# Thought Experiments: Their Structure and Function[1]

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## 1. Introduction

Many philosophers agree that thought experiments play an important role in *analytic philosophy* (at least). Thought experiments are supposed to display somehow the force of the imagination in philosophical (and scientific) thinking. The conclusions reached in thought experiments are usually taken as evidence for or against certain thesis or theory (cf., e.g., Williamson 2007, chap. 6; Machery 2011, 191-192). Although there are concerns about the epistemic reliability of thought experiments in general, they nevertheless occur in philosophical (as well as scientific) literature.[2]

In what follows, I try to elaborate basic ideas of Cooper (2005) into a more complex account of thought experiments, as both, methods and products. I employ the discourse of possibility and necessity (of different kinds) to distinguish *aims* and *characteristics of philosophical* and *scientific thought experiments*. However, to introduce the topic of my paper, I, firstly, present several examples of philosophical and scientific thought experiments; then I briefly discuss the most established accounts of thought experiments in the literature. I try to show how some of the characteristics found in these (conflicting) conceptions can be implemented (meaningfully) into my account.

I conclude with answering some of the epistemic issues of thought experiments.

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[2] Sorensen (1992, chap. 2) discusses many sceptical objections to thought experiments. Bunzl (1996) argues for a limited version of scepticism aimed at showing that the goal of thought experiments is to produce knowledge.

**2. Examples**

There is no agreed upon account of thought experiments, of their function or epistemic status. However, there seems to be clear agreement on cases which are taken to be instances of (the category of) thought experiments. Thus, in our situation it is convenient to commence with some of the classic examples of thoughts experiments. They display many characteristics, some of which different accounts try to cope with as (ir)relevant for their nature.

I come with both kinds of thought experiments: *philosophical* as well as *scientific*:

a) Galileo on falling bodies

Let us assume – as Aristotle held – that heavier bodies fall faster than lighter ones, that is, for any bodies H and L, if H is heavier than L then H falls faster than L. Now imagine than H is a canon ball and L is a light musket ball and both are conjoined by a cord (to form a body H+L). What would happen if they were released from a certain height? Would H+L fall faster than H alone?

According to the assumption that heavier bodies fall faster than lighter ones it would seemed that a composite body H+L is heavier and, hence, faster than object H alone. On the other hand, the same assumption seems to support the view that the lighter object L, when conjoined with object H, will retard body H, and thus the resulting speed will be slower than that of H itself. Therefore, Aristotle's view that heavier bodies fall faster than lighter ones leads to contradiction. Galileo's conclusion is that both objects fall at the same speed (acceleration) – cf., e.g., Brown 2004, 24-25; 2011, chap. 1; Daly 2010; 102-103).

b) Galileo on the law of equal heights

We assume that the law of equal heights holds, that is, that a ball rolled along a double inclined plane (as in Figure 1a) will recover its original height. Now suppose that one side of the double inclined plane is progressively lengthened (Figure 1b) so that the ball must travel still farther to reach its original height. Finally, imagine that we lengthened the plane to infinity (Figure 1c). Then the ball will travel on such a plane forever in a straight line (cf., e.g., Sorensen 1992, 8-9).

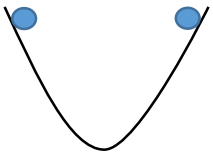

Figure 1a

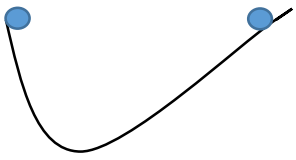

Figure 1b

Figure 1c

c) Searle's Chinese room

Imagine that you are in a room with two slots – one for seeing inputs and other for sending outputs. Let's say you have to carry out a program for answering questions in a language you do not understand, e.g., such as Chinese. You have a program rule book inside your room which specifies which operations to take when certain input symbols come in. The operations transform certain input symbols of Chinese into some output symbols of Chinese. After carrying out the operations, you have to display the output symbols to those standing outside the room. It may seem to those outside the room that you master Chinese quite well. However you know that you manipulate Chinese symbols without understanding them. Then, in that situation, you are like a computer implementing a program for answering questions in Chinese without understanding anything of the symbols you manipulate with (cf. Searle 1997, 11; or Daly 2010, 104).

