

Science and Fiction: Analysing the Concept of Fiction in Science and its Limits

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Abstract A recent and growing discussion in philosophy addresses the construction of models and their use in scientific reasoning by comparison with fiction. This comparison helps to explore the problem of mediated observation and, hence, the lack of an unambiguous reference of representations. Examining the usefulness of the concept of fiction for a comparison with non-denoting elements in science, the aim of this paper is to present reasonable grounds for drawing a distinction between these two kinds of representation. In particular, my account will suggest a demarcation between fictional and non-fictional discourse as involving two different ways of interpreting representations. This demarcation, leading me to distinguish between fictional and non-fictional forms of enquiry, will provide a useful tool to explore to what extent the descriptions given by a model can be justified as making claims about the world and to what degree they are a consequence of the model's particular construction.

Keywords Fiction · Representation · Denoting · Reference · Philosophy of science

A fast growing debate in the philosophy of science has taken an interest in fictionalisation strategies for scientific reasoning. Unlike other areas of philosophy such as metaphysics, ontology, aesthetics, philosophy of language and mathematics, the concept of fiction in this debate does not concern issues surrounding the problem of truth in fiction (Lewis 1978; Salmon 1998),¹ the existence of fictional entities such as Pegasus (Meinong 1904; Kaplan 1973; Kripke 2011), or the existence of mathematical entities and the interpretation of existential quantifiers (Balaguer 1998; Priest 2003, 2005). Fiction here refers to the role played by particular methods of model building such as abstractions, idealisations and the

¹ This concerns propositions such as “Sherlock Holmes is a detective” versus “Sherlock Holmes is the fifth member of the Sign of Four”.

employment of highly hypothetical entities. Since a variety of concepts and models in scientific practice—e.g. frictionless planes, ideal gases or *Homo economicus*—do not denote any particular physical target system, the question emerging is how science aims at describing reality (Cartwright 1983; Suárez 2009, 2010).

Addressing the underlying question of scientific realism, the claim I want to defend is that denoting, i.e. referring to a particular physical entity, is not a necessary condition for scientific representations to make claims about reality. By using the concept of fiction as a tool for analysing non-denoting elements in science, this paper aims to address the ways in which scientific representations, even though employing non-denoting elements, are said to provide information about the world. Rather than structural criteria such as the degree of similarity a representation exhibits towards its represented entity, I will argue that the reference of representations is determined by their epistemic function. This function does not merely concern the capacity of a representation to allow for inferences about an intended physical target, but is also defined by its relations towards other representations making similar or conflicting claims about the same target system. The reason for this, I will argue, is that elements, even if identical in semantic content, only denote by virtue of their contextual embedding. To analyse epistemic relations, my argument points out, requires a form of enquiry different to the interpretation of fiction.

To introduce my argument, this paper proceeds as following. First I will present the context in which the concept of fiction became part of the philosophical debate on scientific realism. Following this, I will focus on the hybrid character of representations that, employing both denoting and non-denoting elements, makes it hard to mark a distinction between representations that refer and those that do not. After emphasising the limits of structural criteria such as similarity, I want to make use of the concept of fiction in science by drawing a distinction between the interpretation of a representation as either fictional or non-fictional. The aim of this approach is to present reasonable ground to distinguish between fictional entities and non-denoting elements in science. The basis for this distinction is the context in which denoting and non-denoting elements are used. This, I hope, will also provide further insight into the characteristics of scientific enquiry.

1 Fiction in Science?

Most of the philosophical difficulties that spurred interest in the concept of fiction in the philosophy of science are a consequence of fundamental changes in the scientific understanding of nature. The legacy of, on the one hand, the substitution of phlogiston for oxygen in 19th century chemistry and, on the other hand, radical theory changes in earlier 20th century physics led to growing scepticism about the reference of scientific concepts and cast doubt on the reality of scientific objects (Kuhn 1970 [1962]; Feyerabend 1962; van Fraassen 1980). These changes suggested that even supposedly fundamental scientific concepts are dependent on the theoretical framework in which they are embedded. If this framework is replaced, the concepts may either change their meaning or become redundant.

The history of science provides a rich inventory of concepts of entities abandoned in the course of theory changes such as phlogiston, the ether or pneuma. What all these examples have in common is that the entities described were once assumed to exist but later turned out to have no instantiations in the world, neither in a literal nor in an idealised sense. When Galen assumed the existence of *pneuma*, it was considered to be the principle of life and served as an explanation for three different life processes: visual perception, blood flow and metabolism (Johansson and Lynøe 2008, pp. 82). Albeit the *explanandum*, in the case of the

blood flow the process and its physical parts such as the heart and arteries were real, the *explanans* was not. Nevertheless, the concept of *pneuma* served a theoretical purpose by providing a model under which certain life processes were fruitfully investigated.

Philosophical scepticism raised by historical changes resonates with further doubt about the reality of scientific entities and phenomena that are not directly observable. Contemporary scientific theories often subsume entities under concepts that assume specific experimental settings and conditions under which certain effects are produced. The interpretation of these effects facilitates claims about the nature and existence of particular entities that are assumed to underlie these phenomena. Examples for such entities are genes and electrons that are investigated as causes for phenomena of inheritance and electricity. However, these entities are only indirectly traceable and our knowledge of them remains hypothetical to a certain extent. For these reasons, the border between the concept of an entity and the entity conceptualised are called into question and seem to blend. Perfectly sharp distinctions between ‘hypothetical’ and ‘real’ objects in science can no longer be expected. By drawing on the influence of models and experiments in guiding research practice, awareness of the not only descriptive but also constitutive function of scientific concepts and representations has been raised in the last few decades (Cartwright 1983; Hacking 1983; Rheinberger 1997; Morgan and Morrison 1999; Radder 2003; Suárez 2009). Models often determine the conditions under which materials are transformed into epistemically accessible research objects (Rheinberger 2005, 408).

