# How to Reconstruct a Thought Experiment

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**Abstract**: The paper is a contribution to the debate on the epistemological status of thought experiments. I deal with the epistemological uniqueness of experiments in the sense of their irreducibility to other sources of justification. In particular, I criticize an influential argument for the irreducibility of thought experiments to general arguments. First, I introduce the radical empiricist theory of eliminativism, which considers thought experiments to be rhetorically modified arguments, uninteresting from the epistemological point of view. Second, I present objections to the theory, focusing on the critique of eliminativism by Tamar Szabó Gendler based on the reconstruction of Galileo's famous Pisa experiment. I show that her reconstruction is simplistic and that a more elaborate reconstruction is needed for an appropriate assessment of the epistemic power of general argument. I propose such a reconstruction and demonstrate that the general version of the Pisa experiment is epistemically equal to the particular one. Thus, from an epistemological perspective, Galileo's thought experiment is reducible to a straightforward argument without particular premises.

**Keywords**: argumentative reconstruction, eliminativism, epistemic power, Galileo, thought experiment.

Although thought experiments are widely used in the sciences, in philosophical arguments as well as in everyday communication, there is no consensus among scholars about their nature. It is striking that such a common method has no generally accepted definition and no set of sufficient and necessary characteristics. It is not clear what a thought experiment is and how to distinguish one from other forms of speculation. One cannot rely on a widely recognized typology of

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thought experiments. There is no consensus about the way a thought experiment reaches its goal, and it is not even clear what the goal is supposed to be. It is difficult to recognize a thought experiment. It is even more difficult to theorize or come to an agreement about one. Different authors emphasize different aspects: some emphasize the similarity of design between thought experiments and real experiments; others point out their relevance to cognitive models, works of art and mnemonic devices.[2] I will treat thought experiments as narrative structures that use scenarios with particular details and hypothetical premises to give an answer to a presented question, but where none of the scenarios must be realized to reach the goal.

This text is a contribution to the debate on the epistemological status of thought experiments. How can hypothetical examples participate in the process of obtaining knowledge? Is it ever possible to accept an imaginary scenario as a source of justification, that is to say, to accept it as a good reason to embrace an opinion? These questions have been a source of lively debate[3] and have resulted in a division of scholars into those who think that thought experiments are epistemologically important concepts and those who consider them uninteresting.

The difference in their opinion of the epistemological status of thought experiments can be demonstrated by two questions: 1. Are thought experiments sources of *new* knowledge? 2. Are thought experiments *unique* sources of knowledge? The first question concerns if thought experiments can justify beliefs that cannot be justified by other means prior to the experiment. Is drawing conclusions from imaginary scenarios merely reformulating what is already known? Are thought experiments merely aids facilitating the acceptance of

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2 The defense of thought experiments considered as an evolutionary stage of real experiments can be found especially in Sorensen (1992). For the conception of thought experiments as mental models cf. Nersessian (1993). The relation between literary fiction and philosophical thought experiments is analyzed for example by Camp (2009). Ernst Mach studies the role of thought experiments in the process of recollection and explication; cf. Mach (1905).

3 Brown (1991a), Norton (1996), Gendler (1998), Bishop (1999), Borsboom et al. (2002), Häggqvist (2009). Only a partial list is presented here. The discussion is very rich.

views we have already accepted and observed, but refused or failed to accept consciously? Although I will touch upon these issues at several points, the second question will be my primary concern.

Epistemological uniqueness can be understood in various ways. Are thought experiments structures enabling us to obtain information that we could not obtain by other means? Are they structures that make use of our otherwise latent cognitive functions? Is a thought experiment basically an idiosyncratic and irreducible structure? None of these questions will be the topic of this text. What I am interested in is whether the epistemological importance of thought experiments can be identified with the epistemological importance of other, less elusive structures. I am interested in the epistemological uniqueness of experiments in the sense of their irreducibility to other sources of justification – I will, in particular, criticize an influential argument for the irreducibility of thought experiments to arguments. First, I will introduce the radical empiricist theory of eliminativism, which considers thought experiments to be rhetorically modified arguments, uninteresting from the epistemological point of view. Then, I will present objections to the theory, focusing on the critique of eliminativism by Tamar Szabó Gendler, analyzing her objections and showing their drawbacks.

## 1 Empiricism and thought experiments

Thought experiments pose a challenge for empiricist epistemology, that is, for the theory that all true synthetic beliefs must be directly or indirectly grounded in sensory experience only. Leaving aside analytic truths, the only ultimate source of epistemic justification is, for an empiricist, sensory experience. Thought experimenting is, obviously, incompatible with this project, since it is a way of obtaining information from the armchair, that is, lacking the relevant perceptions that could justify our beliefs. There is no doubt that there have been plenty of cases in the history of science and philosophy in which the evaluation of a belief or a theory was based on the supposition of fictional events, the mental manipulation with imaginary objects and the investigation of hypothetical states of the world. Thus, thought experiments have traditionally been conceived as good reasons for accepting or rejecting a standpoint, which deserves critical attention from the

empiricist: If thought experiments provide us with knowledge of our world, where does this knowledge come from? How can we explain the epistemological status of thought experiments as well as remain loyal to the tenets of empiricism?

Of course, the empiricist cannot admit that thought experiments lead to knowledge of contingent things by means of rational inquiry. Such sources of justification are not acceptable; knowledge must be derived from sensory perception. Ernst Mach was an initiator of the attempts to expose the epistemic value of thought experiments in the framework of empiricism. In his *Science of Mechanics,* he presents a conception according to which thought experiments are tools that enable us to bring to surface our hidden beliefs.[4] Mach supposes that not all of the information obtained through sensory perception is used to form explicit beliefs, much of it is processed on the unconscious level for which Mach uses the term 'instinctive'. Our minds contain imaginary stocks with the well-lit areas filled with reflected, explicitly embraced beliefs. Besides those, there are, however, dark corners, whose contents are unknown but which influence our behavior and decisions. Thought experiments are one way of bringing beliefs from the dark corners into the light, that is, they enable us to turn instinctive knowledge into explicit knowledge.

Mach's model is fully compatible with the empiricist tenets. The role of thought experiments is limited to processing information obtained through the senses. The imaginary scenarios help structure, conceptualize, and explicate the information.[5] His conception of thought experimenting could be very loosely associated with hypnosis, in which the subject is able to recollect details of past events of whose existence she has been completely unaware. Mach naturalizes the experiments. His solution to the problem is based on the understanding of thought experiments as ways of processing information coming from unquestionable sources: experiments provide us with new knowledge of the world as they are intermediaries between per-

4 Mach (1960, 27-28).

5 Mach distinguishes between implicit beliefs obtained by means of personal sensory experience and innate implicit beliefs – those are, however, ultimately obtained by means of our ancestors' (personal) sensory experience.

ception and consciousness. Thought experiments without prior perception are, in fact, no thought experiments at all, they are different modes of thinking utilizing imagination.

What are the answers that Mach's naturalist explanation strategy can give to the two epistemological questions above? With regard to the first question, that is, whether thought experiments are sources of new knowledge, naturalism distinguishes between an externalist and an internalist variety. These varieties differ in their opinions on the requirement for the accessibility of the justification process to the subject. In other words, the question is if the subject must be aware of having an instance of knowledge. Externalists claim that the subject has a given knowledge prior to the experiment – even if in a tacit form, nevertheless influencing her decision-making and behavior. According to externalist empiricism, thought experiments are not sources of new knowledge. They only change some properties of old knowledge. Internalists, on the contrary, consider as knowledge only those beliefs that are justified by a process cognitively accessible to the subject. If the subject is not aware of the reasons that justify her belief, her belief is not knowledge. It is impossible to know without knowing that one knows. Internalist empiricists consider thought experiments as genuine sources of knowledge, since it is only the experiments that bring the subject to the acceptance of the justified true belief.

