Upper Wessex,” etc. refers to *nothing* or at least not to any actual regions of the earth’s surface bearing those names, because Wessex is a fictional region made up by Thomas Hardy for his novels and poems.

There are strong reasons for us to understand in the same way Rosen’s fictionalized van Fraassen’s CE. Unlike the new fictionalists who regard models as self-referential and claims as mostly internal, the CE’st account of models, with Rosen’s interpretation, is a truly fictionalist approach on the unobservable. The terms in the models or theories (according to van Fraassen’s semantic approach to theories, theories are classes of models!) do refer to things beyond the models (as “Upper Wessex,” etc. refer to regions beyond the map) but the things simply do not exist; they could be fictional. It is not the model that is fictional, it is what the model represents (or genuinely refer to) that is non-existent, and therefore, fictional. As I cautioned in footnote 5, one can still be a Platonist (i.e. a realist) about the abstract entities that constitute models sans RDs, even if one does not believe what such models (when equipped with referring devices) represent can be true or one may be agnostic about that. This is the only version of fictionalism on scientific models that is analogous to the case of literary fiction and that makes good sense, but this is obviously not a fictionalism that can be made compatible with scientific realism.

I do not think van Fraassen would have objected to this fictionalist interpretation of his view on literally construed models/theories (in a prompt response to Rosen’s critique, van Fraassen (1994) does not raise any objections to this particular point of Rosen’s). However, in its original form, a CE’st needs only to hold an agnostic attitude towards unobservable objects, while a fictionalist has to at least *prima face* deny their reality.[[6]](#footnote-6)

But aren’t literary fictional worlds model-worlds, and if so why can’t we analogously take *all* scientific models to be fictional? Are not works of fiction, such as Hardy’s *The Mayor of Casterbridge* or *Tess of the d’Urbervilles*, themselves models rather than representing anything beyond? This is a challenge the new fictionalists would, I think, raise against my approach and analysis of the fictional. Let us look at the map case again. The question is: does it make sense to say that since there is nothing that “Upper Wessex” refers to, it must denote the space in the map? But that is tantamount to saying because “Tess” does not refer to any actual person, it must refer to the appropriate set of sentences or propositions in *Tess of the d’Urbervilles*. But how could that even make good sense? It does not seem to make sense to say that “Tess,” clearly a name for a person, may name a person if there is actually one for it to name; otherwise, it may name a set of sentences or pictures. Similarly, it does not seem to make sense either to say that “Tess” refers to Nastassja Kinski in the film version of *Tess of the d’Urbervilles* directed by Roman Polanski, does it? Therefore, there is no good reason to believe in the new fictionalism in this respect.

What is the upshot here? Again, it is the distinction between the symbolic and the modelistic. If all the new fictionalists are claiming is that models sans RDs (= modelistic elements) are fictional entities, then I have no objection at all, as I do not have any objection to fictionalism about numbers and other mathematical entities. But that does not entitle one to say that models with RDs are also fictional unless one is committed to taking what the RDs refer to as objects of fiction. That means one takes airplanes, galaxies, and quarks, etc. to be fictional because that’s what those corresponding symbols refer to. This is not what the new fictionalists are ready to hold, and it only makes sense for CE with respect to unobservable objects.

A work of fiction may be taken as a model of a fictional world, because it is more likely than not an abstraction (or idealization) of that world. For example, Thomas Hardy’s fictional world of Wessex appears in his many novels and poems. Each of those can only show us some aspects of Wessex and its inhabitants (= abstractions), and yet all of them refer to the same world, which might have been modeled further had Hardy lived longer and produced more works about it. This must be true if we can, and I think we should, believe that, for instance, there is a definite number of houses in Wintonchester even though the number was never mentioned anywhere in Hardy’s works. So models, either scientific or literary, are not fictional objects (other than being fictional in the trivial sense of being abstract artifacts if one rejects both Platonism and nominalism regarding abstract entities); they are vehicles that represent fictional as well as real objects.

Besides, whether one agrees with Rosen’s fictionalist CE on the unobservable, one must admit that there are purely fictional models in science. Models that scientists themselves call “virtual models” are an example. This category of fictional models in science is a grab bag of items, and it is a conception that should clearly be distinguished from taking all scientific models to be fictional (as the new fictionalism does). In another paper I have enumerated and categorized such models in a more systematic way, but here the mentioning of some examples should suffice. In physics, there is a well-tested method of introducing imaginary objects at chosen places in a system to create identical effects that divergent or near-infinite substances cause. The physicists know that the objects are not actually there in the system but all relevant causal effects can be conveniently obtained by pretending that they are there. There are also models that exemplify a large variety of types of systems, such as the “harmonic oscillator” or the “rational man” or the “hawk-dove game.” These terms do not refer to any particular types of systems in reality. They are rather like terms for a trope of properties or functions; in other words, they are analogous to terms referring to geometric figures that can be used as modelistic elements. The study of a harmonic oscillator or a rational man or the hawk-dove game is not a study of a natural system, but rather a study of a model. Terms for the components of such systems are clearly terms referring to the parts of the models. The hawks and the doves in the evolutionary game of hawk-dove do not refer to hawks or doves, nor do they refer to any groups of people in our society, not even idealized groups of people. They refer to strategies that idealized people adopt in idealized situations. Are there hawk-dove games in reality? No, not directly. There are situations in real life that we can use this model to represent, and most likely, when the hawk-dove game models is used to represent some real situations, additional names will be given to them to denote the situations as hawk-dove games. This is no different from using a geometric figure known as the “vertical line segment” to represent the free fall of an object in the Galileo case, when it is attached with a label “free-falling body.”