d) Thomson's Violinist

Judith J. Thomson comes with this imaginary case. Suppose you wake up in the morning and find yourself to be wired up to a person who happens to be a famous violinist. He has a fatal kidney failure. There are some members of the Society of Music Lovers who kidnapped you for they found your blood type is just the right one and your kidneys can be used to filter violinist' blood as well as yours. Moreover, a doctor tells you that he's sorry for your situation but to unplug you would kill the violinist. The good news is that after nine months of being plugged to your circulation the violinist will fully recover and you will be unplugged, then. Now, Thomson asks, do you have a right to disconnect yourself from the violinist? And isn't such a situation similar to that of a woman becoming pregnant after rape? (cf. Thomson 1971, 48-49; or Cohen 2005, 86-88)

e) Gettier's cases

According to the standard analysis of (the concept of) knowledge, knowledge is identical to justified true belief. Suppose I tell you that the only pizza I ever baked was a total failure. Now, imagine that from that information you infer that I've never baked a tasteful pizza. In fact, what you inferred is true – I've never baked a tasteful pizza. You reached a true belief which is justified by what I said to you before. However, I had never baked a pizza. So you inferred your true belief from a false assumption. Hence, do you really know that I've never baked a tasteful pizza? (This case is a true variation of Williamson's own example which in turn is a variation of Gettier's case. See Gettier 1963; and Williamson 2007, 192).

## 3. Theories of Thought Experiments

There are many more interesting pieces of thought experiments found both, in science and philosophy (see, e.g., Brown 2011; or Norton 1996 for more scientific thought experiments; and Cohen 2005 for examples of philosophical thought experiments). Nonetheless, the cases presented in the former section present a sufficient background for our upcoming considerations.

What do these thought experiments have in common? What is their nature? To answer such questions bounds to presenting a certain conception of what thought experiments are. Indeed, we can find various different views on thought experiments in literature. This section provides a brief overview of those most discussed.

### *3.1. Kuhn's account*

Thomas S. Kuhn in his paper *A Function of Thought Experiments* (see Kuhn 1977) views thought experiments as certain memory devices. They represent situations which have been found in the process of inquiry as anomalies to the established knowledge, but meanwhile have been ignored. They are supposed to be triggers of previously reflected scenarios which have been temporarily put aside. Note here that the thought-experiment talk presupposes an acceptance of Kuhn's broader view of science, including notions of normal science, anomalies, etc.

Moreover, Kuhn's view is confined to the domain of scientific thought experiments. In that domain, however, the role of thought experiments is modest one. It is not in their power to disconfirm or confirm certain theoretical thesis. They are just means of remembering that the established systematizations have some unresolved problems. On the other hand, in Kuhn's account it is easy to explain how it is possible to attain knowledge through imagination: all there is in thought experiment is remembered knowledge from certain previously experienced situation (cf. Cooper 2005, 331).

Leaving aside the cases of philosophical thought experiments, it is difficult on Kuhn's account to make sense, for instance, of Galileo's thought experiment on the law of equal heights. This thought experiment had been far from being just a memory device for someone working in an 'aristotelian paradigm'. For Galileo, it didn't represent an anomaly. Rather the scenario presented in this experiment became a lucid evidence for taking seriously the idea expressed later as Newton's first law of motion (cf. Sorensen 1992, 9).

To conclude: Kuhn's account highlights one of the didactic functions of thought experiments. However, it is neither necessary, nor sufficient characteristic of what makes anything a thought experiment. *Pace* Kuhn, it is not his aim to come up with such a general theory.

