A Game of Perspectives: On the Role of Imagination in Thought Experiments

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Abstract

Thought experiments are fictional narratives that widen our cognitive horizons both in the sciences and in philosophy. In the present paper we argue that they can perform this function by bringing one's perspective into view. Despite being traditionally conceived as devices that transmit true propositions to their readers, thought experiments are also particularly apt to express a specific theoretical perspective through the use of imagination. We suggest that this is a significant epistemic feature that is often overlooked in the debate. After presenting our analysis of thought experiments (Section 2) and of the role that imagination plays in them (Section 3), we revisit Galileo Galilei's use of imaginary cases in light of our account (Section 4). We show that the main aims of Galileo's thought experiments are to highlight how different perspectives endorsed by fictional characters affect imagination and to invite readers to actively engage in perspectives that are different from their own. This results in a clash of perspectives which plays a crucial epistemic role (Section 5). Readers of thought experiments do not passively absorb information, but critically assess the other's perspective. In the final part of the paper, we individuate different ways in which readers can react to thought experiments.

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1 Introduction

Thought Experiments play a central role in scientific and philosophical practices.[1] While for a long time they have been belittled as illustrations, intuitions pumps, or poor substitutes when real experiments are too costly or too complex to be conducted, they have regained reputation in recent debate in philosophy of science and in metaphilosophical discourse (cf. Levy & Godfrey-Smith, 2020; Stuart et al., 2018 among others). Yet, there seems to be something paradoxical about them, which is tied to an aspect already noted already by Thomas Kuhn: albeit "relying exclusively upon familiar data" and without appealing to scientific reasonings, thought experiments can "lead to new knowledge or new understanding of nature" (1977: 241).

A crucial point in the current debate is the question of whether thought experiments are a source of knowledge *sui generis.* Do they impart new knowledge in their own, characteristic ways, or are they merely arguments "in disguise", that can be reduced to explicitly formulated arguments without epistemic loss? James Brown, for one, has opted for the former and forcefully defended the view that thought experiments involve a special form of intellectual perception. According to him, they are akin to "telescopes into the abstract realm" (2004: 1131) of independent laws of nature. John Norton, on the other hand, has suggested that thought experiments are just rhetorically and pictorially adorned arguments (1996, 2004) that can, thus, be reduced to a set of propositions linked through inductive or deductive relations. A third family of accounts, the so-called "Mental Model Views" (Gendler, 2010; Miščević, 1992, 2007; Nersessian, 1992, 1999, 2018), occupy a middle ground between these two extremes. According to them, thought experiments are special devices that allow us to obtain empirical knowledge based on "instinctive experience" (Mach, 1976) that is not "organized under any theoretical framework" (Gendler, 2010: 39). These accounts focus on the reconfiguration of past experiences through mental simulation, memory and forms of tacit belief.

Notwithstanding the differences, all the positions mentioned share a basic assumption that is inherited from Kuhn's outlook, according to which thought experiments fundamentally serve to contribute to our knowledge of nature.[2] This might be *prima facie* surprising, especially if we take an important aspect concerning the

[2] It is worth noting that Kuhn himself concludes that thought experiments do not provide information about nature, but add to our conceptual apparatus—and then rejects a clear distinction between the two realms. His paper, however, was important in setting the stage for the current knowledge-oriented epistemological puzzle of thought experiments (cf. Davies 2007, 2018).

nature of thought experiments into consideration: they are *fictional narratives*[3] (cf. Elgin, 2014; Meynell, 2014, 2018; Willée, 2019 among others). In consequence, authors of thought experiments are not committed to the literal truth of the scenarios described. Einstein has never pretended to report the actual adventures of a person inside a large enclosed elevator that is falling freely in space, nor has Bernard Williams affirmed that an actual person, Jim, had really been forced to choose between killing one person or having to witness the assassination of twenty.[4] Like in Galileo's famous scenario of two bodies dropped from a high tower,[5] it is not decisive whether these narratives are literally true to the facts.

Catherine Elgin relies on this point in her argument that literal truth is not always required when it comes to deepening our scientific understanding or widening our cognitive horizons (Elgin, 2017). According to her, the fictional narratives of thought experiments—along with scientific models, diagrams, and *ceteris paribus* claims (among others)—are "felicitous falsehoods" that can play a decisive role in our attempts to develop faithful representations of reality. Along similar lines, Michael Stuart suggests that the main role of these imaginative devices is not to provide us with new knowledge, but to increase our understanding of scientific theories (2018), to "help us to determine the content of theoretical structures" (2017: 25) and to "stimulate learning and the development of new skills" (2020: 7).

In the present paper we build on this insight and argue that thought experiments can do more than provide the reader with true propositions about the world. We suggest that they are also suited to express a perspective onto the world.[6] Thought

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[3] The analogy between thought experiments and literary works of fiction is at the core of some recent philosophical debates. For instance, Elgin recognizes the same dynamics of exemplification at work in both kinds of devices (2014), while Egan focuses on their different context of use, thus arguing for a skeptical outcome. Unlike fictional stories, as he claims, thought experiments are always used to make arguments (2016). On the other hand, Vidmar emphasizes the cognitive role of hypotheses that can be found in both thought experiments and literary fiction (2013) and, more recently, Murphy focuses on the ongoing presence of aesthetic details in thought experiments and the flexibility of their interpretations (2020a). See (Davies 2007, 2018) for two excellent overviews of the debate. We choose not to further elaborate on this analogy in our paper, as we have explored it elsewhere (Molinari 2020).

[4] For Einstein's and Williams' thought experiments, cf. Einstein (2006: 63f) and Williams (1973: 98f), respectively.

[5] Galileo has considered the described scenario in (1974: 66ff). Vincenzo Viviani, Galileo's secretary and biographer has reported that Galileo had actually conducted the experience "in the presence of other lecturers and philosophers as well as of all their students" (Viviani 2019: 15), though this account is much debated. It seems obvious, however, that the question of whether the experiment was actually conducted does not have any consequences regarding its plausibility or success. As Galileo states himself in his Postils to Rocco (1890–1909: Vol. VII, p. 731), it was reason, and not experience, that persuaded him of the conclusion of the thought experiment (see Palmieri 2005: 231 on this).

[6] Claiming that one significant epistemic feature of thought experiments is to express a perspective on the world does not, of course, exclude the possibility of obtaining true propositions from them. The perspective conveyed by a thought experiment can, for instance, mark one or more propositions as salient (more on this in Sect. 3). If a perspective is suitable to shed light on a theoretical problem at stake, some of the propositions it highlights are likely to result as true. Moreover, if the perspective is innovative, it could allow us to affirm propositions that are both true and novel. Although such propositions may already be present at the so-called periphery of our belief systems, the cognitive role of perspectives is to render them salient and to connect them to other propositions and elements at play such as methodologi-

experiments are most efficient when it comes to prompt imagination; they invite readers to engage in games of make-believe that allow them to grasp how the world is organized and which aspects result salient when viewed from a different (theoretical) perspective which, in turn, allows them to confront this other perspective with one's own.