The proponents of empiricism also differ in their answers to the second question, that is, whether thought experiments are unique sources of knowledge. On the one hand, we find enthusiasts, who are convinced of an irreducible epistemological importance of thought experiments. Thinking over imaginary scenarios cannot, in their opinion, be fully replaced by another source of justification. Thought experiments offer a unique method of obtaining knowledge. On the other hand, there are eliminativists, who consider thought experiments uninteresting from the perspective of the theory of knowledge and, in a sense, epistemically parasitic.

### 1.1 The eliminativist thesis

According to the eliminativist version of empiricism, thought experiments have no unique and independent epistemic power and are, in fact, uninteresting as a method of obtaining and justifying beliefs. Eliminativists consider thought experiments to be epistemologically

marginal extensions of other, less problematic sources of justification. In particular, thought experiments are just dressed-up arguments and what is interesting about them with respect to the justification of beliefs can be fully derived from their argumentative core. The most prominent proponent of eliminativism is John Norton, who describes the relation between an experiment and an argument in the following thesis:[6]

> Thought experiments can be reconstructed as arguments based on hidden or explicit assumptions. The resulting belief can be considered justified only to the extent that the reconstructed argument is capable of justifying its conclusion.

It is a radical opinion according to which the justificatory power of thought experiments is no stronger than that of the corresponding arguments stripped of the particularities of their experimental design. That does not mean thought experiments have no epistemic power whatsoever. It is only that they have no special and unique role. If we strip a thought experiment of its particular sets, actors and attractive plot, its justificatory power does not change. Of course, we lose what is attractive about thought experiments, but the particular details of the experiments do not add any epistemologically relevant features to the arguments.

Tamar Gendler, whose critique of eliminativism I will focus on, refines the key thesis.[7] First, she points out two possible but incorrect interpretations of the eliminativist thesis. The first interpretation is that a straightforward argument, that is, an argument without particular premises, can be used to derive the same conclusion as can be derived from an experimental scenario. This interpretation makes the eliminativist thesis trivially true and every physics textbook proves that. There is no doubt that the conclusion we derive from a thought experiment can be derived from a straightforward argument as well. The other incorrect interpretation of the eliminativist thesis is that a person who understands the conclusion of a thought experiment can have demonstrated to her the same conclusion by means of an argument. This interpretation is trivially incorrect as it ignores the extraor-

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6 Norton (2004b, 1142).

7 Gendler (1998, 398 and further).

dinary didactic qualities of thought experiments. A thought experiment may reveal to a person what a straightforward argument may not be able to. The first incorrect interpretation is too weak; the other is too strong. To prevent possible misunderstandings, Gendler formulates the eliminativist thesis in the following way: reasoning about specific entities within the context of an imaginary scenario does not lead to a rationally justified conclusion that would not be rationally justifiable on the basis of a straightforward argument based on the same initial information.

Thus, the issue is whether particular details influence the process of belief justification. Eliminativism claims that if we can talk about justification in the context of thought experiments, it is the underlying straightforward argument that does the job. A straightforward argument is able to justify the conclusion with the same strength as the thought experiment if it is based on the same premises. If we have the same initial conditions, the absence of particular details has no impact on the justificatory power. Enthusiasts, on the contrary, say that the loss of particular details leads to a loss of justificatory power.

The dispute between eliminativists and enthusiasts takes place in the context of Galileo's famous thought experiment with falling objects. The bone of contention is the sufficiency of the argumentative reconstruction of this imaginary scenario launched against Aristotelian physics – Galileo's example is put forth as a model of a great, cogent thought experiment in which the loss of particular details would lead to the loss of epistemic power. I will present James Brown's reconstruction of Galileo's experiment in Chapter 2, and then the way John Norton replies to the critique. Chapter 3 deals with a sophisticated critique of eliminativism by Tamar Szabó Gendler, who revises Brown's reconstruction of Galileo's experiment, supplements it with potential opponents' replies, and shows how the robustness of the thought experiment differs from the robustness of its straightforward reconstruction. She then generalizes the identified difference and puts it forth as an argument against eliminativism. In Chapter 4, I will first reconstruct Galileo's experiments using argument diagrams and then a simplified Toulmin model of an argument. I will show that Gendler's critique of eliminativism is based on a simplification and an inadequate description of the relevant characteristics of Galileo's experiment. I will show a way of defending eliminativism from the charge based on this particular thought experiment.

## 2 Brown's critique of eliminativism

James Brown's rationalist conception is an alternative to the eliminativist attitude. Brown believes thought experiments are tools that enable direct access to the ideal world of physical laws. He answers the question of how purely rational activity can lead to the acquisition of new empirical knowledge by postulating the existence of a special epistemic channel between reason and the system of independent abstract entities whose relations constitute the laws of nature. His views are in sharp contrast to empiricist epistemology and his Platonism is, thus, a parallel rival theory to eliminativism. The main topic of this paper is, however, not the polemic between empiricism and rationalism, but the polemic between eliminativism and the rest of the world, a polemic to which Brown has also contributed in a way that is not seriously contaminated by his unorthodox epistemological views. Brown is considered to be an influential scholar for his advanced typology of thought experiments, among other things, which he introduced in his monograph.[8] This typology is a suitable starting point for the introduction of his critique of eliminativism as he uses it to identify those experiments that resist elimination. He believes there is a group of experiments whose epistemic value cannot be fully represented by a set of general premises and a conclusion.

Brown distinguishes destructive and constructive experiments. Destructive experiments provide counterexamples to a theory; constructive experiments are meant to support one. The support can have three forms. Firstly, we have a theory and the experiment is an example that can illuminate the theory and help apply it to particular phenomena. The experiment plays the role of an illustration. The situations and phenomena used in the experiment are unproblematic and usually refer to ordinary experience. Brown calls these experiments mediative. Secondly, we do not have a theory; we are looking for one. The thought experiment presents an unusual or speculative phenomenon that we attempt to explain. This type is called conjectural. Thirdly, Brown speaks about direct thought experiments, which result from a combination of both of the above mentioned types. They share the lack of a theory with conjectural experiments and the unproblematic character of the phenomena we are trying to

8 Brown (1991a, chapter 2).

explain with the mediative experiments. Direct thought experiments draw attention to a phenomenon that can neither be doubted nor adequately explained. That results in the creation of a suitable explanatory framework.

The identification of conjectural and direct thought experiments is the key point of Brown's critique of eliminativism. Brown believes one cannot form their adequate argumentative reconstruction:

> We have clearly specified premises to work from in either destructive or mediative examples; but in the case of either direct or conjectural thought experiments we simply do not have a definite background theory from which we can be said to be arguing to our conclusion. (Brown 1991a, 47)

Some thought experiments are not based on a well-formed theory that forms a derivative basis of the argument. Brown assumes that argumentative reconstruction must be in the form of a derivation of a conclusion from premises that, among other things, contain the hypothesis that serves as an explanatory framework of the phenomenon established in the experiment. I confess that I do not clearly see what justifies this assumption. Brown believes that the only adequate structure of a reconstructed argument is the following: Considering phenomenon P under theory T, conclusion C follows. I believe this conception of argumentative reconstruction, that is, the conception of what kind of argument the reconstruction should be, is too narrow. It seems that Brown means by reconstruction (a) the formulation of a deductive argument where (b) all premises must already be explicitly formulated in the unreconstructed form. It follows, then, that experiments in which the theory is derived inductively or abductively cannot be reconstructed (ad a). Further, experiments in which the theory is not explicitly introduced among the premises cannot be reconstructed (ad b). Brown's interpretation of the eliminativist thesis is not in accordance with its intended sense. The conditions that Brown states are not part of it; Norton explicitly denies them. Eliminativists do not assert that all thought experiments can be reconstructed as deductive arguments without a loss of epistemic power, but they do claim that all thought experiments can be reconstructed as deductive or inductive arguments whose epistemic power does not change if particular premises are removed from them. Neither is it asserted that the premises of the reconstruction should only include the explicit statements

given in the experiment. The eliminativist thesis explicitly speaks about 'hidden' premises.