Indeed, it is the striking theoretical usefulness of many scientific concepts and models that nevertheless lack proper reference to physical target systems and objects, which became the centre of recent philosophical attention. Familiar examples involve models such as frictionless planes, ideal gases or *Homo economicus*. Models such as these are often idealisations and imply assumptions seldom realised in the physical world (Cartwright 1983; Suárez 2009). Consider, for instance, the model of the pendulum that assumes an environment lacking air resistance. To apply this model to an environment that is not a vacuum additional calculation about the variables have to be made, which serve as approximations of the real situation. Yet, taken in its literal and unmodified sense, the pendulum does not refer to any physical system and therefore does not seem to have a denoting character (Morrison 1999, 49, 63).

What brings these two related concerns together, the abandonment of scientific concepts in the course of theory change and the distortions brought about by contemporary model building, is the problem of the reference of scientific representations. The question emerging here is how to decide *whether* and *when* a particular scientific representation makes truthful claims about the world. A number of philosophical arguments have addressed this question by exploring criteria for denoting such as “similarity”, “resemblance”, or definitions of “structure” that determine the relation between a representation and its intended target system (Goodman 1969; Frigg 2002; van Fraassen 2008; Frigg 2010). The insufficiency of these criteria for an understanding of scientific representations, however, has directed philosophical debate towards an analysis of the construction of models as a fictionalisation technique (Sugden 2000; Suárez 2009, 2010; Toon 2012). Guiding scientific reasoning, the application of models often lacks accuracy and truthfulness in favour of making highly idealised or abstract claims about their intended target system. Likewise, many models employ hypothetical entities that serve a heuristic role, e.g. aiding in calculations or hypothesis-making, rather than presenting real entities (Suárez 2010). The concept of fiction in the philosophy of science, therefore, is used to explore the strategies that underlie model thinking in scientific reasoning.

Two responses should be offered to the employment of the concept of fiction in science. First, and most obvious, the alleged similarity of scientific model building with fictionalisation techniques involves two meanings of fiction (Frigg 2010, 247). One meaning concerns distortion techniques such as idealisations and abstractions. These, when compared with fiction, are described as cases of mimesis. Even though they closely resemble some entities in the world, they do not denote anything in particular but, rather, provide a more abstract understanding of the world and its affairs. By contrast, abandoned scientific concepts such as phlogiston or pneuma, like fiction, do not denote real entities.² On this account, the second meaning of fiction concerns whether some concept denotes an entity or not. Unlike fictional characters that were never thought to denote, however, scientific entities are commonly assumed to exist. If they turn out to be fictitious, such as in the case of phlogiston or pneuma, their lack of reference is not intended. Even in the case of highly hypothetical entities such as the Higgs boson particle (where, until debate reignited recently, there was no general consensus about its alleged ontological status within the scientific community), these entities are still handled as candidates for truth.

Corresponding with these two meanings of fiction, i.e. mimesis and non-existence, are two positions in the philosophical debate. For some philosophers such as Cartwright, Suárez, Frigg and Fine, who argue for *wide fictionalism*, the comparison of scientific representations with fiction involves both meanings of fiction. Other philosophers such as Morrison, Teller, Giere and Winsberg, who advocate *narrow fictionalism*, restrict the concept of fiction in science to concepts of non-existent entities only (Suárez 2009).

My second response to the concept of fiction in science is that the two positions just distinguished nevertheless have one major aspect in common. With philosophical debate focussing on the general problem of reference, the concept of fiction in science appears to be associated with different forms of *non-denoting elements* in scientific representations. The central idea of identifying non-denoting elements with fiction is to understand the ways in which our modelling strategies may or may not reflect reality. Notwithstanding their conceptual affinities, I tend to be sceptical about conceiving particular representational elements in science as fiction only on the grounds that neither of them denotes. The question that interests me here is thus: is something similar to fiction because it does not denote, or do such non-denoting elements in science have other characteristics that distinguish them from proper fiction? Furthermore, if there is a characteristic difference between fiction and non-denoting elements, what does this difference tell us about the character of scientific enquiry? Therefore, the issue that guides the following sections is whether ‘non-denoting elements’ in science really are fictions, and where the limits of such a comparison are.

2 The Hybrid Character of Fictional and Non-Fictional Discourse

The common denominator I identified in the widespread debate on fiction in science is the involvement of different kinds of non-denoting elements in scientific practice. In comparison to the problem of non-denoting elements addressed by the concept of fiction in science, a similar difficulty occurs in other discourses such as history and literary theory. Consider, for instance, the interpretation of historical documents and the assessment of the authenticity of their embedded claims. Historical documents are used to account for past

² Existence here means the physical existence of entities, that is their concrete being in space and time, and does not involve any possible metaphysical existence of fictional entities (Frigg 2010, 247).

events; they are thought to prove, certify or witness something that really happened and are used to inform later generations about, for instance, political decisions and social norms of earlier times. Yet the border between fiction and historical documents often seems to blur. Like the first meaning of fiction as forms of distortion mentioned above, a range of fictional works such as Victorian novels do not denote particular people but can be employed as a historical source to provide information about the society and manners of that time. Furthermore, many fictional works employ historical documents as props for their plot setting and, conversely, elements and characters of fiction also appear in historical documents, for instance as satire or for illustrative and political purposes (Werle 2006, 113). With respect to the second meaning of fiction, regarding non-existent entities, historical documents can likewise turn out to be forged and completely fictitious, for instance, in the spectacular fraud of “Hitler’s diaries” (Henry III et al. 1983).