2 Games of Make-Believe and the Dialectics of Thought Experiments

It seems obvious that the imagination is of central importance in scientific practice. After all, it takes curiosity, creativity and openness to develop an original outlook and substantially add to the advancement of the sciences. When we look at science not as an activity or organically growing practice, but as a stable system of established doctrines, however, other aspects come to the fore. Elements such as internal coherence and rational argumentation—that are pertinent to the internal architecture of a standing theory—gain importance and eclipse the dynamics of imagination. These latter aspects are without any doubt of central importance, as theories play a central role in the sciences, both as output of scientific practice and as object of critical scrutiny. We do think, however, that a focus on the role of the imagination in the sciences, which gains momentum in the recent debate (cf. French, 2020; Levy & Godfrey Smith, 2020; Stuart, 2017, 2021), is of central importance for understanding science as a rational *practice*.

The role of the imagination is most evident in thought experiments. Kendall Walton's theory of fiction (cf. 1990) and especially his conception of games of make-believe emphasizes, as is well known, the role that works of fiction play for our imaginative activities. Although his analysis primarily focuses on representational arts, his central notion of "games of make-believe" is well suited also to advance our understanding of the nature of thought experiments, as the contributions of Meynell (2014, 2018), Salis and Frigg (2020) and Sartori (2023) show.[7] While other philosophers have often focused on imagination as a subjective experience, Walton reminds us that it can also be conceived as an activity that can be shared with others and involves a normative dimension. To partake in this activity one has to be prepared to play along with others. All participants in the game, in other words, have to be attuned to the same *principles of generation* that determine what they are required to imagine to play it properly. In this conception, imagination is not an unregulated, creative faculty but an activity bounded by socially accepted constraints.

Footnote 6 (continued)

cal or epistemic desiderata and purposes which structure our scientific endeavors. On a similar view see (Kuhn 1977: 263). According to the purpose for which a perspective is adopted and expressed, the relevance and quantity of true propositions made salient by it might be taken as a criterion for evaluating its potential impact. We thank an anonymous referee for guiding our attention to this point.

[7] The authors mentioned do not agree, however, on what kind of imagination is at stake. While Salis and Frigg focus on propositional imagination, Meynell is less restrictive, suggesting, as she does, that different kinds of imagination play different roles in games of make-believe because "both the content of a representation and some (perhaps most) imaginings are non-propositional" (2014: 4159). Cf. (Murphy 2020b) for an interesting review of the arguments of both Salis and Frigg and Meynell.

Principles of generation are more or less explicit rules[8] that give structure to a fictional world. They can be commonly stipulated by the players ("Let's pretend that this stick is a sword") or be transmitted to them, as it is the case when they engage in a work of fiction, where they are required to imagine a (fictional) scenario ("When Gregor Samsa woke up one morning from unsettling dreams, he found himself changed in his bed into a monstrous vermin." (Kafka, 1972: 3)). The respective principles are like rules that guide the readers' imagination—if one would refuse to imagine the given scenario, one would not play the game in an authorized way. However, the mere desire to comply with a rule is not enough to act in accordance with it (cf. Wittgenstein, 2009: §202). In Walton's perspective, props function as external criteria by generating fictional truths and giving structure to a fictional world. In the children's game, the stick is the prop that generates the fictional truth that they have a sword in their hands; Kafka's novella is the prop that makes it true in the fictional world that a certain Gregor Samsa was transformed into a monstrous vermin. Although the fictional worlds that emerge from a work are self-standing, they are incomplete and not determined in all their properties. Works of fiction usually omit minor details and authors use this as a tool to guide the reader's attention to the aspects they consider relevant. Despite this underlying indeterminacy, props—being concrete objects such as sticks and words—provide intersubjective criteria clear enough for regulating our social imaginative endeavors and, at the same time, leaving room for imaginers to express their own voice.

Fictional worlds are distinct from the real world, but they are not hermetically sealed off from it, nor are they like "distant planets": elements of the real world are typically carried over to the fictional worlds[9] and, vice versa, immersion in fictional worlds can be contagious and alter one's outlook on reality.[10] Moreover, players tend to actively participate in the game of make-believe, as imagination always requires a first-person engagement. Imagination, as Walton reminds us, has always a *de se* aspect[11]; in a way it is always "about oneself"—which explains its capacity to absorb the audience and so accounts for the power of the imagination.

Most of the aforementioned accounts that adopt Walton's theoretical framework to discuss social aspects of the scientific imagination tend to conceive games of

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[8] In some contexts, the principle of generation does not need to be stated explicitly, but is determined by genre conventions or implied by the makeup of reality, as Walton states in his discussion of the "Reality Principle" and the "Mutual Belief Principle" (1990: 144ff).

[9] Walton explains this phenomenon with the "Reality Principle" (1990: 144ff). For a more recent discussion, cf. Friend (2017).

[10] Cf. Gendler (2006) for an illuminating discussion of the phenomenon of imaginative contagion, namely, of "cases where merely imagining or pretending that P has effects that we would expect only believing or perceiving P to have" (183). More recently, Huemer et al. (2022) have employed the metaphor of a trade exchange—and smuggling—that goes on between worlds of fiction and the real one to explain the relations between reality and the imagination. Such a metaphor has the power to highlight the dynamics of both importing elements of reality into fiction (thus giving structure to an imaginary world) and exporting fictional details into reality in order to observe and live in the world from a new perspective.

[11] First-person engagements can take one of two forms: one can imagine oneself in the shoes of others and identify with (one of) the characters, or imagine to observe the scenarios described from another (e.g., the narrator's) point of view.

make-believe as harmonic activities, where imaginers conform to the same principles of generation in order to explore the same fictional scenarios. We suggest that this harmonic view is overly idealistic and does not do justice to the role the imagination plays in scientific practice, where clashes between imaginers are common practice and play a crucial role in the dialectic exchange between scientists or philosophers.[12] A thought experiment proposed by one scholar invites others to explore a certain fictional scenario in order to arrive at a clear-cut conclusion—which might nevertheless run against the interlocutor's or the reader's intuitions. When participating in the game, these interlocutors will likely propose variations, be it because they fill in the blanks with details that run against the author's intentions, or because they vary the scenario by revising some of the principles of generation. In this way, they can critically adapt the scenario to their own theoretical needs and dialectical purposes. In Sect. 5 we will discuss these dynamics on concrete examples.

Before that, however, we need to address a crucial question: thought experiments prompt the dialectic exchange of *what*? In the next section we will show that thought experiments are particularly apt to highlight differences in theoretical perspectives.