Brown's demand for the derivation of the conclusion from a well-formed theory is too strong, since the theory does not always need to be contained in the premises. His structural objection is based on an inadequate understanding of what is meant by the argumentative reconstruction of a thought experiment. The refutation of the objection is not particularly difficult. It is sufficient to point out the misinterpretation of the criticized view. However, this is not the only objection Brown raises against eliminativism. Another of his objections concerns the ability of the reconstruction to represent all of the epistemological contribution of the experiment. Brown asks whether the reconstruction by means of a straightforward argument leaves something important out. His typology of thought experiments is relevant here again. The last item in his typology is experiments that he calls Platonic. They are experiments that fall into two of the above mentioned categories. They are both destructive experiments, as their role is to reject a theory, and direct experiments that establish a new theory by means of an unproblematic phenomenon. A Platonic thought experiment is a scenario in which thinking over hypothetical but relatively common situations leads to the disclosure of drawbacks in the current explanation and the formulation of a new, better and more adequate explanation. It is supposed to be the highest form of thought experiment, as it shares the qualities of all the other types: it refutes the old conception and establishes a new one by means of an unproblematic phenomenon. Platonic thought experiments are epistemically richer than straightforward arguments; their contribution cannot be fully represented by a sequence of premises and a conclusion.

### 2.1 Galileo's experiment with falling objects

Brown claims that it is not possible to reconstruct a Platonic thought experiment by means of a straightforward argument without a loss of epistemic power. He presents the EPR paradox, Leibniz's experiment to prove *vis viva* and Galileo's example of falling bodies as examples of such scenarios. For its ingenious simplicity, cogency and clarity, Galileo's thought experiment has become the focal point of the debate on the epistemic power of thought experiments. Brown recon-

structs the scenario and shows where the experiment and the argument, in his opinion, gap.

Galileo's experiment attacks Aristotelian physics and in particular the view that the natural speed of bodies is directly proportional to their weight. Aristotle claims that heavier bodies will fall more rapidly than lighter bodies and Galileo's literary projection raises doubts whether Aristotle actually verified his statement empirically. It would surely be possible to conduct an experiment to confirm the truth of the claim, but it is not really necessary. The falsity of the Aristotelian principle can be shown without a real experiment, says Galileo. It is sufficient to reason as follows: let us assume with Aristotle that bodies of different weights fall at different speeds in the same medium – if we take two bodies of different weights, the heavier body will fall more rapidly than the lighter one – at what speed will the connection of the two bodies fall?

> Then if we had two moveables whose natural speeds were unequal, it is evident that were we to connect the slower to the faster, the latter would be partly retarded by the slower, and this would be partly speeded up by the faster. ... But if this is so, and if it is also true that a large stone is moved with eight degrees of speed, for example, and a smaller one with four [degrees], than joining both together, their composite will be moved with a speed less than eight degrees. But the two stones joined together make a larger stone than the first one which was moved with eight degrees of speed; therefore this greater stone is moved less swiftly than the lesser one. But this is contrary to your assumption. So you see how, from the supposition that the heavier body is moved more swiftly than the less heavy, I conclude that the heavier move less swiftly. (Galileo 1974, 65)

Galileo constructs a reductio ad absurdum in the experiment. He assumes Aristotelian dependence of the speed of a body on its weight and shows that the assumption leads to unacceptable results. One material system would have to fall at two different speeds. How can this thought experiment be transformed into an argument? Brown suggests the following reconstruction:[9]

[9] According to Norton (1996, 341 and further).

[Argument A: Brown's reconstruction]

(1) The natural speed of falling bodies in a given medium is proportional to their weight.
(2) If a large stone is moved with eight degrees of speed, a smaller stone with half the weight will be moved with four degrees of speed.
(3) If the slower stone is connected to the faster stone, the slower one will decelerate the faster one and the faster one will accelerate the slower one.
(4) If the two stones from premise 2 are connected, the resulting object will fall more slowly than at eight degrees of speed.
(5) The weight of two connected objects is higher than the weight of the bigger of the two objects.
(6) The connection of the stones from premise 2 will fall faster than at eight degrees of speed.
(7) Premises 4 and 6 contradict each other.
(8) Thus, premise 1 must be rejected.
(9) Thus, all stones fall alike.

Leaving aside the fact that the proposed reconstruction contains particular premises,[10] this argument represents precisely what is attractive about Galileo's example from Brown's perspective. The reconstruction shows that Galileo's thought experiment has an unproblematic design, since with the exception of the initial Aristotelian premise necessary for the reductio, there are no controversial statements. It is a Platonic thought experiment: statements 1-8 describe its destructive component; statement 9 is a constructive step leading to the establishment of a better theory. It is this very step from the rejection of the Aristotelian thesis to the acceptance of the Galilean thesis that, according to Brown, presents an insurmountable challenge for the eliminativist conception. What is the challenge? The move from 8 to 9 is neither an inference nor an inductive generalization grounded empirically. Nevertheless, after careful consideration of the experiment, this move is believed to be justified and hardly anyone would hesitate to make it. Brown sometimes refers to this move as a 'Platonic leap' that cannot be represented by a straightforward argument as a legitimate

[10] Namely premises (2), (4), and (6), whose dispensability will be dealt with below.

move from the premises to the conclusion. Eliminativists are bound to regard this move illegitimate as it is not sufficiently supported by the premises of the reconstruction. It is, however, completely acceptable in the context of the thought experiment. The epistemic value of the experiment parts with the value of its reconstructed form at this point, the experiment is richer.

Norton answers this critique in two steps. In the first step he supplements Browns reconstruction with implicit elements that serve to represent Brown's interpretation of the experiment more precisely. In the second step he shows that (i) these elements enable us to analyze the Platonic leap as a straightforward argument and that (ii) Brown's interpretation of Galileo's experiment is incorrect.

As I have said, the Platonic leap is supposed to occur between the destructive premise/intermediate conclusion 8 and the constructive conclusion 9. A common interpretation of Galileo's experiment, one that, according to Norton, Brown would share, works with a hidden assumption that to determine natural speed, it is not necessary, according to Aristotelian physics, to consider any quantities other than the weights of the falling bodies. In other words, natural speed depends *solely* on the weights of the falling bodies. Norton believes that if we put this hidden assumption into the reconstruction, no Platonic leap is needed and the conclusion can be reached by a simple inference. The key step from 8 to 9 can be reconstructed as a straightforward argument:

[Argument B: Norton's reconstruction of the Platonic leap]

(8a) The natural speed of falling bodies depends only on their weight.

(8b) The natural speed of falling bodies is some arbitrary, monotonously rising function of their weight.

(8c) If the function is anywhere strictly increasing, then we can find a composite body whose natural falling speed is intermediate between the falling speed of its lighter components.

(8d) Premise 8c is incompatible with premise 8b.

(9) Thus, the function is constant and all stones fall alike.

Norton presents the Platonic leap as an ordinary inference from implicit and explicit premises. 8a contains an implicit assumption about a strict dependence of natural speed on body weight. 8b is

a specification of the dependence. It says that whenever the weight increases, the speed must increase as well. It further says that, for the purposes of the inference, it does not matter at what rate or according to what factor the quantities increase. What is important is that the weight of an object cannot increase while its speed remains constant. Premise 8c is deduced from 3, 5 and 8b. A compound body falls, according to the third premise, more slowly than its parts. According to the fifth premise, the weight of a compound body is always higher than the weight of any of its parts. Premise 8b says that there can be no exceptions with very heavy or very light parts. The intermediate conclusion 8d claims the incompatibility of premise 8b and the inferred conclusion 8c: if speed must accelerate with any increase in weight, the same must hold for the increase in weight when two objects of different weights are connected. According to 8c, however, the speed will not increase in such cases. Conclusion 9 says that premise 8b is false, as it leads to a contradiction. This way one can derive a constructive conclusion from Galileo's experiment. The natural speed of a body is independent of its weight, because to suppose otherwise leads to a contradiction. The new hypothesis is not formulated by means of a mysterious insight into the world of the laws of nature. It is a plain inference from premises. If we supplement the reconstruction of the argument with implicit premises 8a and 8b, we can show that the conclusion is not a Platonic leap, but a simple inferential step.