Common to all these representations, whether these be works of fiction, historical documents or models in science, is their “hybrid character”. By hybrid character I mean that representations as public devices of description are permeated by denoting as well as non-denoting elements. Non-fictional representations such as models in science or historical documents can include elements that do not denote anything particular in the world whereas fictional works can employ elements known from reality, containing real places, events or people such as Napoleon in *War and Peace*, London in *Sherlock Holmes*, or the Cuban Crisis in *X-Men*.

Approaching the hybrid character of fiction, this hybridity resonates with Terence Parson’s analysis of fictional elements and his distinction between “objects *native* to the story versus objects that are *immigrants* to the story” (Parson 1980, 51). “Objects native to the story” are those that are a genuine creation of a representation such as Sherlock Holmes. Immigrant objects are elements that are not inventions originating from a particular representation but are ‘imported’ from other contexts such as the element of London. However, this distinction does not necessarily provide a basis to decide whether such immigrant objects (when employed in fictional contexts) are properly referring to the real counterparts on which they are modelled. “Immigrant objects”, e.g. the character of Napoleon in *War and Peace*, are nevertheless part of a particular fictional discourse and their interpretation is informed by their occurrence in this particular representation.

Such mixtures of real and unreal elements in the composition of fictional representations are not surprising. First, the interpretation of fiction relies on the same principles and conventions about language that also give meaning to words and signs in non-fictional discourse. When Barbarella and Jane Fonda are, for instance, both portrayed as blondes, we say the same about both of them. Even though one is a fictional character and the other one is a real person, by describing the two of them as blonde we attribute a particular hair colour to them. Convention about the meaning of words is external to fictional discourse. Unless a different meaning is made explicit in fictional discourse, a word has the same meaning as it has in non-fictional discourse (Heintz 1979, 89). Second, fiction is often based on knowledge about particular places, events and people. Previously mentioned examples such as Napoleon in *War and Peace*, London in *Sherlock Holmes*, or the Cuban Crisis in *X-Men* illustrate that the interpretation of fictional discourses often requires knowledge about elements of non-fictional discourses. By virtue of this, fiction has been described as dependent or even ‘parasitic’ on non-fictional discourse (Searle 1975, 326; Eco 1994, 95). This twofold dependency of fiction on non-fictional discourse thus constitutes the grounds for its often ‘hybrid character’.

Comparing the hybrid character of fictional with non-fictional representations, the question arises how to evaluate whether a representation has a denoting or a fictional

character, i.e. whether and when its claims truthfully refer to the world or are merely fictitious? For many representations, the case seems intuitive. When chemists investigate the transformation of chemical substances, they assume that the underlying elements indeed correspond to their concepts of atoms and molecules. If, however, Star Trek's Captain Picard gives the order to engage to Warp 3, it would not convince people that this refers to an actual velocity. Nonetheless, it would not be considered as either false or nonsense. Although there is nothing in our world to which Warp 3 refers, it makes sense when understood as a construct within a particular fictional context. In the case of fiction reference to the world is therefore suspended (Eco 1994; Werle 2006). For other examples, however, the case appears less obvious. What anecdotes of Casanova's memoirs are factual or fiction (Casanova 2007 [1725–1798]), and what elements of hypothetical computer models of olfactory receptor proteins are real (Crasto 2009)? Scientific discourse is permeated by idealised or often figurative descriptions and the issue is how literally to take them. To emphasise the importance of DNA in life processes, for instance, DNA is often referred to as "the book of life" in analogy to its coding function; yet this vivid metaphor has developed a problematic life of its own (Kay 2000). Moreover, the concept of 'metaphors' has been used to describe the function of theoretical models in biology and economics (Sugden 2000; Morgan 2002). Metaphors are figurative descriptions that are not understood literally but, although they conflict in their literal sense, they convey an element of meaning (Eco 1994, 68, 139).

The issue at stake is the epistemic function served by non-fictional elements. The epistemic function of denoting representations is to tell us something about the world (Sugden 2000, 1). To the contrary, fiction deals with entities and descriptions that are not bound to be truthful descriptions of our world. Even though fiction contains entities that have familiar counterparts in the world, these elements are not automatically seen to serve as a truthful description of their counterparts.³ Consider, for instance, Tolstoy's *War and Peace*, which, contrary to historical fact, describes a victorious Napoleon in Russia. Tolstoy neither *lied* to his reader nor *assumed* something historically inaccurate. He merely used the knowledge about a historical character and created a fictional course of history, which is not bound to be accurate or true of the actual historical events. Hence, fictional discourse is not required to *prove* or *argue for* the truth of its presented claims. For these reasons, fiction lacks an epistemic function; it is not used to truthfully reflect states of affairs in the world (Albrecht and Danneberg 2011).