3 Imagining Another Perspective

With exception to Norton's Argument View, most accounts attribute a central role to imagination in thought experiments.[13] But what exactly is it that readers have to imagine? The first thing that comes to mind is that thought experiments typically invite us to imagine possible states of affairs or events which—independently of whether they are real or have actually taken place—serve to destroy an old or existing theory or to create a new one (cf. Brown, 2011, 98f). The states of affairs and events in question are presented in an "objective" manner that makes them equally accessible to all readers. Even though they are particulars, they often do not contain an explicit reference to a perspectival or indexical element—which might explain why this *de se* aspect of imagination is often overlooked in thought experiments.[14] Against this tendency we propose that the efficacy of thought experiments often relies on their prompting imaginings that do not primarily focus on objective descriptions of states of affairs or of sequences of events, but rather on the perspective that becomes manifest in these descriptions.

Perspectival and indexical elements are always tacitly present in thought experiments, also in scientific ones. This point was argued by Bas van Fraassen (2008),

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[12] This point is argued in detail by Molinari (2022).

[13] Even Timothy Williamson, whose position is quite close to the Argument View, acknowledges that "the imagination plays an irreducible role in warranting the premises" (Williamson 2007: 188).

[14] There are important exceptions: thought experiments that are used in moral philosophy and, to some extent, in philosophy of mind, for example, often serve to sharpen our intuition of how a moral agent should act or what a *person's* mental states are like in given situation. Think, for example, of the explicit mention of "Jim" in Williams's influential thought experiment (1973: 98f) or the role of Mary's subjective perspective in Frank Jackson's *Mary's Room Argument* (1982: 130, 1986). Moreover, some thought experiments in physics, like Einstein's *Train*, have the relativity of standpoints as their target, and, thus, attribute a central role to perspectival and indexical elements.

who emphasized the relevance of perspective for scientific representation, which is always a representation from a given point of view that selects some aspects, occludes or distorts others, and irreducibly contains an indexical element.[15] Van Fraassen characterizes perspective in a quite literal sense as having (*i*) an origin and (*ii*) orientation, namely, the observer's location and her spatial relation to the objects perceived, respectively. Moreover, van Fraassen points out that (*iii*) "the content of this visual perspective is expressible in an indexical judgment" (2008: 85) of the form *this is how it is from here*. In addition, (*iv*) there is a systematic distortion as well as (*v*) phenomena like occlusion, marginal distortion and degradation of the grain.

According to this line of reasoning, any scientific theory describes facts and regularities from a specific point of view, using specific methods of measurement and a conceptual repertoire that render some features of reality salient and occlude other ones or filter them out as irrelevant. This does not entail, of course, that science is not objective. Scientific theories are publicly accessible, they are testable and evaluable and are open to use for the whole community of scientists. Nonetheless, "they cannot plausibly be construed as embodying the view from nowhere or the way the world is anyway" (Elgin, 2017: 159). Thus, every scientific theory makes a specific perspective manifest—along several parameters including the five listed above.

The relevance of perspective for scientific theories is easily overlooked, as the members of the scientific community are typically more interested in the phenomena described and in the regularities that hold between them and that are unveiled by the theory. Things are different with thought experiments. They are, as we have seen above, fictional narratives that invite the readers to imagine particular hypothetical or counterfactual scenarios. So how can they contribute to our understanding? Although this goal can be achieved in different ways,[16] we aim to show that thought experiments—that are designed by a scientist and become discussed and potentially accepted within a research community—are particularly apt to share with readers what "things look like" from a different perspective, with the goal to falsify an existing theory or to raise the plausibility of a new theoretical outlook. They are, thus, *loci* where the clash between whole theoretical perspectives can become particularly manifest. This clash can take place within one work, as it is the case in Galileo's famous scenario of the falling bodies, in which three characters stand for different theoretical perspectives regarding Aristotelian physics[17]; or in the dialectic exchange between scholars, each of who might make reference to the same thought experiment or a significant variation of it.

In our understanding, thus, thought experiments invite the readers to engage in "games of perspectives". These games require a form of *active engagement* on the

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[15] Van Fraassen mainly discusses scientific models, but, as Salis and Frigg have pointed out, thought experiments and scientific models involve the same kind of imagination (2020: 22), so the point generalizes.

[16] Stuart, for instance, argues that thought experiments may make scientific theories more applicable in everyday contexts (2018) while, according to Elgin, they exemplify properties that they share with phenomena (2014).

[17] We will discuss this case in more detail in Sect. 4 below.

part of the reader, who has to accept the author's invitation—as well as the rules of the game—and *cognitively immerse* into the fictional scenario, which allows her to critically assess it and to partake in the dialectical exchange of perspectives.[18] Recalling, again, van Fraassen's point concerning the central role of perspective to our scientific practice, we propose that thought experiments are particularly efficient when they present the reader with a specific perspective on the world.

We understand "perspective" as a technique of representation that is tied to the epistemic standpoint of the (implied) author as it becomes manifest in the way the (fictional) scenario that is described. By paying attention to the aspects that are explicitly affirmed or highlighted, that are neglected or deliberately hidden in the narrative (*selection*, *occlusion* and *distortion*), as well as to the context in which the narrative is situated, readers can gain an understanding of the author's theoretical perspective.[19]

Linear perspective, as it was developed in Renaissance painting, is a technique to represent spatial depth on a bi-dimensional surface that makes it possible to locate the depicted objects in their mutual spatial relations to one another. Analogously, in scientific contexts we represent objects or events in a theoretically construed space, maintaining the mutual relations that hold between them. These mutual relations are depicted or described, however, in the way they are organized from a given epistemic standpoint. Both in paintings and in scientific representations, perspective has an indexical or, as van Fraassen has it, a "I am here and this is how it looks from here"-aspect (cf. 2008: 72). It, thus, points back to the painter's or the scientist's point of view.

A look back at the dynamics that were triggered by the invention of linear perspective in Renaissance painting can be instructive. The main goal of this innovation was to develop a technique that allowed painters to "correctly" represent the world, that is, to faithfully depict scenarios "as the eye sees them". The method of painting was invented by Brunelleschi and codified only decades later, by Leon Battista Alberti, Piero della Francesca and Albrecht Dürer[20] among others, who drafted treatises that presented the underlying rules and principles in a systematic and scientifically informed manner. In this way, they conferred a specific authority on this technique. Painters who merely relied on their "natural talent" could easily develop personal idiosyncrasies that resulted in errors and flawed representations.[21] Painters

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[18] Walton's theory of make-believe can shed an interesting light on this dynamics: thought experiments can be conceived as props that invite readers to participate in games of make-believe. They do so by triggering a form of imagination that allows readers to *explore* a broader theoretical picture, in a way that is to some extent analogous to how works of art *absorb* appreciators into fictional worlds. In both cases, thus, props prompt (different levels of) personal engagement. The parallel between art and thought experiments allows us to appreciate the overall importance of the readers' participation in games of make-believe.

[19] See (Huemer 2022) for a disambiguation of the multifaceted term "perspective" as subjective experience from a point of view or as a method of representation.

[20] Brunelleschi's invented linear perspective before 1413, Leon Battista Alberti's *De pictura* dates from 1435, Piero della Francesca's *De prospectiva pingendi* was written in the in the mid-1470s to 1480s, and Dürer's *Underweysung der messung* was completed in 1525 (cf. Kemp 1992).