Norton points out another interesting thing: premise 8a is not contained even implicitly in Galileo's experiment. The above stated enrichment of the reconstruction does represent a way of deriving a new theory from the experiment, but this derivation is not sufficiently grounded in the experiment itself. Where is the problem? Premise 8a expresses an idealized situation of natural speed in vacuum. In such a situation, one need not consider differences in speed caused by different aerodynamic shapes of falling bodies, and natural speed is, given Aristotelian principles, solely a function of weight. Galileo's experiment is, however, explicitly designed for bodies falling in a medium – as stated in premise 1 – and it is illegitimate to take the step from 8 to 9 under such circumstance. The interpretation of the experiment described above is, thus, an anachronism. We are only confronted with the scenario ex post, we know its purpose and know the relevant polemic to an extent. Galileo's goal in the experiment was

merely to rebut the Aristotelian conception of natural speed of bodies in a medium, not to create his own theory. His experiment is not sufficient for that purpose. What is, then, Norton's reply to Brown's objection? Galileo's example is not an instance of a Platonic experiment! The step from 8 to 9 is not sufficiently justified by the experiment; we only accept it, because we have been instructed to do so. And we do that by inferring the desired conclusion from some implicit premises.

## 3 Gendler's critique of eliminativism

Tamar Szabó Gendler has formulated a noteworthy critical reaction to eliminativism.[11] Like Brown, she attempts to show that thought experiments are epistemically richer than straightforward arguments. She also makes use of Galileo's example of falling objects to demonstrate the inadequacy of the argumentative reconstruction of the experiment. She bases her critique of eliminativism on the same view: while an inferential step is epistemically justified in a thought experiment, it is illegitimate in the argumentative reconstruction of the experiment. Brown defends the uniqueness of Galileo's experiment by pointing out that it leads to the *formulation of a better theory*. Gendler bases her defense on the idea that, unlike the argument, the experiment can tell us *what is wrong with the original theory*.

The basis of her critique of eliminativism is a minimalist reconstruction of Galileo's experiment. She removes all premises that are, in her view, irrelevant and puts the remaining ones into the following argument:

[Argument C: Gendler's reconstruction]
(I) Natural speed is mediative.
(II) Weight is additive.
(III) Thus, natural speed is not directly proportional to weight.

Statement I is a general principle concerning the interaction of two connected falling bodies with different weights. The corresponding premise in Brown's reconstruction is premise 3. Statement II is a reformulation of premise 5 of Brown's initial reconstruction. Statement III contains the conclusion of the argument, to which the intermediate conclu-

11 Gendler (1998).

sion 8 above corresponds. Particular premises 2, 4 and 6 have been omitted; the remaining ones have been formulated as generally as possible.

Gendler believes that conclusion III receives different degrees of justification from the thought experiment and from the corresponding straightforward argument. The key idea is that while the straightforward argument offers a number of ways to improve the refuted Aristotelian theory, the thought experiment reduces them to a single one. The thought experiment can tell us that something is wrong with the original theory, as well as reveal the problematic point. The straightforward argument is less potent in this respect**.** We can look for the problematic aspect of the refuted theory basically anywhere in the context of the argument. The crucial difference between Gendler's and Brown's critiques of eliminativism lies in a different target of their objections. Brown disputed the move from intermediate conclusion 8 to conclusion 9*;* Gendler attacks the move from premise 7 to intermediate conclusion 8. Let us look at her critique in a greater detail.

Assume you are a proponent of Aristotelian physics who would like to reply to Galileo's example and revise your theory of natural speed. There are several ways to supplement or refine the theory, so that it could avoid the paradox described in the experiment. Gendler identifies what she calls four ways out, that is, four procedures the proponent of Aristotelian physics can employ to save the hypothesis that natural speed is proportional to weight.

(C1) Natural speed is not physically determined for connected bodies.
(C2) Weight is not physically determined for connected bodies.
(C3) Natural speed and weight are mediative for those connected bodies that are *united*. Natural speed and weight are additive for those connected bodies that are *unified*.
(C4) The natural speed and weight of connected bodies are determined by the rate of their connection.

Statement C1 introduces an exception in the calculation of natural speed of free falling bodies. The dependence of speed on weight only concerns individual bodies. If two bodies are connected, their resulting speed is not determined by the relation. The scope of the given physical theory is limited here – the Aristotelian theory is valid, but only for unconnected bodies. When they are connected, their speed is

no longer a function of their weight. The same idea is used in C2, but the relation in question changes there not due to a change in the speed of the fall after the connection, but because the connection affects the calculation of the total weight. Both cases offer the Aristotelian a solution to the paradox. The key idea of Gendler's critique is that while the proposed solutions are acceptable in the context of the straightforward argument, they are illegitimate in the context of the thought experiment. When we conduct the thought experiment, we simply ignore the ways out. When we evaluate the straightforward argument, we cannot reject the exception in the same way.

The same critical procedure is used in the remaining two ways out. C3 introduces a new distinction in the category of connected bodies. Unified bodies are such that they retain their identity after the connection, that is, there are still two distinct bodies. The process of uniting bodies is, however, a process resulting in a single object. The bodies in Galileo's experiment are merely unified, which affects the calculation of the resulting weight; it is mediative in that case. C4 assumes that the rate of connection of the falling bodies is a relevant physical property and that it determines the dependence of their speed on their weight.

Some of the proposed ways out are relatively sophisticated. Others are based on a robust change in the view of how nature operates. The particular character of the ways out is, however, not essential for the critique of eliminativism. The point of the presented ways out is to demonstrate the idea that the Aristotelian has, in principle, a number of ways to save his theory. While the thought experiment reduces the number beforehand, the straightforward argument does not.

### 3.1 How to block the ways out?

According to Gendler, the above stated ways out are rejected prima facie when conducting the thought experiment. It is possible to block the ways out with some effort even in the argumentative reconstruction. Additional premises are required, though. The first two ways can be blocked by adding premise

(D1) Natural speed and weight are physically determined.

This premise states a fundamental principle that the weight and natural speed of connected bodies are quantities fully determined within the physical domain. The formula excludes any extra-physical factors.

The connection of simple bodies does not affect the calculation of the resulting weight or speed.

The third and fourth ways out are blocked by an additional premise stating what is not part of the physical domain:

(D2) Entification is not physically determined.

That is, the division of a system into individual objects is not one of the fundamental principles of physics. It is up to us how many objects we identify in a given system; it is a matter of a decision whether we consider a system to be a single body or several distinct bodies. The number of objects, bodies, or things is not firmly determined by any physical properties. It is a matter of our point of view. The distinction between unified and united bodies in C3 is then arbitrary and has no effect on the physical theory. Neither is the rate of connection, the key term in C4, a physically determined property. It is merely a matter of how we describe the system.

The straightforward argumentative reconstruction can, thus, close some ways out of the paradox of the Aristotelian conception too, and maneuver the Aristotelian towards a better theory. The point is that what the imaginary scenario achieves without effort the reconstruction can only do by means of complicated metaphysical principles that represent our ideas about the operation of the physical world. According to Gendler, the additional premises are not a matter of course. Their explication in the argumentative reconstruction is a process different from the process of their acceptance in the thought experiment. Gendler says that part of the contemplation of the experiment is a survey of the possibilities for solving the paradox, and some of the possibilities are already rejected in the course of the experiment. The reconstruction achieves the same goal in a more complex way and with additional and controversial premises only. Gendler's argumentation can be summarized as follows:

[Argument D: Gendler's argument against eliminativism]

(i) Some objections are refuted when conducting the thought experiment.

(ii) The same result can only be achieved in the argument by adding premises.

(iii) Thus, the argument and the experiment differ in the way they refute objections.

(iv) Thus, there is an epistemological difference between the argument and the experiment.