*3.2. Brown's Platonism*

James R. Brown's conception of thought experiments, elaborated in Brown (2004; 2006; 2011), is (again) limited to science cases. Brown's a priori account rests on two main assumptions: i) platonistic epistemology; and ii) the universals view of laws of nature. According to i), we 'perceive' or intuit abstract objects such as numbers, sets, universals, etc., in a similar vein as we perceive the objects of our empirical experience. It is universals as a kind of abstract objects which play an important role in Brown's conception of thought experiments. Brown holds a realistic position saying that "universals (properties and relations) have an existence of their own and like mathematical objects can be grasped by human mind" (Brown 2011, 108). And according to ii), laws of nature are relations (of necessitation) between properties. It is the theory of Dretske, Armstrong and Tooley which fits Brown's purposes. Those two assumptions make him able to demonstrate an argument of how it is possible to reach a priori knowledge of empirical world by means of thought experiments.

Brown realizes he has no definition of thought experiments to work with, but he says, "it is not important. We know them when we see them, and that's enough to make talking about them possible" (Brown 2004, 25). On the other, he make some of their common features explicit, such as:

i) they are carried out in the mind;
ii) they involve something akin to experience;
iii) (i+ii): we typically 'see' something happening in a thought experiment;
iv) there is more than mere observation in them (such as calculating, application of theory, guesswork, etc.);
v) sometimes, they contain idealizations (cf. Brown 2004, 25).

Anyhow, Brown takes thought experiments to be the devices which enable us to 'perceive' (abstractly) laws of nature, and, hence, to gain knowledge of empirical world in a priori way.

To make the machinery of Brown's conception explicit, let me reconstruct his argument as follows (cf. Brown 2004, 34):

1. We can intuit some mathematical objects.
2. Mathematical objects are abstract entities.
3. [Conclusion 1] We can (at least in principle) intuit abstract entities.
4. Laws of nature are abstract entities.
5. [Conclusion 2] We might be able (at least in principle) to intuit laws of nature as well.
6. We seem to have a special access to the facts of nature in thought experiments.

7. [Conclusion 3] It is possible that thought experiments (at least in some cases) allow us to intuit laws of nature.
8. Intuitions are non-sensory perceptions of abstract entities.
9. [Conclusion 4] Intuitions give us a priori knowledge of the laws of nature.

It is interesting to note that Brown's argument uses modality ('possibility', 'in principle') to weaken some of the (partial) conclusions of his argument – such as Conclusion 2 and Conclusion 3. Let me briefly comment on some of the inferential steps of this argument.

First, the inference from 1. and 2. to 3. is valid. Moreover, if both of the premises are true, so must conclusion, too. Second, the inference from 3. and 4. to 5. is valid insofar as we formulate 3. more precisely: "We can (at least in principle) intuit *all kinds* of abstract entities". Third, to count inference from 5. and 6. to 7. as valid would require a better specification of the premises. Even granting the validity of that step, Conclusion 3 is a pretty weak statement for a theory which aims at showing that it is, *in fact*, that thought experiments allow us to intuit laws of nature. And, finally, to validly infer 9. from 7. and 8. we need such a stronger version of 7., that is, "Thought experiments (at least in some cases) allow us to intuit laws of nature."

Hence, Brown's position is that thought experiments enable us to intuit laws of nature which themselves are abstract entities; they provide us with *a priori* knowledge of nature. He makes this point vivid in his reflection on Galileo's thought experiment on falling bodies:

> The most interesting example is surely Galileo's. This seems to play a negative role – it refutes Aristotle by means of a *reductio ad absurdum* – then, in a positive vein, it establishes a new theory of motion. There are lots of wonderful thought experiments, but only a small number work in this way. Elsewhere I have called them Platonic (Brown 1991). I think they are rather remarkable – they provide us with *a priori* knowledge of nature. (Brown 2004, 30)

Brown in his (2011, 32-33) distinguishes, broadly between destructive and constructive (functions of) thought experiments. What he calls Platonic thought experiments are experiments having both of these functions. However, there are several problems with his account of how we gain knowledge in thought experimentation. Definitely, he rests silent on an epistemological mechanism underlying intuition of laws of nature. Brown realizes that and defends his conception by a counter-view that there has been no knowledge of perception-mechanisms for a long period. Thus, he does not take the absence of the theory of abstract-objects-perception (and a priori knowledge) as a real threat for his account.