[21] This consideration is explicitly endorsed by Dürer in the opening of his treatise.

who followed the rules and principles laid out in the manuals, on the other hand, could transfer the method's authority onto the painting; in a way, it allowed them to affirm that "this is what a person would have seen if she had been in the relevant position at the right moment in time." This entails that there are criteria of correctness for pictorial representation, and invites to hold the painting against reality.

Paul Feyerabend's discussion of Brunelleschi's experiment[22] sheds serious doubts on this claim, however. He suggests that it is not possible to determine how we are supposed to hold a painting against an independent reality. Instead, we should understand the painting, the depicted object, and the method of representation as elements of an artifactual stage that is organized by the painter himself (Feyerabend, 1999: 100). We cannot simply treat the painting and the building as two independent objects and compare them with one another, as "whatever 'reality' is being taken into consideration is manufactured by the stage, it changes with the setting" (1999: 111). Applying a clearly defined method, the painter projects a three-dimensional scenario onto a bi-dimensional canvas. This projection is faithful to some, but systematically distorts or neglects other aspects of reality. Thus, when we hold the painting against the depicted object or scenario to judge whether the representation is faithful, we need to focus on the aspects which—relative to the method applied—result either as salient or negligible, which are distorted and which occluded.

These aspects can be detected particularly well when we confront different paintings that represent the same scenario, fictional or not, and so unveil differences in perspectives that are operative in the representations. This suggests that Feyerabend's point can also account well for the very existence of clashes between perspectives, insofar as a contrast of competing theories at work can make manifest how they assign different values to different aspects of reality which, in turn, shows differences in the respective theoretical perspectives they are applying.

Even though linear perspective is not a universally valid technique, it is important to emphasize that the early treatises mentioned above present the method by making the rules and principles that guide it explicit. In this way, they show that linear perspective was a method based on rules and principles that could be passed on to others. Moreover, through its codification the method reached a level of abstraction that made it possible to use it to "construct and thus to introduce entirely new worlds" (Feyerabend, 1999: 100)—which, of course, stands in a creative tension to the method's assertive force, which we have discussed above. Linear perspective was conceived as a method that allows the painter to faithfully represent, down to the last detail, any real scenario. Although the informed spectator knows that the implied assertive has to be bracketed, it remains subliminally

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[22] Brunelleschi liked to demonstrate his mastery with an experiment that involved two of his paintings that faithfully represented two eminent buildings in Florence, the Baptistery and the Palazzo de' Signori, in their actual contexts. He invited people to assume a clearly defined position in front of one of the two buildings, presumably the position he had occupied when drawing the paintings, and to peek through a small hole in the plane of the painting that was positioned in front of their eyes, with the backside facing them. Moreover, it was possible to place a mirror between the observer and the building at an appropriate distance, in which the painting could be reflected. The test persons peaked through the plane towards the building and were asked to decide whether they saw the actual building or the reflection of the painting in the mirror.

present even when the method is applied to present hypothetical or counterfactual scenarios—which gives force to the painter's invitation to explore it in the imagination and so adds to its epistemic efficacy.

Moreover, once the rules and principles that govern the method are made explicit, they can be reflected, criticized, or revised; most importantly, they can be used creatively or even violated. This happened already in the Renaissance, with the spread of *anamorphisms*, when painters found ways to bend the rules in order to achieve particularly powerful effects. The high aesthetic quality of these paintings, thus, is a result from the fact that painters systematically began to violate (some of) the rules they had interiorized. It is important to note that with these moments of transgression, painters did not cancel the rules; after all, transgression is possible only when there are rules to be transgressed. Rather they drew the observers' attention towards these very rules and so, in a way, reinforced them.

As we have seen in Sect. 2 and will further explore in Sects. 4 and 5, even the practice of thought experiments flourishes through critique and reflection of the rules that structure fictional worlds. In a nutshell, scientists and philosophers design thought experiments along lines that are similar to how Renaissance painters depicted fictional scenarios; in both cases, the imagination is employed with assertive force and through a system of rules that are observed (and violated) by the author.

Unlike Elisabeth Camp, who defines perspective as "an open-ended disposition to notice, explain, and respond to situations in the world—an ability to 'go on the same way' in assimilating and responding to whatever information and experiences one encounters" (2017: 78), we want to underline that perspective is a technique that is governed by rules and principles that can, at least to some extent, be stated explicitly. Camp's conception is particularly fruitful in (though not limited to) the context of literary works of fiction, where perspectival imagination is often related to moments where readers identify with fictional characters or the narrator's voice. In these moments, readers make the others's perspective become their own, if only temporarily; they "try on perspectives momentarily" (Camp, 2017: 74) and, in doing so, imagine thinking or perceiving in other ways. A well-drafted work of fiction can invite "us in to its world and way of seeing, thereby temporarily altering us 'as we are'." (Camp, 2017: 94). In Camp's words, imagining another perspective "involves actually, if temporarily, re-structuring our thoughts, by altering what we notice and care about, what explanations we assign, and what emotional and evaluative responses come naturally to us" (2017: 94). This kind of temporary perspectival reorganization can be quite minimal as a single sentence—such as "Juliet is the sun" (Shakespeare, 2003: 106)—or more complex, such as imagining being a main character throughout the unfolding of a fictional work.

Camp's account can be understood as an interesting descriptive psychology of the cognitive functioning of perspectives (Camp, 2020; see Stuart & Wilkenfeld, 2022: 8 for more on this). In our account, however, the notion of perspective plays a far more normative role. Imagining another's perspective consists of reconstructing the rules and principles that govern the respective technique, figuring out which results

they would produce in determinate circumstances, and grasping the criteria that determine whether a resulting representation is correct according to a given theoretical background. This does not require us to temporarily give up our own perspective and thinking or perceiving in another way, it merely requires us to understand, interiorize and apply rules of representation that are different from those we endorse.

We believe that this normative, rule-following level of the notion of "perspective" is more relevant than that described by Camp when it comes to accounting for the practice of thought experiments in research communities. A well-drafted thought experiment prompts members of a research community to take a perspective into consideration and reflect about its implications for a broader scientific theory—but not to think or perceive as the person who has submitted it to their attention. When trying to understand other perspectives in thought experiments, a researcher does not (necessarily) show a genuine interest in the other person as a person, but rather as an epistemic agent who has adopted a certain set of rules and principles.[23] In a way, we could say, it is not relevant that "this is how things look like" for any particular person who happens to occupy or endorse a given point of view; rather, we are interested to find out *what "things look like" for whoever happens to occupy or endorse this point of view.* The perspectival aspects of the imagination in thought experiments we wish to highlight do not concern taking on another person's *dispositions* to notice, explain and respond to situations in the world, as Camp suggests. They merely require us to imagine where organizing the target in light of the theoretical commitments she endorses would lead us.