## 4 Reconstruction: a diagram

In the following sections, I will defend the eliminativist position against the above objection. Norton's own response is relatively brief. Argument must be able to provide the same results as thought experiment. Otherwise, it would be impossible to consider a thought experiment as a reliable cognitive procedure. Norton creates a dilemma for enthusiasts: either argument is as potent as experiment, which means that a thought experiment might be epistemologically reliable – or experiment provides something more, which however goes beyond its epistemological reliability. Either a thought experiment is a source of new knowledge and therefore it is not epistemologically unique, or it is unique and therefore cannot be source of new knowledge.

Particular details of the scenario may enable us to obtain beliefs that we could not obtain by means of the argumentative reconstruction, or that we could only obtain indirectly. However, that does not mean that beliefs obtained that way are also justified by that process. While Norton's strategy relies on a reliabilist condition of epistemic justification at one horn of the dilemma, I will attempt to present a different view. I will face the objection directly, that is, I will question the view that thought experiments are unique sources of knowledge. I will also show that the conclusion Gendler reaches in her work results from the wrong argumentative reconstruction of Galileo's experiment.

The core of Gender's critique of eliminativism is the objection that the recipient obtains a belief in a thought experiment that she may not obtain in a straightforward argumentative reconstruction. There is no doubt about that, since the information presented in the form of a thought experiment is easier to grasp than when in the form of a straightforward argument. Experiments no doubt make obtaining new information easier and their didactic value is beyond dispute. We commonly and successfully use thought experiments in this way. The question is whether the obvious difference in reception is only caused by the individual intellectual abilities of the audience, or whether a contributing factor is that there is an epistemic difference between

thought experiments and their argumentative reconstructions. Gendler attempts to show that beliefs obtained by means of a thought experiment cannot be obtained by means of a straightforward argument with the same initial conditions; particularly, some ways out are unacceptable. Using stronger analytic tools, I will show that the ways out are as blocked in the argumentative reconstruction of Galileo's example as they are in the thought experiment. The difference in recep-

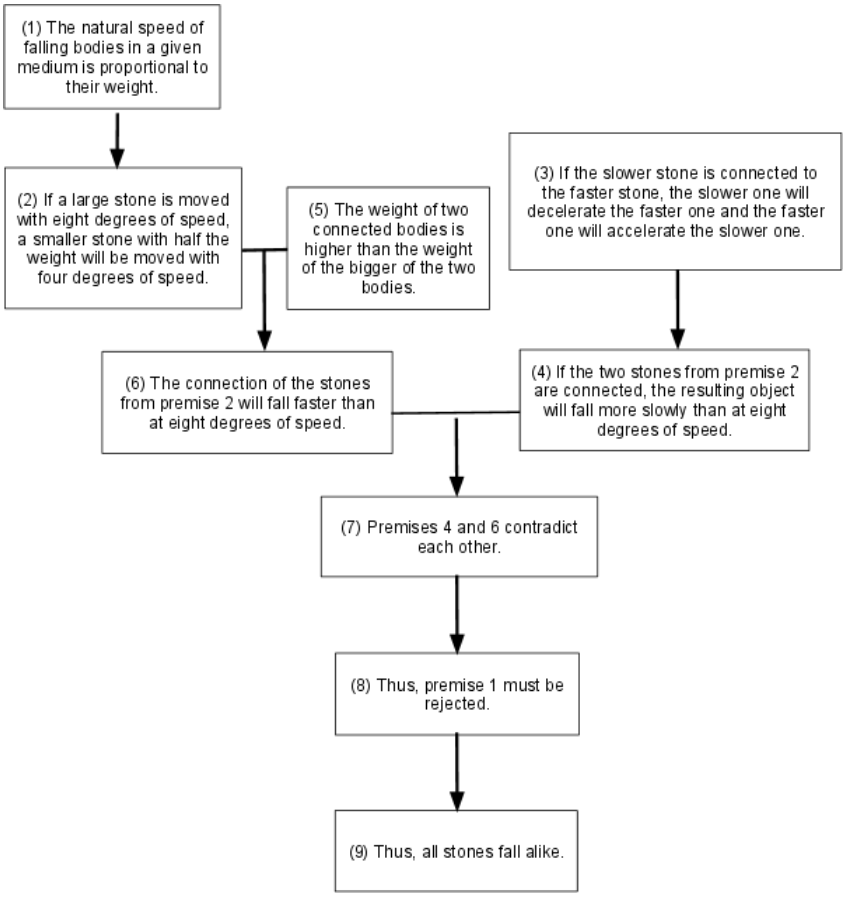


Diagram 1: Brown's reconstruction

tion is not caused by an epistemic difference, but a rhetorical one – we tend to overlook some aspects simply because our attention is focused on other aspects.

My defense of eliminativism against the 'Galilean' attack is based on the rejection of premise ii in argument D. I claim that the straightforward argument reaches the same goal even without additional premises. The ways out are blocked in the argument by the same procedure as in the thought experiment and no controversial, general or questionably justified metaphysical premises are needed. I will proceed as follows: I will present and comment on some models of argumentative reconstructions for Galileo's experiment in this chapter. First, I will present a diagram of Brown's reconstruction as a starting point of the polemic. Then, I will present a concise model of Gendler's. Finally, I will propose my own reconstruction, in which I will employ some basic concepts of the Toulmin model to show that the straightforward argumentative reconstruction can block the ways out.

The polemic between eliminativists and their critics over Galileo's example proceeds by means of an unstructured list of premises and conclusions. To highlight the relationship between the elements, I will first write the reconstructions in the form of diagrams. Diagram 1 shows the relationship of the statements in argument A, i.e. the Brown reconstruction that opened the debate.

Diagram 1 takes the statements from argument A. They are arranged in an inferential tree. The reconstruction contains the problematic conclusion 9, discussed in detail above. The major problem concerns particular premises 2, 4, and 6. The subject of controversy between eliminativists and the rest of the world is the particular details in the scenario of the thought experiment. Eliminativists claim that, without the details, the experiment has the same epistemic power as with them. Such a claim cannot obviously be tested if we compare an experiment with particular premises with an argument with particular premises. We have seen that Brown formulated his reconstruction for the purposes of a different critical strategy, and that is probably the reason why it does not meet our demands. For our purposes it must be rid of the particular premises, which I will attempt to do in my own reconstruction of Galileo's example below.

Let us now get back to the alternative model presented by Gendler. Her version of the straightforward reconstruction is put in argument

C. This minimalist version is trivially represented by Diagram 2. Gendler formulates premises 3 and 5 so as to emphasize their general character, skips premises 2, 4, and 6 dealing with particular characteristics of falling bodies.

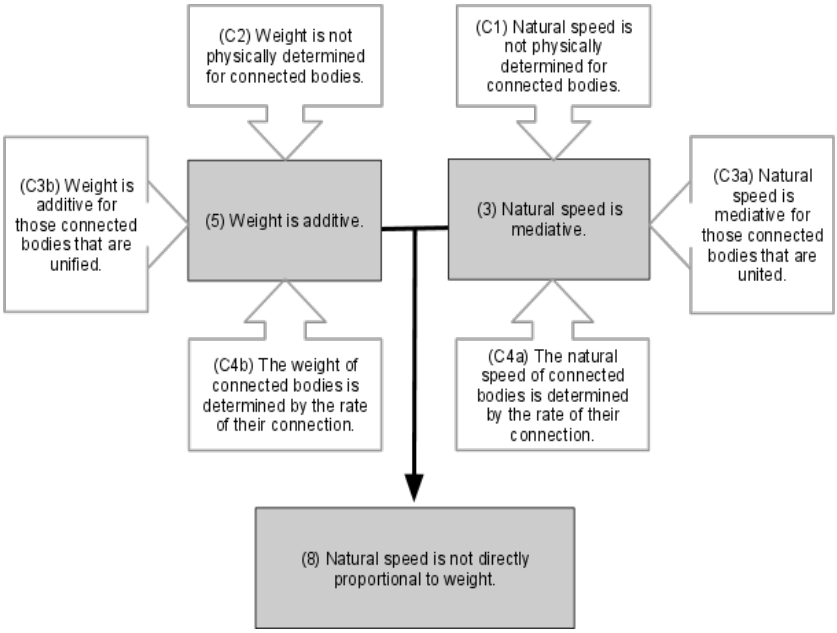


Diagram 2: Gendler's reconstruction with the ways out

The brief reconstruction is supplemented in the diagram by the ways out that Gendler opens for the Aristotelian advocate. They are types of objections that question the plausibility of the premises. The first way out C1 attacks premise 3, claiming that natural speed is not physically determined for connected bodies. It does not follow, then, that the total weight of the compound object will be higher than the weight of the heavier body taken independently. The second way out C2 states that the weight of connected bodies is not physically determined and attacks premise 5. While the first two ways out speak about speed and weight independently, that is, each quantity corresponds to one way out, the third and fourth ways describe them simultaneously. The reason for this move is not clear, as both ways can