Concerning this divergence over epistemic function, how does one determine the grounds for the adequate epistemic use of a representation? Addressing so-called fictions in science, Hans Vaihinger suggested considering them as useful heuristic tools that, unlike hypotheses referring to real phenomena, are not verifiable by observation (Vaihinger 2008 [1928]; Fine 1993). A problem with this suggestion is that the distinction between what

³ A question arising here is whether fiction might be said to be accidentally true. Consider, for instance, the possibility that we find a real person that matches every description of a fictional character's biography without the author's knowledge. Is the fictional character now a true description of the real person? A discussion of such an example can be found in (Ryle 1933): "Now suppose by sheer chance, without any knowledge of Dickens, one person had existed, such that the Pickwick Papers were in fact faithful biography. [...] it seems obvious that we could not say of the real Mr. Pickwick > Oh, he is not identical with the hero of the story <." An alternative answer is given in (Danneberg 2006a) Cited is the extended online version: (Danneberg 2006b, 14). I agree with Danneberg that the reason why we intuitively suggest the fictional character is a faithful depiction of a real person only rests on intuition based on a structural similarity by coincidence. There is, however, no causal connection that would allow for the justification of this inference. Therefore, fiction might seem accidentally true, but still lacks argumentative justification for the truthfulness of its claims.

counts as observable and unobservable in science had been called into question (Maxwell 1962). How are assumptions assessed as fictional or non-fictional if the model context from which they are derived relies strongly on mediated forms of observation? Although Vahinger admits that distinctions between fictional and non-fictional elements in science are not fixed but can change over time (and, furthermore suggests approaching these elements as fictions first), he does not provide “firm grounds for sorting and grading into fictional versus nonfictional” elements (Fine 1993, 12). It is these grounds that I want to address in the following sections. Vahinger excluded proper fiction in literature and art from his analysis of fictional elements in science. However, I suggest reconsidering this move and using proper fiction for a comparison with apparently fictional elements in science. This, I claim, will provide a basis on which the grounds for distinguishing between apparently fictional and non-fictional elements in science can be clarified.

Previous philosophical comparisons of scientific models with works of art, for instance in the work of Goodman (1969), Suárez (1999), Frigg (2002) and van Fraassen (2008), have demonstrated that there is no intrinsic structural trait that can unambiguously distinguish them. This alleged ambiguity has been taken as a good reason to support an antirealist interpretation of scientific practice. Since many scientific models lack accuracy or truthfulness to their physical target system and, the argument continues, if taken literally, are false, there are no grounds on which the claim that science aims at truth can be defended (van Fraassen 1980, 2008). In response to this view, I argue that concern about the truth of claims given in scientific representations and, in further consequence, the relation of representations to the real world should not address structural criteria such as similarity but the interpretation of representations.

3 Transposing Fiction and Reality

Arguments for understanding representations in terms of their interpretation instead of their internal structure have already been given in the works of Kendal Walton (1990) and Adam Toon (Toon 2010, 2012). According to their theory of *make-believe*, fiction is considered to simulate particular affairs under the assumption that these are not to be taken literally. Here representations are “props” in a conventionalised form of game play. The interpretation of scientific representations is understood as intentionally accepting a set of definitions and rules. Interpreting them in an *as if* relation to the world, these rules are used to derive “fictional truths”, i.e. to provide theoretical inferences about real phenomena within a particular model framework (Fine 1993; van Fraassen 2008).

The concept of fiction employed here is an umbrella term for a variety of interpretative acts, ranging from children’s games to scientific modelling in the laboratory. This use of fiction may thus explain strategies of imagination, yet it lacks an answer to the question of how to distinguish the particular epistemic differences that seem to underlie the use of genuine fiction in contrast to the use of scientific models. Let me emphasise this issue by considering examples of the misinterpretation of fictional works.

First, consider the tragic case of a Japanese woman who died in the snow of North Dakota woods (Berczeller 2003). She was looking for the fictional treasure of \$1 m that was buried in the fictional placement of North Dakota woods in the Coen brother’s film *Fargo* (1996). Police stated that, before she was found dead, she had been reported wandering around with a crude map of these woods taken from the movie. What happened was that she failed to distinguish between fiction and reality. Since North Dakota Woods is an element known from reality she assumed a proper referential relation between the

representation and the actual place. But she did not understand that “North Dakota Woods” was only a fictional placement of a denoting element and therefore it did not suffice to make proper inferences to the ‘real thing’. The descriptions of North Dakota Woods in Fargo are part of the fictional story in which they take place. Their only function is to provide the space of action for the fictional characters of Jerry Lundegaard and others.

A second example is *Foucault’s Pendulum* by Umberto Eco. In Chapter 115 the character of Causabon walked along the Rue Saint-Martin in Paris on the night of 23–24 June 1984. Eco described this scenery as realistically as possible, even consulting weather reports of that night. Yet when a passionate reader went to the archives he found out that on this very night there was, in fact, a fire on Rue Saint-Martin. This fire was not mentioned in the novel! But if Causabon had *really* walked along that street that very night he must have seen the fire. So why was it not mentioned, the reader questioned? Despite Eco’s rather mocking answer (that Causabon might have had his reasons not to mention the fire that may be beyond the author’s knowledge), the reader’s enquiry is clearly an over-interpretation. The detailed knowledge about the real place was adopted to generate a strikingly realistic fictional counterpart. The descriptions of this counterpart, however, cannot be held epistemically accountable for their truthfulness. Whilst it is not used to make any proper claims about the real place, it was in fact this striking similarity that caused the reader to “believe that my story took place in “real” Paris” (Eco 1994, 76–77).⁴

Both examples of misinterpretation have the assumption in common that some elements known from reality embedded in fiction provide a truthful source of information about their counterparts in reality. This, however, is an act of transposing fiction and reality. By ‘transposing’ fiction and reality I mean that a fictional element is used as if it genuinely refers to a real thing only because it resembles a non-fictional counterpart. That being said, it is neither impossible nor forbidden to transpose fiction and reality, and quite often this presents a fascinating cultural phenomenon. The many tourists visiting the real Baker Street in the real London looking for Sherlock Holmes’ fictional whereabouts are an entertaining (and for the city of London quite lucrative) example of over-interpretation, i.e. the act of assigning to an element of fiction reference to real things. Nonetheless, such fiction-tourism is an *intended* over-interpretation (Eco 1994, 84). It is in the light of the straightforward fictionality of the Holmes stories that, although people are visiting the real Baker Street in the real London, no one expects to really go to the real place Sherlock Holmes lived since he never actually lived. The function of the fictional placement of London as “the place where Sherlock Holmes lived” is not to provide genuine statements about London nor is it bound to do so. Instead, the element of London here is part of a fictional discourse and thereby it is not bound to provide accurate claims about the real London.