Still, there is a related problem for his epistemology, which is not easy to set aside in his own conception. In fact, his division of thought experiments to (solely) destructive, (solely) constructive, and destructive-cum-constructive presupposes not only our ability to 'detect' the laws of nature (the cases of constructive and destructive-cum-constructive thought

experiments), but also the cases when something is not a law of nature (the cases of destructive and destructive-cum-constructive thought experiments). Put differently, Brown needs to explain the difference between perceiving or intuiting when such-and-such is a law of nature and when it is not.

On general ground, there is a serious explanatory gap between his conception and the platitude that our empirical experience makes indispensable contribution to what we take to be a law of nature, what is physically or nomologically possible, etc. (see, especially, criticism of Norton 2004a; 2004b).

*3.3. Norton's Argument Account*

A different account is provided by John D. Norton in several of his papers (see Norton 1991; 1996; 2004a; 2004b). Norton characterizes thought experiments as "arguments, which i) posit hypothetical or counterfactual states of affairs, and ii) invoke particulars irrelevant to the generality of the conclusion" (Norton 1991, 129). Norton acknowledges that those two are only necessary conditions for something being a thought experiment. However, he believes that such a characterization is sufficient for elucidation of the most interesting thought experiments found in physics. (Note again that Norton is focusing just on the cases of scientific thought experiments.)

In his later work, Norton generalizes his thesis and argues for the view that thought experiments are just *picturesque arguments*, either deductive or inductive (or abductive). In Norton (2004a), he tries to justify his position by the following:

> First I urge that thought experiments in science can always be reconstructed as arguments based on explicit or tacit assumptions that yield the same outcome. … If thought experiments are to teach us about the world, empiricism tells us that they can only do so by drawing on our experience of the world.
> Second, I urge that the actual conduct of a thought experiment consists of by the execution of an argument. (Norton 2004a, 1142)

Norton employs this idea to deal with what he calls *the epistemological problem of thought experiments in the sciences*. The problem stands: "Thought experiments are supposed to give us knowledge of the natural world. From where does this knowledge come?" (Norton 2004a, 1139). And the answer supplied by his account is quite straightforward: "Since I claim that thought experiments are merely picturesque arguments, my solution is that this knowledge comes from premises introduced explicitly or tacitly into the thought experiment" (Norton 2004a, 1139-1140). Moreover, he seems to be satisfied also with how good his account fares with the question of reliability. He says: "If thought experiments can be used reliably

epistemically, then they must be arguments (construed very broadly) that justify their outcomes, or reconstructible as such arguments." (1143)

However, there are some troubles with Norton's view. First, even if we accept his aim to provide just necessary conditions for something being a thought experiment, we are left with more interesting part of our endeavour – to answer "When does an argument amount to thought experiment?" Clearly, not every argument is a thought experiment. Second, assuming that thought experiments are arguments of certain type, what does it mean to say that conducting thought experiments amounts to conducting arguments? Does it mean just to derive conclusion from premises?

Third, Rachel Cooper in her (2005) notes that Norton's main reasons for identifying thought experiments with arguments is that "he has shown that some of Einstein's thought experiments can be replaced by arguments, but this demonstration is not sufficient to prove his claim." And she objects: "All Norton have shown is that Einstein's thought experiments lead to a conclusion that can also be reached via a logical argument" (Cooper 2005, 332). To play a fair game, it should be added that Norton reconstructs more than some of Einstein's imaginary experiments (see Norton 1996; 2004b).