further be broken down into two independent objections, that is, they can apply to weight and speed independently. The third way out, then, attacks premise 5 in version C3a, and premise 3 in version C3b. This yields six ways out in total. I have said that Gendler also presents two theses, two "approximate articulations of defeasible assumptions about the physical world" (Gendler 1998, 408) that block the ways out when added to the reconstruction: statement D1 asserts the physical determination of speed and weight in connected bodies, blocking C1 and C2. Statement D2 then claims the arbitrary character of the connection when calculating the resulting speed, thus blocking ways C3a, C3b, C4a, C4b.

I do not think the proposed reconstruction is suitable for two reasons. First, Gendler does not consider the Aristotelian premise 1. The plausibility of Galileo's example is, besides the unproblematic requisites, mainly based on its form: it is a reductio ad absurdum, that is, a mode of argumentation in which the premises lead to a contradiction. A strong point from Galileo's example is that the initial premise is the Aristotelian thesis, that is, the opponent's premise, whose plausibility need not be defended against the Aristotelian. The opponent cannot question its plausibility, which prevents a potential dispute about the matters of fact. Gendler instead reconstructs the thought experiment as an argument based on mathematical reasoning about the relation of two functions with different graphs. The conclusion of the argument is then claimed to be inconsistent with the Aristotelian principle.

Second, the formulation of premises 3 and 5 is deliberately too brief. The concise statements and terms used give the impression of complicated, controversial claims whose intuitive plausibility can be easily refuted by the ways out. The implausibility of the ways out is based on the acceptability and cogency of the targeted premises 3 and 5. Gendler chooses formulations that decrease the intuitive plausibility. I believe Gendler has thrown the baby out with the bathwater in her generalization. The effort to create a contrast between the particular information in the experiment and the generalizations in the argument results in the fact that her reconstruction fails to contain all the elements needed to assess the argument. The possibilities of criticism for such an argument – the crucial ways out – are limited by this drawback.

The reconstruction represented in diagram 1 contains elements that it should not contain. Diagram 2 is, on the contrary, too concise. I will, therefore, present my own compromise reconstruction. What are the requirements that a successful reconstruction of Galileo's experiment should meet? First, the condition of *generalization* must be met: the reconstruction must not contain premises with particular details, as those distinguish straightforward arguments from experiments. If we want to defend the view that the absence of details does not affect the epistemic power, we must do without them, of course. The reconstruction must also be *adequate*: the straightforward argument must be an instance of the same scheme of reasoning as the thought experiment. Premises and the way the conclusion is derived from them are

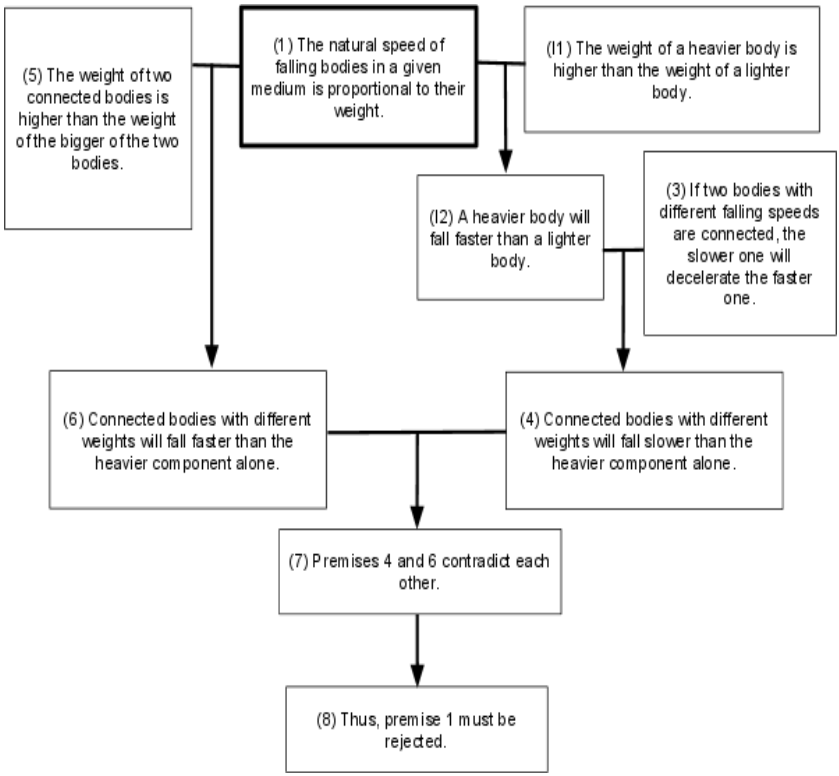


Diagram 3: A compromise reconstruction

argument identifiers. They tell us whether the straightforward argument is a reconstruction of the thought experiment or whether it is a different, independent argument. Third, there is a condition of *plausibility*: the reconstruction must work with premises whose plausibility, which is responsible for blocking the ways out, is the same as the plausibility of the relevant premises of the thought experiment. Gendler, of course, believes that the third condition (plausibility) cannot be met due to the first condition (generalization). The plausibility of the generally stated premises in her minimal reconstruction is really incomparable with the plausibility of the particular premises of the experiment. Could we perhaps find statements that are both general and plausible?

Diagram 3 offers such a reconstruction of Galileo's example. The condition of generalization is met**:** the argument does not contain any premises giving particular weights and speeds of bodies. It does not mention stones weighing so and so much, falling at such and such speed. It only mentions a heavier and a lighter body, a connection of such bodies, and their relative weights and speeds. The adequacy condition is met as well, the reductio ad absurdum is clear: the Aristotelian assumption is present at the beginning of both argument branches. Its role in both branches is the same – it is a rule that, when combined with the identification of object weight, determines its natural speed. The reconstruction contains two sub-arguments that lead to incompatible results from a common premise. In one branch, the Aristotelian principle of natural speed is applied to bodies before connection. In the other, it is applied to them after their connection. The satisfaction of the third condition will be demonstrated using the Toulmin model of argument in the following subsection.

### 4.1 Reconstruction: a functional analysis

The diagrams presented above may be clearer than a simple list of premises and conclusions – they even contain additional information about the relations between the individual premises – but they still do not exhaust everything that can be represented in a reconstruction. For a further analysis, I will use a stronger analytic tool – the Toulmin model – which can represent a characteristic that I consider crucial to the refutation of Gendler's critique. I repeat that the core of Gendler's critique is the assertion that the straightforward argument does not

lead to the conclusion in the same way as the thought experiment. Gendler believes that the argument cannot only be refuted by denying the Aristotelian principle, but by other means as well. Also, the denial of the principle has no privileged status in the argument. The reason for that is that while we accept certain premises in conducting the thought experiment, these are subject to independent evaluation in the argument. In particular, the ways out identified above are prima facie blocked in the thought experiment, but we need additional non-trivial premises to block them in the argument.