The role of the imagination in expressing a perspective using a thought experiment is, thus, of a more detached attitude and does not (necessarily) prompt empathy or immersion.[24] Rather it allows us to assess the scenario that is submitted to our attention and to get a better understanding of the theoretical commitments endorsed by the proponent—without the need to assess the premises of theoretical arguments she could submit to enforce her position, which easily might appear implausible or even wrong from our original epistemic standpoint. Rather, it adds to our understanding by providing a clearer idea of the coherence principles and criteria of correctness and relevance that constitute the other's perspective, without requiring us to endorse them nor to temporarily "try" them on. It is, thus, a perfect instrument for us to enter into a dialectical relation with the proponent of the thought experiment.

This "game of perspectives" accounts for an important way in which thought experiments can advance our understanding. When imagining another person's perspective, we can identify its strengths and weaknesses with respect to our own. Thought experiments guide the reader's attention to the basic choices that shape the perspective and determine which elements will result salient and which might

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[23] This may be not the case when it comes to employing thought experiments in non-academic contexts. In educational or therapeutic settings, for instance, thought experiments are often used with the purpose of immersing readers in a fictional world rather than analyzing and interiorizing its constitutive rules. See (Stuart 2018, 2020) for an inspiring overview of the use of thought experiments in pedagogical-educational contexts and (Gendler 2004: 1160) for interesting insights on the invitations to imagine stressful situations that psychotherapists give their patients in order to proceed with appropriate therapies.

[24] See (Chasid 2021) for an interesting account of imaginative immersion in terms of rule-following behavior with no explicit thought of how to follow them.

be distorted or occluded. If a researcher would like to share her own perspective with others, she could try to devise a thought experiment that describes a familiar (yet fictional) scenario in terms of the theory she endorses. She would, thus, put the theory "at work". The others, if they accept the invitation to imagine the scenario in the terms proposed, will get a better hold on how the respective theory works, and on the methods and procedures it uses to produce such a scientific representation. In radical cases, this might lead to one's giving up one's own (previous) perspective and adopting the new one; in less radical cases one might just revise one's own perspective by integrating elements of the one that was proposed. If, in contrast, the other's perspective does not convince us, our old views are enforced and can become immunized against a potential critique that might emerge from the thought experiment.

It could be suggested that arguments or case studies can be used for the same purpose—and that they do so by making the involved inferential patterns explicit and without recurring to fiction. We do think, however, that thought experiments are more efficacious when it comes to highlighting and sharing a perspective. First, unlike arguments, they require the reader to participate in the imaginative project. This participation can come in different forms of imagination. In some cases, such as in Thomson's *Dying Violinist* (1971: 48f), the reader is supposed to imagine the scenario *from the inside*, while in others, like in Einstein's *Chasing the Light* (cf. Norton, 2013: 123), she is asked to engage in a form of perceptual imagination.[25] Second, unlike case studies, thought experiments give the author full control over the design of the scenario and the elements involved, as they are not constrained to remain faithful to reality in each and every detail. Authors can profit from this narrative power in different ways: they can make thought experiments more compelling by designing idealised scenarios, or raise their rhetorical power by enriching the narrative with aesthetic details that assume an ornamental role, or more generally by making their own voice manifest.

The author's *full control* and the reader's *active engagement* are peculiar to thought experiments. Both characteristics contribute to making thought experiments most efficient tools for authors to display how certain phenomena look like from their theory and make it possible for the readers to confront the proposed perspective. In other words, thought experiments are powerful devices to put perspectives into play.

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[25] Einstein's *Chasing the Light*, as well as Hume's *Shade of Blue*, express a perspective by involving some sort of visual imagination. Does this mean that people with aphantasia, that is, people affected with the inability to produce sensory-like mental images, may not be able to successfully perform thought experiments of this kind? We suggest that in these cases thought experiments could still convey a perspective without requiring the reader to be able to visually imagine. This can be done, for instance, with the use of visual tools such as images or diagrams (for an enlightening discussion on this, see Meynell, 2018 and Stuart, 2022). Cf. Frappier (2023) for an interesting discussion of the case of people with neurodiversity performing thought experiments. Thanks to an anonymous referee for providing insights in this direction.

4 The Clash of Perspectives Inside the Text: Galileo Galilei's Use of Imaginary Cases

In the preceding section, we argued that thought experiments permit cognitive progress insofar as they invite readers to reconsider a certain phenomenon or situation by grasping the rules that structure a fictional world and by imagining it from a different perspective, offered by the author. It is easy to see that this thesis suits well to some thought experiments that are advanced in e.g., ethics or philosophy of mind, such as Thomson's *Violinist* ([1971]: 48f) or Hume's *Shade of Blue* ([1999]: 9f). It is less obvious, perhaps, how this reading could extend to thought experiments that are proposed in the natural sciences. This is because, as was said earlier, many tend to think of science as something that has to do more with objective data and theories than with subjective perspectives or experiences. Nevertheless, we suggest that our analysis of thought experiments—and of the normative role that imagination plays in them—may be usefully applied also to the sciences. To show this we chose to focus on Galileo Galilei's use of imaginary cases to disprove parts of the Aristotelian physics. This is because some of Galileo's hypothetical scenarios have become paradigmatic cases in the literature, where they are usually treated as examples of how an effective thought experiment should work.

In the present section, we interpret Galileo's imaginative experimentations as dialectical strategies that are used by the author with a twofold aim. First, they highlight that the different theoretical and conceptual outlooks with which we approach reality may interfere with how we imagine hypothetical situations and draw conclusions from them. Second, they invite the interlocutor to imagine (and possibly, if the thought experiment is compelling, to adopt) a new perspective from which to assess a given phenomenon. This new perspective is conveyed to the readers by presenting them a scenario that is initially depicted in a familiar and traditional "flavor", but in which, as becomes clear in the narrative, some of the elements are rearranged and recombined in a new way, highlighting new features as relevant or irrelevant to the evaluation of the phenomenon in question. This re-arrangement of (ir)relevant elements constitutes the change of perspective from which the scenario is imagined.[26] What is primarily at stake in Galileo's thought experiments—rather than the demonstration or justification of some new truth or conclusion per se—is, in this reading, the exchange between different perspectives on reality and the offering of a new one on some traditional problems.[27]

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[26] Stuart has recently connected the analysis of scientific thought experiments to some observations put forward by Feyerabend about the use of narratives and stories in science. Stuart's use of Feyerabend seems particularly appropriate to express what is effective in Galileo's thought experiments: they are effective in that "they describe 'perfectly ordinary situations' in a way that is 'slightly off center'. This may be affected by a sudden change in framing or point of view, which helps us to combine objects and events we are comfortable with in ways that reveal something new" (Stuart [2021]: 267; the author attributes this point to Feyerabend [1995]: 142). As will become clear in this section, Galileo's famous thought experiment on two falling bodies relies on a similar rhetorical strategy.