Fiction-tourism such as in the case of Sherlock Holmes’ London is a form of game-play as it is described by Walton and Toon. Yet, what distinguishes this case of fiction tourism from the previous two examples that seem to present less adequate interpretations of fiction? On the account of make-believe, the intuitive answer would be convention, or alternatively in Searle’s terminology, institutional or collective agreement (Searle 2010, 7). Even though this solution appears attractive, it is obviously insufficient in this simple form. Convention is a fickle friend, and collective agreements are arbitrary to a certain extent. As a radical example, consider Duchamp’s *readymades*. Readymades, basically being random and trivial objects of utility such as a urinal or bottle racks, were claimed as art in order to challenge rigid definitions of art and representation. Now, however, readymades are an

⁴ Note Eco’s own quotation marks.

established part of art discourse. They partake in this discourse not because of Duchamp's intention alone but due to the collective acceptance of the wider audience involved in this judgement. Likewise, Galileo's telescope was not accepted immediately as a proper technique of observation but invoked a now infamous controversy among his contemporaries (Harries 2002, 282).

Therefore, reference to convention does not explain *on what grounds* something is used to provide a truthful description of reality or only taken to be a fiction. The theory of make-believe explains how we use representations as vehicles for imagination and interpretation but, moving beyond convention, it does not provide a satisfactory answer to the question on what basis we distinguish between scientific models and fictional works. I therefore propose an alternative answer, suggesting that the divergent use is visible when we take a look at *how* these fictional and non-fictional representations and their embedded claims are interpreted differently.

4 Denoting Elements Versus Images of Denoting Elements

My claim is that strategies of interpretation and not structural criteria such as similarity or semantic content elucidate the suggested epistemic difference between fictional and non-fictional representations. To analyse the difference in the interpretation of fictional and non-fictional works, I argue that we should reconsider the hybrid character of representations more carefully. Starting with the interpretation of fictional representations, I focus on the particular relation of denoting and non-denoting elements to the representational context in which they occur. For comparison, I then consider the interpretation of non-denoting and apparently fictional elements in non-fictional representations. This will aid me in showing why the interpretation of these hybrid elements is dependent on the overall representational context in which they are embedded. This context concerns the particular representation in which specific elements are embedded as well as the wider discourse in which the representation is interpreted.

The interpretation of a representation can focus on two things; it can concern, on the one hand, the entire representation or, on the other hand, the individual elements contained. To distinguish between fictional and denoting representations I want to follow Lutz Danneberg's proposal. He suggests that only reference to the entire representation provides feasible grounds to discern between fictional and non-fictional uses of representations (Danneberg 2006b, 10). The basis for this claim has nothing to do with the particular character of the elements involved; it does not concern the issue of whether these elements might be considered to denote or not. Rather, this claim is based on the function these elements are assigned. As the following examples will show, this function depends on the entire representation and its wider use.

My first example in support of this claim is the *X-Men: First Class* movie (Vaughn 2011). Based on the Marvel comic series, it tells the story of a young group of mutants preventing a cold war scenario from turning into a third World War. Halfway through the storyline the group watches the president of the United States give a speech on TV. This is a curious case, because the president's speech is in fact not a re-enactment but an original recording of a Kennedy speech. Not only does the movie utilise a person known from reality but, moreover, it uses the copy of a proper historical document, the recording. Nonetheless, this denoting element does not lead to doubt about the fictionality of the entire story told. Although the recording is an historical artefact, the fictional story is not; the representation, of which this recording is an element, is not used to provide any

explanation of the real events taking place during the Cuban Crisis. Furthermore, the recording itself in its fictional context is not used to provide an explanation of past events. The function of this element, in fact, only reflects its own placement within the *X-Men* story: it sets up a historically grounded and convincing background for the fictional characters to act in. By employing a copy of a proper historical document the fictional story does not suddenly become factual; it cannot be used, for instance, to argue for an alternative interpretation of real historic events. Thus, individual elements cannot be judged on their own for referentiality. Examples of this kind are legion (Eco 1994; Werle 2006; Danneberg 2006b).

The general point of this example is that denoting elements are self-referential when used in fictional discourse, meaning that their placement only serves a particular function within the specific context in which they appear. The implicit consequence is that denoting elements and their counterparts in fiction are somewhat different. This difference concerns their function for and within a representation and, as it will become clearer in the remainder of this paper, its relation to knowledge claims made by other representations. To examine this difference, I suggest distinguishing between *denoting elements* and *images of denoting elements* (Werle 2006). The original recording of the Kennedy speech in this sense is a denoting element whereas the copy of the Kennedy recording in *X-Men* is only an *image of a denoting element*. The basis for this distinction, however, is not that the image of a denoting element is just a copy of the denoting element since there are various copies of the original speech also in historical documentaries. The point I want to emphasise instead is that, although all these elements—the original Kennedy speech, copies used in historical documentaries or copies used in fiction like *X-Men*—are *structurally identical*, i.e. identical in semantic content, they are not *epistemologically equivalent*.