Nevertheless, as I will try to elucidate in section 4, none of the above mentioned conceptions of thought experiments distinguishes between the methods of thought experimentation (a recipe for doing something) and the products of such methods (thought experiments). If such a distinction were accepted, we could explain that arguments can be (part of) the results of conducting some method of thought experimentation. However, arguments are relations on propositions (premises and conclusion); they do not instruct an agent to assume, accept, imagine or judge something as a case. Of course, they may arise as a result of such instructions.

### *3.4. Other approaches*

There are several other approaches coming up with a picture of what scientific or philosophical thought experiments are. For example, Sorensen (1992) presents the conception of thought experiments as the *limiting cases* of standard experiments. He defines (the concept of) *thought experiment* as follows:

> A *thought experiment* is an experiment that purports to achieve its aim without the benefit of execution. (Sorensen 1992, 205)

And, he takes experiments, in general, to be procedures for answering or raising questions about the relationship between variables. In experiments we try to manipulate the values of one or more independent variables while tracking whether there is any response on the part of the values of dependent variable(s) (cf. Sorensen 1992, 186-190). Although I'm fully

sympathetic with Sorensen's (as well as Cooper's 2005) idea that thought experiments functions as testers of modal consequences (of a theory), there are various troubles with his view.

Cooper (2005) brings two simple objections to Sorensen's account. First, the fact that real experiments involve some intervention or manipulation on material objects whereas their thought counterparts do not "is a difference … that cannot be ignored" (see Cooper 2005, 335). Moreover, Sorensen holds that thought experiments are paradoxes. But, as Cooper explains, "insofar as a thought experiment is identified with a set of propositions, however, Sorensen's account will run into the same kinds of problems as Norton's argument-based account" (Cooper 2005, 335).

Still another picture comes with Tamar S. Gendler's (2000). She seems to hold a view that there is some constructive element on the part of the thought experimenter which is reducible neither to Norton's arguments, nor to Brown's platonic laws. It is, however, unclear what such a constructive element is supposed to be.

## 4. Methods of Imagination and Their Products

As I noticed in section 3.3., none of the theories of thought experiments, which we have focused on here, distinguish between a method of thought experimentation and its product (that is, a thought experiment). The theories we have been analysing so far made implicit use of both these categories. In what follows I try to outline a general structure of, at least, some of the methods of thought experimentation and thought experiments (as their products). I employ some of the ideas discussed so far in my account. It is an open question how much diversity of thought experimentation is overlooked in my account. Ideas developed here owe much to the model-based account of Cooper (see Cooper 2005). In this section I briefly present the core of Cooper's approach. Then I clarify the difference between methods and their products. Finally, I outline the schema of what one of the methods of thought experimentation could look like.

### *4.1. Cooper's model-based account*

Rachel Cooper takes thought experiments (in a sense of method) to be "attempts to construct models of possible worlds" (Cooper 2005, 336). For her, a model is a dynamical representation of a situation, such as where falling objects are conjoined with a cord or where a stranger is wired up to a famous violinist. Propositions and pictures suit well to be such models.

As a starting point for Cooper, thought experiments present us with "what if" questions:

> For example, we may seek to discover what would happen *if* there were no friction, or what would happen *if* people split into amoebas. (Cooper 2005, 336)

In answering such questions, we try to follow some of their relevant implications and check whether they allow for constructing a coherent model of the situation we are imagining:

> Sometimes we shall have explicit laws governing how entities of the type we are imagining act in the types of situation we are imagining. …
> Sometimes the answers to the "what if" questions are provided by implicit laws that are contained in the implications of the concepts we are employing. For example, it is part of the meaning of "light" that it travels at the speed of light … (Cooper 2005, 336)

That is, answering "what if" questions relies on both, our knowledge of empirical facts (or laws of nature) and conceptual knowledge.