[27] Before we proceed, we should say that Galileo was not always consistent in his use of thought experiments. It is questionable whether he even conceived these appeals to imaginary scenarios as having anything in common. Indeed, as Kristian Camilleri has recently pointed out, it rather seems that Galileo used

In a recent article, Carla Rita Palmerino challenged the usual reading of Galileo's thought experiments as "demonstrative tools", in which the construction of imaginary scenarios is used primarily to convince the reader of the truth of a certain proposition. She suggests that in fact "in Galileo's dialogues, thought experiments function less as demonstrative tools than as magnifying glasses that render the different theoretical assumptions of the three interlocutors visible" (2018: 907). The interlocutors she refers to are the three characters appearing in Galileo's dialogues, namely, Galileo's alter-ego Salviati, the Aristotelian Simplicio and the independent-minded Sagredo. The focus of Galileo's thought experiments, according to her view, are not the conclusions that are drawn from them, but rather the arguments put forward by the three interlocutors "to motivate their predictions about what would happen in a given imaginary situation" (2018: 907). What Galileo would be most interested in when proposing a thought experiment, then, is to highlight that the different conceptual and epistemic backgrounds held by the interlocutors affect their ways of reasoning from counterfactual premises.

Palmerino supports this view by referring to a number of imaginary cases put forward by Galileo and discussed by his characters in the dialogue. In addition to embracing her interpretation, we also wish to show that, in many of these cases, Galileo aims to guide the readers' imagination to focus on a number of elements or features that are, according to him, relevant or salient for the evaluation of the given scenario. By bringing certain elements into focus and occluding other ones, he leads his readers to a better understanding of another perspective on the phenomenon in question.

This is evident in Galileo's most famous thought experiment concerning two falling bodies, which is used by the author to disprove the Aristotelian theory according to which "bodies with different weight move through the same medium with different speeds—speeds which are proportional to their weights" (Galileo 1974: 61). The Aristotelian principle concerning the proportionality of speed to weight is first challenged on the grounds of "real" experimentation: Aristotle is charged of not having performed the relevant experiments in support of his claim; Sagredo mentions a test that he has made in which two objects of very different weight (a musket ball weighting half a pound and a cannon ball of 200 pounds) are dropped from a height of 200 cubits. This appeal to factual experiences, however, is not seen as conclusive here. Indeed, Salviati admits that he has not actually performed the test, but that nevertheless he is able to prove, "by means of a short and conclusive argument", that two bodies having the same material and therefore also the same "natural velocity" fall with equal speed despite their difference in weight.

Footnote 27 (continued)

thought experiments in different ways and for different aims, and not as a "unitary epistemic category" (Camilleri 2015: 111; cf. Palmerino 2011: 125). Nevertheless, the use of thought experiments is at the core of some of Galileo's most important innovations, as many have pointed out. In this article, we do not venture to claim that our interpretation necessarily applies to all uses of imaginary cases by Galileo. We do, however, hope to capture a feature that can shed light on what we might call Galileo's "meta-methodology" for thought experiments, that is, his theory on how thought experiments should be construed and used sensibly for scientific purposes.

The thought experiment begins when Salviati asks Simplicio and Sagredo to consider a hypothetical scenario and to imagine what would happen in it. The scenario is depicted in an entirely Aristotelian way that connects to the interlocutors'—and the readers'—epistemic background: the language is that of Late Medieval Aristotelianism, invoking concepts such as bodies "in natural fall", moving through a "medium" with a certain "definite speed fixed by nature", and excluding any "impetus", "resistance" or "violence" that may interfere with their fall. As Palmieri has remarked, the linguistic and conceptual context invoked in Galileo's construal of this scenario was well familiar to his interlocutors, and it prompted a number of implicit background concepts which attentive readers immediately recognized (Palmieri, 2018). Within this scenario, which the Aristotelian interlocutor easily accepts as imaginable or conceivable—it is his own way of describing reality that is at play, after all—Galileo/Salviati operates his "switch of perspective". He asks the reader to imagine how some elements of the scenario would interact when re-combined in a certain way: the heavier and the lighter body, say A and B, are mentally united to form a third body C, the weight of which would be composed by those of A and B; and the question is: how would this composition of bodies and weights affect the velocity of C, which is now in free fall? According to Salviati, the Aristotelian should infer that C falls more slowly than A, because the adding of B would retard A's fall. At the same time, he should also infer that C falls more rapidly than A and B, because it is heavier than both of them, and being of the same material it would have their same natural speed. By pointing out these two incompatible conclusions, Salviati arrives to deny one of the premises with which the scenario was construed, namely, that speed is proportional to weight.

The details of Galileo's thought experiment have been object of countless interpretations and we do not enter specific exegetical analysis here. We rather want to highlight that Galileo invites the reader to "imagine another perspective" by rearranging the elements of his initial and apparently innocuous Aristotelian scenario. He does so by guiding the reader's attention to factors that were neglected in the Aristotelian description but that he considers crucial, as for instance the question: how would the recombination of bodies during free fall impact speed? By bringing these new elements to the limelight, he guides the interlocutors to observe the scenario and the phenomena described from his own perspective. Note that Simplicio's reply to the thought experiment consists exactly in challenging the relevance of some elements that are central to Salviati's perspective. He asks questions like: what if we compose the third body C by putting the heavier body A on top of the smaller B, rather than *viceversa*? Should we not say that the adding of B to A will be hastening, rather than slowing down, the fall of A, given that it makes A heavier? What if rather than a height of a few cubits we take into consideration, for performing the experiment, a height of some thousands cubits?

The matter of question in the exchange between Salviati and Simplicio is thus which elements, within the imagined scenario, are important (and which, on the contrary, are insignificant) for determining the nature of fall. By staging this exchange between the two characters, Galileo asks the reader to imagine both Salviati's and Simplicio's perspectives. The author does so by guiding the reader to understand how the two characters take different elements as salient, while others are occluded

from their perspectives. The Aristotelian reader is thus induced to acknowledge the inconsistencies hidden in Simplicio's perspective, which leads him—as Gendler puts it—to "recognize the inadequacy of his [previous] conceptual framework" and "see familiar phenomena in a novel way" (Gendler, 2000: 51).

Also in other parts of his works Galileo uses imaginary experiments as show-cases in which incompatible perspectives are confronted. As Palmerino shows, this is especially evident in those in which the interlocutors in the dialogue do not arrive to an agreement upon the hypothetical scenario, that is when they advance a different assessment of the proposed imaginary situation and advance different predictions on what would happen in it (2018: 913f). Here, Galileo clearly shows how the contemplation of imaginary scenarios is biased by our theoretical assumptions, to the point that it might be impossible for the interlocutors to abandon their previous perspective and "observe" the phenomenon from a different one. While considering these cases, Galileo's use of thought experiments is meant to "bring to light the incompatibility between the Aristotelian and Copernican worldviews" (2018: 916).