On this account, although fiction employs copies of denoting elements, these are merely images of denoting elements as long as they are only used as features to back up the fictional story. To the contrary, if an element is used to refer, its function is to present a claim about some element in the world. Any claim about elements in the world, however, is subject to argumentation and justification, and can be judged as either true or false. A seemingly denoting element when used in fiction thereby constitutes an *image of a denoting element*, because it refers to *the conventional knowledge of* a particular denoting element but not strictly to *the element denoted*.⁵ To illustrate this difference, consider the following case. A novel employs a denoting element of an entity assumed to be real. In the course of time, however, it turns out that this entity has never really existed. Yet the novel is not suddenly giving a false account of reality but only mirrored the state of knowledge for when it was created. Fiction draws on knowledge without assuming this knowledge is necessarily a truthful account of reality; it just sets up a scenario to convince the reader of a particular act of make-believe. In contrast, any denoting representation employing this non-existent element and assuming it properly represents, becomes a false or inaccurate representation of reality. A model, once its postulated entity turns out not to exist, must either be modified or rejected. No such change is needed for the novel. In light of this, even

⁵ The hermeneutic rules that regulate the reference to general knowledge are the so-called *reality principle* and the more restrictive *mutual belief principle*. The principle of reality states that the interpretation of a representation is guided by the assumption of its closest resemblance to the external world. This means that unless there are descriptions suggesting otherwise, for instance, by leading to a contradiction or formulating explicit differences, a representation depends on the same language conventions and truths as the real world. A contextually and historically restrictive version of the reality principle is the mutual belief principle; closest resemblance here is characterised by the norms and conventions that had been held true at the time of the creation of the representation. (Walton 1990, 144–161; Margolin 1991, 109–110).

if some elements in fiction closely resemble and are even modelled on denoting elements, they are not denoting themselves (Eco 1994, 125; Werle 2006, 120).

Having argued that denoting elements when used in fiction are only images of denoting elements, the converse case also holds for apparently ‘fictional’, i.e. non-denoting, elements in non-fictional discourse. If an element in a scientific representation is non-denoting, the representation does not necessarily become less factual or suddenly lacks reference. The second example in support of this claim is “Twin Earth” in Putnam’s *The Meaning of Meaning* (Putnam 1975). Twin Earth is a fictitious place almost identical to our earth; it only differs in the molecular structure of water. This non-denoting element clearly does not refer to any real place; nonetheless, it is part of a philosophical argument about actual language practice. Of course, the accuracy of Putnam’s theory of meaning might be disputed, but within this argument Twin Earth is assigned an epistemic function. It is used to support Putnam’s position. In parallel with my previous example of the *X-Men*, by employing a non-denoting element Putnam’s argument does not suddenly become fictional or lose its overall reference to language phenomena. Whether such non-denoting elements are a useful contribution to non-fictional discourse, in fact, depends on the strength on the argument these non-denoting elements are employed to support.⁶

In light of this, the position I want to advocate is to define the reference of representational elements with respect to their epistemic function rather than their degree of similarity to a particular entity. This epistemic function is derived from the interpretation of the representation in which these elements occur and its wider use within specific fictional or non-fictional discourses. According to my proposal, the status of non-denoting elements in science is thus not equivalent to fiction. Even if some elements such as idealisations and non-denoting concepts in science are somewhat similar to fictional elements they nevertheless differ fundamentally in their epistemic character. In contrast to scientific representations, fiction is not used to serve as an explanation nor is intended to be a truthful description of the world. While scientific representations are epistemic items, proper fictions are not. In light of this, the difference between denoting and non-denoting elements is not subject to structural resemblance to a physical target system, but concerns their assigned epistemic role.

Like an inferential account of scientific representations, advocated, for instance, by Mauricio Suárez (2004) and Zamora-Bonilla and de Donato-Rodríguez (2009), my account of representation, therefore, concerns the capacity to facilitate ‘surrogate reasoning’ about the world. Rather than defining a structural relation between the representation and its target system, scientific representations are understood as vehicles of reasoning, which often require specific skills of the practitioner for its correct application. Depending on the purposes of enquiry, scientific representations “provide us with specific information regarding their targets [...] in the sense that it could not be equally conveyed by any other arbitrarily chosen sign.” (Suárez 2004, 772) In light of this, an apparently denoting element (such as the Kennedy speech) denotes if the representation in which it occurs is interpreted to make claims about the world. If such an element is only interpreted with respect to the internal narrative of the representation in which it is embedded, then it is not used to refer. Likewise, if an apparently non-denoting element (such as Twin Earth) is used to support

⁶ By virtue of their similarity to fiction yet their different epistemic function, examples such as thought experiments, counterfactuals and *ceteris paribus* clauses have been characterised as ‘Neighbouring Notions’ elsewhere (Albrecht and Danneberg 2011). An analysis of idealisations and theoretical models in comparison with thought experiments, counterfactuals or *ceteris paribus* clauses might thereby be insightful. Sudge (2000), for instance, nicely explores theoretical models in economy in this context), yet these do not necessarily describe cases of ‘fiction’ and an analysis of them would, unfortunately, go beyond the scope of this paper.

claims about the real world, this element may not strictly denote anything in particular, yet in its argumentative context it is used to make claims about phenomena in the world. On this account, I suggest that the epistemic character of apparently denoting and non-denoting elements depends on the interpretation of the representational context in which these elements occur.