On Cooper's account, thought experiments make evident (or explicit) the modal implications to which we are, at least implicitly, committed. Of course, reaching such implications may result in two fundamental states: i) either thought *experimenter* is able to construct an internally consistent model, and to show that such-and-such situation is possible, or ii) she is not (cf. Cooper 2005, 338-339). Since Cooper bound this dichotomy with the capacities of thought experimenter, we better to transfer this force directly to the methods of thought experimentation. For, it makes sense to distinguish between those thought experiment-methods which result in construction of consistent models and those which do not. The former ones point to possibilities, the later ones to impossibilities.

When employing this modal talk, it is rather useful to acknowledge that we should not restrict the range of *possibility* and *impossibility* to logical meaning only. We may consider physical or nomological or moral modalities as well.

To sum up, Cooper's account take thought experiments to be (methods of) model-constructions built upon the relevant implications of our background (conceptual and/or factive) knowledge. Constructing such models produces knowledge of what is possible, impossible or necessary.

### *4.2. Is there any method of thought experimentation?*

In previous sections I mentioned that there is a difference between a method of thought experimentation and a thought experiment. However, isn't such an idea just absurd? Does it make sense to hold that there are methods of imaginary experimentation?

To answer that question, first, let me make clear in what sense I use the term "method". Method is conceived of here as a system of instructions (imperatives) specifying the steps to be followed if a certain (cognitive) goal is to be reached. In this sense, particular steps of a method,

represented normatively as instructions, embody the structure of method (for more on this construal, see Bielik – Kosterec – Zouhar 2014a; 2014b; 2014c; and 2014d).

Now, we can make sense of the question whether there is any method of thought experimentation. Although allowing for the existence of some heuristic rules, there seems to be no method of *inventing* or *discovering* thought experiments. It is a kind of event belonging to the context of discovery. There are no recipes available of how to figure out some particular thought experiment. However, after inventing or discovering a thought experiment, the inventor (discoverer) is able to instruct us what to imagine, assume, infer or judge to reach the goal of the thought experiment. In fact, the methods of thought experimentations prescribe to us what situations to deal with in our imagination. If we – as the method-users – are successful in thought experimenting, we come to a certain product – which may be a certain kind of imaginary scenario, an argument, proposition or a figure.

### *4.3. A Structure of Thought Experimentation*

The account presented here is open to incorporate multiple forms of thought experimentation or experiments. Moreover, it is supposed to cover just *some* of the methods of imagination, *not all* of them. However, I try to show that it is sufficient for making sense of many examples of scientific and philosophical thought experiments.

Let me commence with an idea which seems to be uncontroversial. It has to do with functions of thought experiments and experimentation methods. If we were asked what the function of thought experiments is, we could give an easy-going answer: 'They show what is possible or impossible.' Certainly, such a qualification refrain from some specific background system in relation to which something is possible or impossible. For example, Galileo's thought experiment on falling bodies shows (if we are successful with tracking the instructions behind its argument scenario) that it is impossible (relative to classical logic) to hold consistently the view that heavier bodies fall faster than lighter ones when released. Or consider Searle's Chinese room scenario. It functions as evidence that it is possible (relative to classical logic and our conceptual system) to manipulate the meaningful expressions conforming to the syntax of a given language without understanding what those expressions mean. And the case of Galileo's scenario with the law of equal heights shows how it is (nomologically) possible (that is, possible relative to some laws of nature and some idealization) that the ball could travel (at constant speed) to infinity.