Space limit prevents me from doing justice to Rosen’s fictional interpretation of CE, but one of his critical points of van Fraassen needs to be addressed, for it further illustrates what a proper fictionalism should look like. After pointing out that van Fraassen could not at the same time be a Platonist on unobservable entities, and nominalism and fictionalism shares the belief that those entities do not exist, Rosen raised the question: does *T* exist in the claim “*T* is empirically adequate” (p. 165)? (Here, *T* is supposed to be a literally construed theory.) Rosen argues that “*T”* must refer to an abstract entity, given van Fraassen’s semantic approach to theories; and it has to exist in order for us to believe the claim, and so van Fraassen has to commit to the existence of at least one abstract entity in order for CE to work, but he can’t (pp. 167-169).

I think we have the resources in this paper to defend van Fraassen. First, we note the distinction between models sans RDs and what they represent. The former are no different from, e.g. mathematical entities, while the latter include observable and unobservable objects. A CE’st does not have to deny existence to all abstract entities; but she has to deny it to those that would be physical if they existed. Rosen rightly points out that van Fraassen cannot avail himself of this move (p. 165), but it ought to be available to CE’sts, because (1) even scientific realists may consistently adopt nominalism on numbers and propositions and (2) only those unobservables that may make a difference for empirical adequacy matter to CE (must be denied or held agnostic of its existence); and abstract entities such as numbers and propositions clearly don’t, even if they *are real*. Hence, *T* could well be real for a CE’st; and that avoids Rosen’s challenge, and yet what is genuinely referred to inside *T*, when they are unobservable, is still fictional. This version of CE actually makes more sense and here is why. What does it mean to be fictional in its plainest or original sense? That Tess is fictional means that if we suspend our disbelief of her non-existence, we can pretend that we are reading a history about an actual person named “Tess,” among others, entitled *Tess of the d’Urbervilles*. We do the same for the unobservable in *T* if we are CE’st, but it makes no sense for us to do the same for numbers, sets, and models. For instance, it would not make sense to ask whether *Principia Mathematica* is empirically adequate, whether or not one believes that numbers and sets are real, would it?

Therefore, there is a defendable version of a fictionalist CE that does not treat all unobservable entities (which include mathematical ones by default) equally. To hold this version of CE, one may take, if one wants, all those abstract entities that make no difference to the empirical adequacy of scientific theories to be real (be a Platonist for them); but one has to be agnostic about those abstract entities that may make a difference for empirical adequacy and take them to be fictional.

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1. Throughout this paper, I assume that geometrical figures are abstract entities which we use, e.g., marks on surfaces, to represent. However, if one rejects all abstract entities as an ontological commitment, then one can easily dispense the reference talk such as line segments and dots representing geometric figures and just talk directly about line segments and dots on paper and their geometric relations. [↑](#footnote-ref-1)
2. I say “most,” for there are exceptions to this claim, as we shall discuss separately later. There are “toy” models or fictional models in science that do not fit this claim here. [↑](#footnote-ref-2)
3. NB: this point remains valid if one rejects the abstract-entity conception of modeling and takes all models to be concrete physical objects (such as a scale model of the Rutherford atoms or diagrams on paper as the one shown above). Striping the labels from the parts and removing the name of the model would make the “thing” just another physical object or set of ink marks. This is consistent with what is said in footnote 3. [↑](#footnote-ref-3)
4. Much more liberty may be taken in arts in how and what things and pictures can represent, we are here only concerned with scientific representation. [↑](#footnote-ref-4)
5. One must however be clear again that the problem for the antirealists is not whether it makes sense to regard the model sans RDs as existing. If it makes sense to be a Plationist on abstract entities while remaining an antirealist on hypothesized unobservable systems, then a model of quarks exists for such an empiricist while quarks are not regarded as real as desks and chairs. [↑](#footnote-ref-5)
6. Some violence is done to van Fraassen’s view on models (the semantic view of theory), but hopefully no confusion arises from it. [↑](#footnote-ref-6)