Using the Toulmin model, I will attempt to show that the alleged difference between the experiment and its reconstruction does not exist, that is, the ways out are equally blocked in both versions. The Toulmin model distinguishes premises on the basis of their argumentative function. The simplest model uses two types: data and warrants. Data are statements that indicate "*facts and present them as the foundation upon which our claim is based*" (Toulmin 1958, 90). It is the kind of premises that provide the needed construction material to support the conclusion, that is, they provide the initial information about facts, events, individuals and other things. The data of a given argument represent the initial points of support. Toulmin characterizes them by the question *What have you got to go on?* Warrants are statements that say how the data is connected with the conclusion. They describe the steps needed for the data to support the conclusion. A warrant does not offer additional factual information or additional evidence. It shows how the factual information argumentatively relates to the conclusion. Toulmin characterizes warrants by means of the question *How do you get there?* The warrant is sometimes described as an inferential license that relates the data to the conclusion. For clarity, here is an example of an argument with obvious functions for the premises:

[a datum] Peter is a librarian – [the warrant] Librarians can read – [the conclusion] Peter can read.

Doubts have been expressed about some aspects of the Toulmin model, even at this elementary level. Some critics[12] point out that the

[12] See, for instance, Freeman (1991, 51) or Eemeren – Grootendorst – Kruiger (1984, 205).

criteria of identification of data and warrants are rather vague. In everyday argumentation, it is sometimes difficult to distinguish which statements are facts and which concern the way that the facts relate to the conclusion. It may not be always clear whether the critic of an argument requires the addition of data, or whether she is trying to identify the warrant that justifies the move from the data to the conclusion. How are the categories to be applied in arguments whose premises do not concern facts, such as hypothetical syllogisms? Toulmin was aware of some vagueness in the definition of data and warrants, and admitted that there were situations in which it was impossible to determine the function of a statement uniquely. He stressed, though, that his objective was not to provide precise terminology and demarcation, but to show that it was possible to categorize the premises of an argument very well in some contexts and use the categorization in the analysis of a dispute. I need not defend the universal character of the Toulmin model here. I need not presuppose that the function of a statement in an argument is always clear. It is sufficient for my purposes to accept the central idea of the Toulmin model, that is, the idea that at least in some contexts the premises can have different functions relatively to the conclusion and can either provide facts or relate the facts to the conclusion. Using Toulmin's functional distinction, I propose to model the compromise reconstruction in Diagram 4.

The diagram represents both branches of the argument. Its conclusion, which states the incompatibility of 4 and 6, is not important for our purposes. The argument keeps the form of a reductio ad absurdum in which the initial accepted premise is the Aristotelian premise 1. That premise leads to incompatible conclusions after the application of two different principles. The argument contains an implicit, analytically true principle I1, which leads to the intermediate conclusion I2 in combination with 1. Premises 3 and 5 are presented as warrants that are prima facie plausible. After a more careful consideration it can, of course, turn out that the premises are false and the argument is unsound, but the same holds for the thought experiment. Premises 3 and 5 are as fallible as the particular premises of the thought experiment.

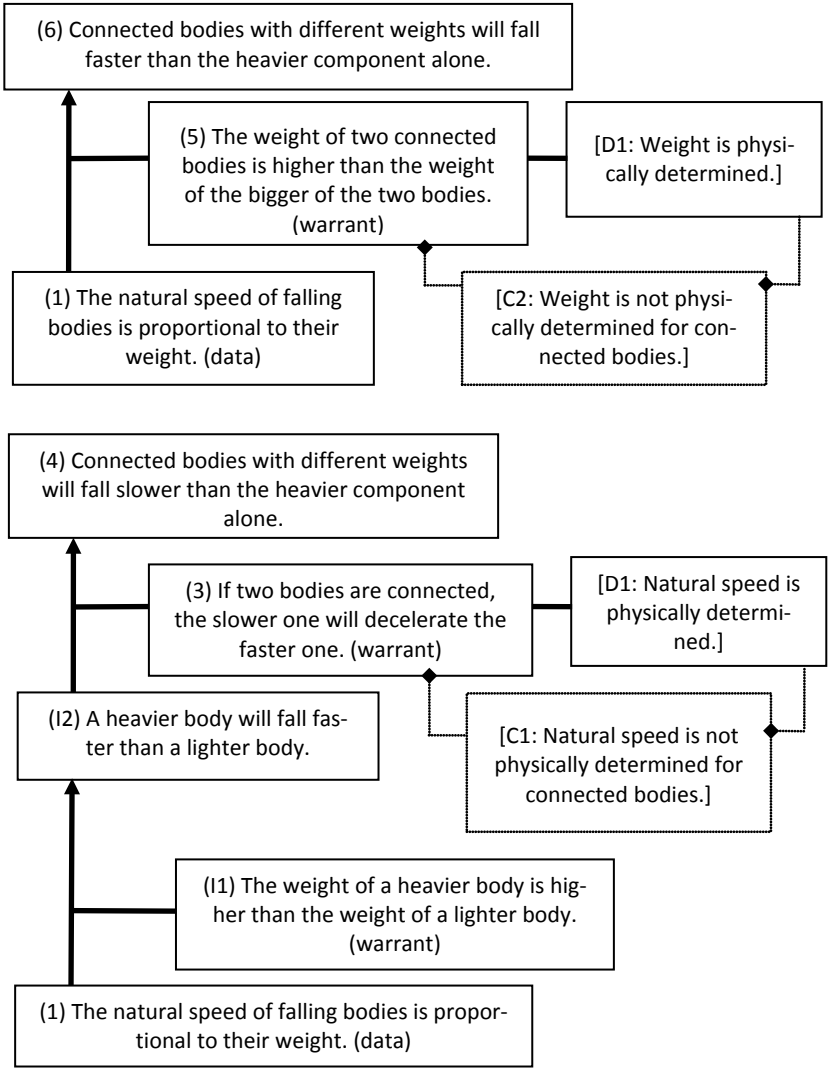


Diagram 4: A partial Toulmin model of Galileo's example

I have also included the metaphysical thesis D1 in the model. What is its argumentative function? One of the distinguishing properties of

the warrant, according to Toulmin, is that it is usually supported by another statement that he calls the backing.[13] Its purpose is to define the conditions for the application of the warrant. The backing in my argument is represented by the two general metaphysical theses D1 and D2, whose role in the argumentative reconstruction is to block the ways out. Both theses define the conditions for the application of warrants 3 and 5: thesis D1 says that the principles apply invariably and there is no exception for unified objects; thesis D2 says there is no exception with respect to the rate of unification of objects.

I reconstruct the metaphysical theses D1 and D2 as premises of sub-arguments whose conclusions are warrants 3 and 5. Functionally, they are the backing and their role is to support and determine the conditions of validity of the relevant warrants. Explicit statement of these supplementary premises/backings/theses may lead to the refutation of some objections. In particular, the explication of D1 leads to the refutation of objections C1 and C2, and similarly for D2, which blocks the remaining ways out.

### 4.2 Support vs. justification

I repeat the essence of Gendler's argument. Explicitly stated metaphysical theses are not part of the thought experiment in Galileo's example, simply because they are not needed. The straightforward reconstruction must, however, rely on some warrant backing due to possible objections, and, as a result, controversial metaphysical theses are added to the reconstruction. My objection to Gendler's argument is that she incorrectly identifies argumentative function with epistemological function. The metaphysical theses surely have argumentative function. Being the backing, they support the warrants and offer reasons to accept them. That does not mean that the theses give the actual reasons why the warrants are accepted. The fact that X is a reason for accepting Y in the argumentative sense does not mean that Y has been accepted for reason X in the epistemic sense.