Those examples illustrate what seems to be the function of many thought experiments. Allowing for the categories of *possibility* and *impossibility*, we can embrace *necessity* as well. In general, we agree with Cooper (see section 4.1.) that thought experiments and experimentations make some of the modal implications of our assumptions explicit. In fact, we can distinguish several levels of modal claims and their implications, such as: 1. *logically*

possible/impossible/necessary; 2. *mathematically* possible, etc.; 3. *conceptually* possible, etc.; 4. *nomologically* possible, etc.; 5. *metaphysically* possible, etc.; 6. *morally* possible, etc., and so on.[3]

Now we come to the core of our approach. First, when we look at various examples of thought experiments (for instance, from section 2), it seems clear that they operate on some background. Such a background can include many different kinds of items and those items can be specified differently. Typically, a background may contain knowledge of certain facts – either empirical, or mathematical, or conceptual, etc., or beliefs in certain possible states of affairs. It may include also values of different types – aesthetic, cognitive, moral, etc. The background also usually contains some toolbox – a set of methods of different kinds, such as deductive or inductive inferences, mathematical operations, abstraction or idealization methods, etc.[4] Some of the items are selected from the background, both, at the beginning of thought experimentation and along its conduct. For the sake of simplicity, I will divide the items of given background into two classes: the class of *objects* and the class of *methods*. In this context the class of *objects* may cover propositions (or beliefs), arguments, values, common-sense objects such as tables and bananas, or situations, events, as well as concepts. In fact, these all are items that thought experiments (as methods) operate on. On the other hand, background covers various *methods* and intellectual *tools* which are used in thought experimentation. The success or failure of many thought experiments depends on how adequately we understand and use methods required by thought experiment.

Second, it seems that there are two basic cognitive attitudes which are invoked in the methods of thought experimenting at their very beginning: *Imagine* X!, or *Assume* X!; where "X" could be some situation described, or some value generally recognized, or some proposition believed, or some argument accepted. We can be initially instructed either to imagine something, or to assume or accept something for the sake of further consideration.

Third, we usually employ some *principle P* or a *method M* from our background to derive some implications Y of X. In many examples of thought experiments the implications of X are directly accessible (for instance, due to definitions), so we do not need to make anything more than to accept (and express) them explicitly.

Fourth, we are invoked to *imagine* or *assume* X* which is the result of applying certain methods from background to the original X (in a sense that X* is a modification of X).

Then we are asked either to apply the original *P* or *M* to infer the implications Y* of X*, or to apply some other principle *P** or method *M** to figure out the implications Y* of X*.

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[3] It is not my aim here to argue for the usefulness of all of these modal levels. The point of such distinctions is to allow various discourses where thought experiments can work meaningfully.

[4] I leave for your consideration whether to accept some further constrains here. Here, it looks like we could refrain from postulating the use of some typically empirical methods such as observation or experimentation.

Finally, depending on which option obtains we are asked to make some modal qualification of *P* (*M*), or *P**(*M**) respectively. If we encounter the former case, we can say that there is some new case Y* which lies in the area of application of *P* or *M*. On the other hand, if we encounter the later case, we can conclude that *P* (or *M*) does not hold necessarily, or that *P** (or *M**) is possible.

Let us summarize this general structure of thought experimentation in the following system of instructions:

I1: Identify/be aware of the background B with its objects and methods!
I2: Imagine/assume (situation, object, proposition, etc.) X!
I3: Applying the principle P or method M (from B), express the consequences Y of X!
I4: Using some methods from B, imagine/assume X* (which is a modification of X)!
I5: Determine relative to B whether i) it is possible to apply P or M to infer consequences Y* of X*; or ii) it is necessary to apply some other principle P* or method M* (from B) to infer consequences Y* of X*!
I6: If I5i) is the case, then make the modal judgement that P (or M) is applicable to some (new) Y*; else, conclude that P (or M) does not hold (applies) necessarily or that P* (or M*) is possible.