My claim, therefore, is that elements in fiction resembling elements known from reality do not strictly denote because they are not used to provide a genuine description of these real entities. What such *images of denoting elements* and properly *denoting elements* have in common is that they refer to a certain body of knowledge about the world. Only if they are used to make claims about the world, do these elements have a *denoting* character. The use of an element as denoting, instead of being merely an image of a denoting element, depends on a different relation to the wider body of knowledge. This relation, I will show, is determined by two conceptually distinct forms of enquiry. Unlike the inferential account, my distinction between *images of denoting elements* and *denoting elements* therefore implies that the representational force of a scientific representation is defined not only by its capacity to derive claims about the world. Rather, these claims must be furthermore analysed and compared with claims derived from other representations aiming at the same target system. Only by being embedded in a polyphonic network of representational sources can a representation exercise its epistemic function. That is to say, if a representation is said to allow for inferences about elements in the world, it is necessary to define a basis on which these inferences are evaluated as ‘providing information’ about a particular target. Its relation to other representations, I will argue in the remainder of this paper, is what grounds a representation’s capacity to allow informative inferences about particular elements in the world. Whether a representation is assigned an epistemic function and, moreover, whether it fulfils this function, therefore, must be explored in its wider context of use and on a case-to-case basis. With respect to the initial comparison of scientific representations with fiction, I shall clarify this contextuality in the following section.

5 Fictional and Non-Fictional Enquiry

As I have argued throughout this paper, no element is denoting on its own account but only by virtue of the use within its wider contextual embedding. This context concerns, on the one hand, the representation in which a certain element is contained and, on the other hand, how this representation is used in the wider discourse with other representations.

To analyse the epistemic function an element is assigned in the interpretation of the overall representation in which it is contained, I suggest drawing a distinction between two kinds of enquiry: fictional and non-fictional. This, I hope, will provide further insight into the characteristics of scientific enquiry. When we question the function of an element for the interpretation of a particular representation I consider it to be a *fictional enquiry* (Danneberg 2006b, 31). Such an inquiry only concerns the placement of an element and its character within the framework of a particular representation, but it is not used to make claims about the world. This means that if the relevance of an analysis is limited to the construction of a representation, the use of a representation is defined as fictional. By contrast, interpretations of an element that address questions exceeding its placement in and function for the composition of a particular representation I consider to form a *non-fictional enquiry*. These interpretations concern claims that are not bound to a particular representational context but address issues about the world that could also be investigated through alternative and partly independent representations dealing with the same phenomenon. On this account, non-

fictional enquiry is inevitably related to a plurality of representations and shows a degree of independence of the investigated element to its particular representational context. The claims made by non-fictional interpretations of individual representations are therefore in constant cooperative and competitive comparison and revision with claims derived from other representations. The pluralistic access to descriptions external to the representation, I propose, is the ground for the epistemic function of scientific representations to prove, witness, certify or support claims about the world.

It is crucial emphasising here that the distinction between fictional and non-fictional enquiry is not to be confused with a definition of fictional and non-fictional representations such as novels and scientific models. Given the earlier described hybrid character of representations, (non-)fictional enquiries define the *use* and *interpretation* of a representation as purporting a fictional or non-fictional claim.

Putting the use of this distinction to the test, I want to address the interpretation of two different examples, a scientific model employing a non-denoting element on the one hand and a historical text in which fictional and non-fictional elements blend on the other. For the first case, consider Eric Winsberg's (2009) analysis of "silogens" in computer modelling. Silogens are hypothetical atoms that aid in the calculation of silicon fractures in nanomechanic models. By having some properties of silicon and some properties of hydrogen, their hybrid character is used to combine the algorithms and the descriptions of two different theories involved in this modelling procedure, namely quantum mechanics and classical molecular dynamics. Silogens do not denote real atoms. Although the overall model in which they are contained makes "good enough" claims about the world, Winsberg argues that these silogens are fiction since, taken individually, they have no identifiable physical target system. I agree with Winsberg insofar as that the overall model is non-fictional and that the individual silogen atoms are non-denoting elements within this model. Where I disagree is to describe silogens as fiction just on the basis that they are non-denoting elements. Instead, I propose to take a look at two different ways in which the element of silogens can be interpreted here. On the one hand, as part of the overall model and its application, silogens are used to make claims about the world. These claims can be furthermore investigated and compared with claims derived from alternative models, resulting in further corrections, confirmations etc. On the other hand, considered separately with respect to their individual placement and function for the model, silogens are not used to make claims about the world but about the particular structure of the representation in which they are embedded. According to my definition, whereas the first interpretation is a non-fictional enquiry, the latter is fictional. Therefore, it is not the element per se that is fictional or non-fictional, and it is not the denoting or non-denoting character of an element that makes it fictional or not, but its use within an interpretation of a representation. As a result, the distinction between fiction and non-fiction is not to be based on the structure of the representation and its individual elements but to be determined by the interpretation strategies addressing the representation.

Let me consider another, literary example to stress this point a little further. In 1634 Johannes Kepler's *Somnium seu Opus de Astronomia Lunari—The Dream, or Posthumous Work on Lunar Astronomy* was published. The enigmatic charm of this book is its twofold character, which places it in an apparently intermediate position between science and fiction. In order to analyse this ambiguous character and determine its denoting or fictional characteristics I will start with a brief summary of its content. Kepler's book narrates a dream that is divided into three levels. The book begins with a first person narrator who describes a dream in which he is reading a book of a fictional author called Duracotus. The second level of narration concerns Duracotus's own story about his life, which involves his

academic study of astronomy and also his relation to his mother, who practices forms of magic. She gains her knowledge from spirits and it is because of her that Duracotus encounters the voice of the ‘*Daemon ex Levania*’, who constitutes the third narration level. The *Daemon* holds a monologue on the moon that is, indeed, a brief account of Kepler’s own argument in support of Copernicus’ heliocentric worldview (Kepler 1965 [1634]).