Let me illustrate the point. How did you learn about the Pythagorean Theorem? I assume you were told by your parents or teachers when you were young. Suppose you accepted the belief on the basis of the testimony of a reliable source. It was only later that you were intro-

13 Toulmin (1958, 91-92).

duced to the rules of mathematical proof that helped you demonstrate the premises that the Pythagorean Theorem depends on and the way it can be deduced from them. In the epistemic sense, the main reason for accepting the theorem is the authority of the testimony. The plausibility is further increased later by the deduction. The deduction is not the main epistemic reason for accepting the theorem; the theorem is accepted on the basis of another epistemically valid procedure. The same holds for beliefs about the physical world. We find out about the existence of regularities in the world by means of our senses. But we accept the existence of physical laws either on the basis of our own reasoning or on the basis of a testimonial. Sometimes we are able to deduce the laws from basic premises, sometimes not. But the point is that deduction is not the only or the primary means of obtaining and justifying beliefs.

By explicating D1 and D2, Gendler has shown a good way to deduce the key principles from general premises. However, it is only one of the ways that the principles can be epistemically justified. I believe that principles 3 and 5 are actually obtained by a different method: induction. We derive, generalize, accept and, if needed, explicate the principles on the basis of our experience with the operation of the world and the behavior of various objects under various circumstances. We accept principles 3 and 5 not because we have deduced them from general premises, but because we derived them from particular situations in early childhood. We repeatedly observed an increase in weight after adding one weight to another. We repeatedly felt deceleration when we held the hand of a slower runner. That is why we obtained the beliefs that two things weigh more than one of them and that the resulting speed of connected objects will be slower than the speed of the faster one of them. When we evaluate Galileo's thought experiment and its argumentative reconstruction, we assume the truth of these beliefs and do not question their prima facie plausibility. If these warrants are attacked, we can, secunda facie, support them by some backing: we can refer to general and common experience with the behavior of bodies or offer a type of derivation from some more general premises. None of the ways of backing are necessarily related to thought experiments or straightforward arguments.

I claim that metaphysical theses D1 and D2 provide argumentative support for the warrants, but do not correspond to the process of their

epistemic justification. The theses are not the reasons why the warrants are prima facie accepted, nor are they needed to refute the ways out. They only become relevant if we want to refute the ways out by a special method, namely by a deductive relation of the attacked warrants to elementary metaphysical premises.

### 4.3 Details

The analysis has shown which premises are presented as starting points in the argument and what their functions are. Finally, we must answer the question of the role of the particular details. According to Gendler, they are responsible for blocking the ways out, that is, they have an argumentative function. The given statements provide the backing due to which some objections are refuted. There is a relation of argumentative support between the statements and the warrants and a reconstruction without them would be incomplete. The support of the warrants would not be fully expressed without the particular premises, as the argument would be open to some objections, unlike the thought experiment.

Is the role of the particular statements in Galileo's experiment really as Gendler claims? Is there a relation of support between the particular statements and the warrants that needs to be included in the reconstruction? I do not think so. The particular statements serve a different function; their task is not to persuade us about the validity of a general principle, but to help us understand it. It is a difference in the interpretation of the argumentative role of a particular example, which Perelman and Olbrechts-Tyteca call a difference between an *example* and an *illustration*.[14] An example is a way of using a case in which the particular statement is meant as a reason for generalization. A particular statement that is an example thus precedes generalization; a general statement is obtained only from a particular example. An illustration is a different way of using a particular case – a general statement is not derived in it, but it is presupposed. Perelman and Olbrechts-Tyteca describe illustration as a particular case whose role is "*to strengthen adherence to a known and accepted rule*". An illustration, according to them, "*clarifies a general statement, shows the import of this*

[14] Pereman – Olbrechts-Tyteca (1958, 350 and further).

*statement by calling attention to its various possible applications, and increases its presence to consciousness*".

The difference between an example and an illustration is analogical to the difference between an argument and an explanation. The latter difference is also characterized by the dialectical status of a thesis. While the thesis of an argument (conclusion) is a point of dispute and must be supported, the thesis of an explanation (explanandum) is accepted by the parties concerned and is not in itself controversial. It is not always easy to determine whether a given statement is meant as an argument or an explanation. Neither is it always clear whether a particular statement is presented to derive a generalization or to illuminate a generalization that has already been introduced. However, this distinction is important for the evaluation. An unsuccessful example means that the proponent has failed to support her thesis and the audience has no reason to accept it; there is, thus, a dialectical consequence. An unsuccessful illustration means that the proponent has failed to strengthen a thesis that the audience has already accepted; the consequence is rhetorical.

Walton[15] describes the scheme of an argument based on example as follows: *An individual has the property P and the property Q in a particular case. Thus, it is generally true that if x has P, x also has Q.* He identifies five questions the answers to which are needed for the quality of the argument. One of the questions is: Does the cited example support the generalization, or is it an instance of it? The answer to this question is essential to distinguish whether a particular case is meant as an example or whether it is an illustration. Let us return to Galileo's thought experiment. The particular statements in his example are not meant to persuade us that natural speed is mediative and that the weight of the whole is higher than the weight of its parts. These principles are deeply rooted in our understanding of the physical operation of the world and we need not be persuaded by them. The particular statements help us understand that these general and accepted principles of the movement and weight of bodies *also apply to free fall*, and, therefore, are not compatible with another relevant Aristotelian assumption. Thus, I claim that the particular details are used as illustrations in the thought experiment.

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15 Walton (2008, 314).

The stones of particular weight falling at particular speed in Galileo's thought experiment are presented as situations instantiating general principles regarding their combined weight and speed that have already been accepted. The goal of the particular example is to point out that the inductively obtained principles are valid even in cases of objects falling freely. The particular premises do not support the plausibility of warrants 3 and 5 argumentatively, and, thus, have no epistemic power. The generalization of Galileo's thought experiment, therefore, has no effect on its epistemic value.

## 5 Conclusion

Gendler describes the crucial place in the polemic about eliminativism as follows:

> Contemplation of the case Galileo describes *brings him* [the proponent of Aristotelian physics, MP's note] *to see* that these principles are not defeated in *this* case. And it is this recognition that serves as the basis for the case's power. No austere argumentative reconstruction will be able to do this, because part of the thought experiment's function is to bring the Aristotelian to accept certain *premises*. (Gendler 1998, 408)

The experiment with particular details, in her opinion, makes the recipient accept certain principles and thus excludes some possibilities for criticism. The straightforward argument does not enable this and all possibilities are open if they are not blocked by further, controversial premises. I have shown that this opinion is based on an inadequate reconstruction of Galileo's thought experiment. The alleged difference between the experiment and the argument is illusory. The reconstruction offered by Gendler contains principles that are formulated very generally and that are most plausibly justified by deductive relations to even more general and problematic premises. This illusion disappears in my reconstruction. I have based the straightforward argumentative reconstruction of the experiment on general but highly plausible principles where the ways out are blocked with the same strength as in their imaginary particular counterparts. The key premises are as plausible as the key premises of the thought experiment, that is, the argumentative reconstruction makes the recipient accept the premises as much as the thought experiment. Their justification is based on inductive generalizations of past experience.

Enthusiasts believe that the particular details in the interpretation of Galileo's experiment have an argumentative value. The particular case is seen as an example that supports the validity of the general principles. This interpretation is, however, not adequate in the context of Galileo's example. It is more plausible to interpret the particular details as illustrations. That way their argumentative relation to the general premises, which is a necessary condition for an epistemic relation, disappears. The particular details then cannot have an epistemic function as they lack an argumentative function.

Gendler claims that the principles in the thought experiment are validated by the particular cases. I have presented evidence that the principles have already been accepted on inductive grounds, their validity is assumed and their point is merely illustrated by the particular examples. In my argumentative analysis I have drawn attention to three mistakes that Gendler makes when criticizing eliminativism: (#1) her demands in the generalization of the thought experiment are too high; (#2) she incorrectly identifies argumentative support of the premises with their epistemic support; (#3) she incorrectly identifies the argumentative function of the particular cases.

Finally, I would like to state more precisely the goal of this paper. It is to defend eliminativism against the criticism relying on Galileo's great thought experiment. I have tried to show that this particular experiment can be reconstructed without a loss of epistemological value, which is directly opposed to enthusiasm. I do not claim, though, that *all* thought experiments can be reconstructed without such a loss.

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