Galileo's insistence on the fact that the evaluation of hypothetical situations may be biased by our preconceptions is understandable given the context in which many of his thought experiments were developed. Indeed, it has been shown that Galileo often re-elaborated imaginary cases that had already been put forward by late medieval or early modern authors. At times, Galileo even took up, word by word, entire passages from texts that had been written by his Aristotelian predecessors and contemporaries.[28] By employing their very own methodology of reasoning *secundum imaginationem* ("according to imagination"), Galileo invites his Aristotelian opponents to reconsider their own examples. This can make it easier for them to realize that their conclusions might be overturned if they abandoned some of the crucial elements of the perspectives they endorse.

5 The Clash of Perspectives Outside the Fictional Text

Galileo's dialogue is an instructive example of how thought experiments can help us to imagine other perspectives. However, this is an "internal" game: all perspectives are represented within the dialogue and "impersonated" by fictional characters. In this case, the clash between different perspectives is under the narrative control of the single author of the thought experiment. It is, thus, designed with the purpose of arguing in favor of one of the epistemic standpoints at stake. This shows the potential of thought experiments to illustrate perspectives, but does not fully explain their dialectical role.

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[28] As Palmerino writes, "Galileo was acquainted—though possibly but indirectly—with the medieval *secundum imaginationem* arguments, and he consciously reused some of them with the aim of either strengthening or subverting the conclusions reached by their first proponents" (2011: 102). On Galileo's use of late medieval and early modern thought experiments see also Camilleri (2015). On the use of thought experiments in late medieval science see e.g. Funkenstein (1986), King (1991), Grellard (2011).

A thought experiment might allow a reader to better grasp the other perspective, but this does not, of course, oblige her to adopt it and make it her own. In fact, in most cases she will continue to take a critical stance towards the other position, and she might be tempted to voice her doubts by using the very same thought experiment, or a variation thereof. Therefore, a clash of perspectives can occur outside the fictional story as well. This second kind of clash of perspectives involves different researchers with their own skills, epistemic desiderata and imaginaries.

The variations proposed by an opponent of a thought experiment can take (at least) three different forms: (i) filling in the blanks, (ii) slightly adjusting the principles of generation or even (iii) challenging the scenario's plausibility. These are common strategies in scientific and philosophical exchanges which we would like to briefly illustrate with three examples.

5.1 Filling in the Blanks

The clash of perspectives outside the text can develop via filling in the blank spots that thought experiments—as well as other fictional narratives—have (Sorensen, 2019: 792). The discussion between Albert Einstein and Niels Bohr about the *clock in a box* thought experiment seems to be along these lines. Einstein's *clock in a box* thought experiment is claimed to provide an imaginary situation in which Heisenberg's uncertainty principle—according to which there is a "reciprocal indeterminacy of time and energy quantities in quantum mechanics" (Bohr, 1970: 226)—is violated (cf. Stuart, 2016: 27). Einstein asks us to imagine that there is a box containing a source of radiation. On one side of it there is a hole that can be opened or closed with a barrier connected to a clock. This precise mechanism allows a single particle to leave the box at a specific time. In such a situation we can weigh the box before and after the release of the particle, measuring the mass loss and, thus, the energy of the single particle. In this imaginary state of affairs we can measure both the exact time of the particle's release and its mass, thus violating the Heisenbergian point.

Bohr carefully analyses the set-up of this thought experiment, trying to understand how such a box should be designed to properly work. The initial scenario turns out to be far too sketchy about the measurement details, insofar as Einstein seems to consider only a generic *weigh the box*. According to Bohr, however, this detail is quite relevant: "it makes sense if we consider Bohr's general philosophy of quantum mechanics: measurement requires action on the part of the measuring agents, whose influence on the system is inseparable from the system" (Stuart, 2016: 28f). This previously implicit detail is then marked as salient in Bohr's theoretical perspective. Therefore, the Danish physicist proceeds in filling in this blank spot and imagines that the box "is suspended in a spring-balance and is furnished with a pointer to read its position on a scale fixed to the balance support" (Bohr, 1970: 226). Accordingly, a previously neglected gravitational field is now included in the fictional scenario. The new detail modifies the spin of the thought experiment, insofar as the clock inside the box will either slow down or speed up depending on the gravitational field. We can have either a precise mass measurement or a precise time

measurement—thus Heisenberg's principle of indeterminacy works even in this fictional scenario. This example shows that Bohr is able to express his perspective on a physical problem by making explicit a detail of the thought experiment that previously had been left undetermined.

5.2 Slightly Adjusting the Principles of Generation

A clash of perspectives may occur as a result of changing some details in the narrative of the thought experiment. Such a clash can be exemplified by Warren's criticism of Thomson's *Violinist* thought experiment. In her famous thought experiment, Judith Jarvis Thomson asks you to imagine yourself waking up in bed next to a famous violinist who suffers from a fatal disease and risks dying. Some members of the *Society of Music Lovers* kidnapped you because you have the same rare blood-type the violinist has, and thus could, with your circulatory system pumping blood also through the violinist's body, save his life. You have to stay connected to his body for nine months in order to save his life. At this point, Thomson asks the reader: "is it morally incumbent on you to accede to this situation?" (1971: 49). It would be quite a kind action, but no one seems to be morally constrained to stay in bed for months to save another life. This thought experiment invites the reader to imagine a fictional world designed to understand some of the moral implications of abortion that could be neglected. Yet, the violent abduction conducted by the members of the *Society of Music Lovers* may lead to think that the political perspective expressed via this thought experiment works only with cases of unwanted pregnancy caused by sexual abuses. Mary Anne Warren claims that this detail is misplaced and proposes a modification. The protagonist of the story is no longer kidnapped but connected to the violinist's body as a voluntary act. In Warren's view, this little modification allows to extend the scope of Thomson's thought experiment to a more general conclusion, including the interruption of pregnancies that are voluntary, and thus less dramatic than sexual abuse (Warren, 1973: 51). In the terminology we have developed in the present paper, we can say that Warren expressed her theoretical perspective on the issue of abortion by criticizing the detail chosen by Thomson and manipulating her story. This kind of clash of perspectives results in a dialectic exchange based on the modification of some details of the fictional scenario which, as it does, causes a significant change in the perspective at play in the thought experiment.

5.3 Challenging the Scenario's Plausibility

A clash of perspectives via thought experiments could proceed by raising doubts concerning the very plausibility of the scenario. In cases like this, critics typically present a substantial modification of the principles of generation and so invite us to imagine a scenario that is claimed to be better suited to the epistemic purposes of the discussion. This strategy has been adopted for example by John Dupré in his discussion of Putnam's notorious *Twin-Earth* thought experiment. In his article "The Meaning of 'Meaning'", Putnam invites us to imagine a planet,

Twin-Earth, that is very much like Earth with the only difference that the liquid called "water" is not H_2O, but has a different, quite complex chemical composition, say XYZ. The liquid on Twin-Earth has the same phenomenal qualities and plays the same role that water plays on Earth: the rivers, oceans, lakes and raindrops on Twin-Earth are composed of XYZ. If astronauts from Earth should come to visit Twin-Earth, they might at first believe "that 'water' has the same meaning on Earth and on Twin-Earth. This supposition will be corrected when it is discovered that 'water' on Twin Earth is XYZ." (Putnam, 1975: 140). The word "water" has a different meaning on Earth and Twin-Earth, according to Putnam, because it has an indexical component that links it to the natural kind to which the paradigmatic instances of the extension of the term belong—on Earth and on Twin-Earth, respectively.