The poetic structure of the text is a technique of *reduplication*, that is to say the frames of narration are embedded within each other. On the first level somebody is telling a dream about a book, on the second level there is the tale of the book itself and, by the third level, the story has turned into a self-contained monologue of the *Daemon* within this book. The effect created is an inverse relation between content and structure: the more fictional elements the text evokes—beginning with a dream leading to a fictional character and ending with a daemon—the more scientifically relevant its content appears. Although introduced by a complex fantasy framework, the astronomic descriptions match the Copernican theory (Schneider 2006, 262). What is fairly clear in this case is that the *Somnium* distinctively exhibits denoting and non-denoting elements. Slightly more problematic is the decision whether to interpret this representation as fiction or a denoting representation. With its astronomic descriptions in mind, is Kepler’s *Somnium* a scientific explanation disguised by its poetic structure? Or are these astronomic descriptions merely background descriptions for a story about a fictional journey?

If one consults the historical background it becomes apparent that Kepler’s own view on the Copernican system was of outspoken advocacy; and he already openly stated this position before and whilst working on the *Somnium* (Schneider 2006, 263). On this account, the fictionalisation might have had a different function if it was not to be a disguise to strategically hide academically controversial thoughts. The point I want to make again is that interpretations focussing on the peculiar poetic structure of this representation and its relevance constitute what I consider to be a *fictional enquiry*; they only reflect the placement of the elements and their relations within a particular representation but do not extend to make claims about the world. This means that if the relevance of an enquiry is limited to a particular and, moreover, *only this* particular context, the use of a representation is defined as fictional (Danneberg 2006b, 31). (It is worth adding at this point that whether the embedded description of the lunar sphere in the case of Kepler’s *Somnium* is adequate or not has no relevance for such a fictional enquiry. Whether the *Somnium* reflects true or false claims about the lunar sphere does not affect the fictional framework.)

By contrast, if one wants to use Kepler’s *Somnium* as a historical document, investigating the astronomic views held at his time, the enquiry exceeds the scope of this particular representation but makes (historical) claims about the world. These historical claims can be addressed by a variety of sources and need not be limited to the *Somnium*. In fact, in order to see, for instance, whether Kepler presented an adequate account of Copernicus’ theory, interpretations have to be related to other representations dealing with the same topic. On this account, *non-fictional enquiry* is inevitably related to a variety of representations and shows a certain independence of the investigated element to its particular representational context. This independence grants representations an epistemic function to participate in the scientific endeavour of making claims about the world.

6 Fictionalism and the Issue of Scientific Realism

This paper argued for a distinction between fiction and non-denoting elements in science by emphasising the different strategies involved in their interpretation. Grounded in two

forms of enquiry directed at the interpretation of a representation, rather than a feature of the representation itself, this distinction accommodated the diversity of ways in which scientific representations aim to address the world, for instance, as mathematical or material models, graphs, computer simulations and so on. The way in which representations were assigned an epistemic function, i.e. were argued to facilitate claims about the world, was grounded in their relation towards other representations making similar or conflicting claims about the same target system. In contrast to fictional enquiry, questions that exceeded the function of an element within a particular representational context but relating it to a plurality of representations were defined as non-fictional. On this account, my approach also provided a heuristic strategy for evaluating to what extent an inference drawn from a representation can be said to present a claim about the world, rather than merely being a result of the representational structure.

I would like to end the discussion of the preceding distinction between fictional and non-fictional enquiry with a brief comment on its implications for the wider philosophical debate on fiction in science. Although a comparison of fiction with non-denoting elements in science may be justified with respect to the shared lack of unambiguous reference to the world, it nevertheless reveals an important epistemic difference for the interpretation of scientific representations. This epistemic difference concerns the evaluation of the claims given in a representation in relation to the claims of other representations.

Instead of employing the concept of fiction in science for non-denoting elements in general (whether this concerns only non-existent entities such as silogens in the case of narrow fictionalism or includes abstractions such as frictionless planes in the case of wide fictionalism), the concept of fiction is best used to understand the question we address with such non-denoting elements. Does this question concern claims about the world? Then it is important to see to what extent the descriptions given by a particular representation relate to other representations with a similar topic, i.e. do their claims conflict, support or complement each other? In these cases, we can speak of a non-fictional use of these non-denoting elements. By contrast, if we address the construction of a particular representation, for instance to analyse the workings of a model and its limits, the interpretation does not primarily concern the world but the structure of the representation. In these cases, we can speak of a fictional use of a representation.

The distinction between fiction and non-denoting elements in science, I conclude, is important for examining the use of scientific representations and to further understand the nature of scientific inquiry. In fact, the distinction advocated here between fictional and non-fictional enquiry provides a useful tool to explore to what extent the descriptions given by a model can be justified as making claims about the world or, rather, are a consequence of the model's particular construction. Applying the model to specific cases and not forgetting the complexity of the world, it can be evaluated where the potential as well as the limits of a particular model lies. The adequacy of the link modelled between the claims made in the representation and the phenomenon explained cannot be evaluated through the model and its structure alone but inevitably requires further investigation and comparison to other models, statistics and case studies. Even highly idealised models or models employing elements that have no direct relation to any physical system can be interpreted as making claims about reality, if their represented explanations can be explored beyond the limits of this model. The use of representations is thereby not determined by literal reference but by the extent to which their claims relate to the world by comparison to other representations, models, experiments, etc.

On this account, the plurality of representations likewise provides a useful tool to draw a line between fictitious and real enquiries about the world. Is something addressed only by a

particular model or can it be further explored by alternative representations? The usefulness of a particular scientific enquiry about the world can be assessed by means of this representational plurality. In light of this, I suggest that representational pluralism is not a problem, but rather a very useful indicator to adopt a realist stance on scientific models and concepts.

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