According to Dupré, Putnam's thought experiment can be convincing only for a reader who already shares the latter's essentialist perspective according to which water (on Earth) is necessarily H_2O. In order to challenge this view, he modifies Putnam's scenario, turning it from a science-fiction style thought experiment to one that takes actual scientific history into account. Dupré reminds us that the first European botanists who have come to study North-American trees encountered a huge number of beech trees which, however, were significantly different from the ones they had studied on the old continent—so different that "they should be assigned to a different species" (Dupré, 1993: 26). The most striking difference was in the size of the leaves, which is why they distinguished between *Fagus sylvatica* and *Fagus grandifolia*. In this context, Dupré invites us to imagine the following counterfactual scenario:

> Let us suppose that one of our botanists was also a linguist. If a native had asked her whether there were beech trees where she came from, what ought she to have said? My intuition, for whatever it is worth, is that she should have said that there were; though naturally if she were talking to a native botanist, she would go on to add that European beech trees belonged to a different species. (Dupré, 1993: 26)

Dupré, thus, modifies Putnam's original thought experiment to illustrate that our intuitions on whether "water" has the same meaning on Earth and on Twin-Earth are not that obvious, suggesting that we are more likely to admit that the term "beech tree" has the same meaning in Europe and in the (newly discovered) North-American context, even though it refers to two different species. Moreover, his move to turn a science-fiction scenario into one that relies on scientific history might bestow additional credibility to his version of the scenario, for it invites to believe that the new scenario is not completely fictional, but recounts what (likely) has actually happened in the relevant situation. With these moves, Dupré does not, of course, show that Putnam's thought experiment is false or fallacious. The dialectic gain of his modified scenario comes, at best, to reveal the implausibility of Putnam's scenario and to neutralize its compelling force. In this way, it can prepare the terrain for other arguments that challenge essentialist positions in the philosophy of science.

All three forms of clash of perspectives presented—filling in the blanks, slightly adjusting the principles of generation or undermining the plausibility of the scenario

and substantially modifying it—take place in a dialectical process that highlights the peculiarities of the concrete perspectives endorsed by different researchers at work within the debate. The examples merely serve to illustrate (some of) the formal strategies that can be adopted in order to undermine the cognitive force of thought experiments—we do not take position regarding the question of whether the respective critical moves are compelling or not.

We suggest that the proliferation of different perspectives at play in thought experiments is epistemically relevant, insofar as it encourages the refinement of fictional scenarios, the unveiling of some implications neglected by the author, and the recognition of which elements are relevant according to a given perspective. As Elgin puts it:

> They [those whose interpretations diverge from ours] evidently see something in the work that we as yet do not. If we seriously entertain their point of view, we may come to discern something of value. […] by accessing the opinions of others and the reasons for those opinions, epistemic agents gain access to insights and perspectives that they would otherwise miss. (2017: 181)

This point underlines once more that the scientific enterprise is essentially a social enterprise which becomes most fruitful where it is a free game of perspectives. It is for this reason that we have insisted, taking up Walton's insight, on the social role of imagination. Thought experiments—as well as other games of make-believe—are not isolated or private phenomena, but embedded in larger social practices, in which they play a specific role. They are devices of a dialectical exchange within a scientific or philosophical community; they form a practice that is constituted, guided and—most importantly—constrained by socially accepted rules which, however, are not fixed once and forever, but are in constant change over time and across cultures. It is important to reflect and, where possible, adjust the rules so as to improve the epistemic efficacy of thought experiments.

Finally, it is worth mentioning that the topic of disagreement in thought experiments—which, in our paper, takes the form of a clash of perspectives—has also recently been highlighted by some interesting papers. Unlike us, some of them focus on overcoming such a clash suggesting that the final phase of thought experimental disagreement is the achievement of some sort of equilibrium—whether reflective (Miščević, 2022) or unstable (Goffi & Roux, 2018)—within the different accounts at stake. Miščević recognizes the role of imagination in the construction of a thought experiment's scenario (although he does not delve into its normative and social dimensions). Therefore, his view might be compatible with our perspective-based account: some opponents may end their clash by reflecting on the perspectives at play and reassessing their merits and flaws, thus achieving a peaceful equilibrium among them. Such a—probably uncommon—scenario seems to be the most *peaceful* one: a clash of perspectives which leads to a reflective equilibrium can easily provide a third perspective as a synthetic product of the previous ones. Goffi and Roux also suggest that the purpose of thought experiment-based discussions is to achieve an equilibrium between claims and critics—an equilibrium that is, however, unstable due to the often controversial epistemic context. We think that they point in the right direction by illuminating the dialectical dimension of thought experiments.

They do not, however, find a place for the imagination in their account. Echoing Norton, they treat thought experiments as arguments—employing an extremely broad notion of "argument" as "what intervenes in a cognitive context to make an interlocutor change her mind" (2018: 452). Thus, our account adds to their views both (i) by identifying more precisely where the clash between interlocutors arises (we see it not as a clash of broadly understood arguments, but of theoretical perspectives), and (ii) by recognizing the essential role of imagination in this kind of dialectical exchange.[29]

6 Conclusion

The goal of the present article was to shed light on the epistemic role of thought experiments. According to the view we have developed, they are best seen as dialectical devices that allow the proponent to invite the reader to engage in a game of perspectives. The main point is not to give an "objective" description of things, but to illustrate the rules that determine how things look like from a specific theoretical perspective. This can lead to a reassessment of which features are central and to a rearrangement of the elements at play. The game of perspectives prompted by thought experiments can take place between imaginary characters, who impersonate different positions for the reader, or between scholars who discuss one and the same thought experiment—and its variations. In both cases, they are used as tools in a dialectical exchange of perspectives between scholars. The discussion we have presented underlines that thought experiments have a social dimension, they are part of a scientific practice that is guided by rules and follow principles which so far have often remained implicit. We, thus, cannot but agree with Stuart and his call for "a normative theory of perspectives in order to work out a normative theory of thought experiments" (2018: 536).

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[29] Other philosophers have focused on the nature of disagreement in thought experiments. According to Luis Rouillé (2020), for example, the core of disagreement in fiction—as well as in thought experiments—concerns the fictional details left implicit in the text (such as the kind of insect Gregor Samsa turned into) (2020:105). Rouillé effectively sheds light on the mechanisms of unveiling implicit fictional truths; nonetheless, he claims that this is the only legitimate way of disagreement in thought experiments. As we have seen, however, thought experiments—unlike many other kinds of fictional works— can be extended and modified by the reader, if this leads to the advancement of the debate. In our view, thus, the unveiling of implicit fictional truths is only one of the techniques used to criticize a thought experiment.

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