Now, it is possible to fill this general structure of thought experimentation methods with details of, at least, one of our examples. Let us use my version of Gettier's cases. The reconstruction of this imaginary scenario would be as follows:

I1: Identify the epistemology discourse containing, beside other things, traditional analysis of knowledge!
I2: Assume, you believe that the notion of knowledge in its traditional definition holds generally (that is, it applies to any case of justified true believe)!
I3: Applying the traditional definition (or principle) of knowledge as true justified belief, you are warranted to apply the notion of knowledge whenever the notion of justified true belief applies.
I4: Now, imagine this specific scenario: I tell you that the only pizza I ever baked was a total failure! In fact, I've never baked a pizza. Suppose yet, you infer the proposition that I've never baked a tasteful pizza which is your true belief (unfortunately) justified by my false claim. So in such a situation you have a justified true belief.
I5: Now, tell me whether you would apply the notion of knowledge to such a scenario!
I6: (Assuming your answer is "No"), conclude that the notion of knowledge does not amount to the notion of justified true belief.

Finally, we can conclude that this thought experiment shows that it is not a conceptual necessity (relative to our conceptual system) that the traditional notion of knowledge is synonymous with that of justified true belief.

When beginning this section I remarked that there is a distinction between thought experimenting as a kind of method and thought experiments as products of such a kind of method. Now you can see that the satisfaction of all prescribed instructions corresponds to thought experiment as a product of thought experimenting. Moreover, it is yet clear that satisfying certain instruction may amount to identification of a proposition or an argument. There is also place for laws of nature as well as for other kinds of laws or principles (depending on a particular background). These all kinds of items may be cognitively reached or employed in certain steps of method. Hence, our approach makes sense of the specific categories from the theories here discussed.

Finally, distinguishing among the various conceivable levels of modality, we can say that philosophical thought experiments are typically concerned with logical, conceptual, metaphysical or moral modalities while scientific thought experiments deal usually with nomological modalities.

### 5. Conclusion

In this paper I've outlined a general structure of thought experiments as methods and products. I tried to implement the ideas from different competing theories. However, I completely refrained from the general epistemological concerns targeting questions of reliability of thought experiments as well as from other possible routes of modelling this kind of (scientific and philosophical) method.

## References

BIELIK, L. – KOSTEREC, M. – ZOUHAR, M. (2014a): The Model of Method (1): Method and Problem. [Originally in Slovak as "Model metódy (1): Metóda a problém"] *Filozofia* 69, No. 2, pp. 105-118.

BIELIK, L. – KOSTEREC, M. – ZOUHAR, M. (2014b): The Model of Method (2): Instruction and Imperative. [Originally in Slovak as "Model metódy (2): Inštrukcia a imperatív"] *Filozofia* 69, No. 3, pp. 197-211.

BIELIK, L. – KOSTEREC, M. – ZOUHAR, M. (2014c): The Model of Method (3): Instruction and Method. [Originally in Slovak as "Model metódy (3): Inštrukcia a metóda"] *Filozofia* 69, No. x, pp. xx-xx.

BIELIK, L. – KOSTEREC, M. – ZOUHAR, M. (2014d): The Model of Method (4): Application and Classification. [Originally in Slovak as "Model metódy (4): Aplikácia a klasifikácia"] *Filozofia* 69, No. x, pp. xx-xx.

BROWN, J. R. (2004): Why Thought Exeriments Transcend Empiricism? In: Hitchcock, Ch. (ed.): *Contemporary Debates in Philosophy of Scie*
*nce*. Blackwell-Publishing, pp. 23-43.

BROWN, J. R. (2006): The Promise and Perils of Thought Experiments. *Interchange* 37, No. 1-2, pp. 63-75.

BROWN, J. R. (2011): *The Laboratory of the Mind: Thought Experiments in the Natural Sciences*. 2nd ed. New York – London: Routledge.

BUNZL, M. (1996): The Logic of Thought Experiments. *Synthese* 106, pp. 227-240.

COHEN, M. (2005): *Wittgenstein's Beetle and Other Classic Thought Experiments*. Blackwell Publishing.

COOPER, R. (2005): Thought Experiments. *Metaphilosophy* 36, No. 3, pp. 328-347.

DALY, CH. (2010): *An Introduction to Philosophical Methods*. Broadview Press.

GENDLER, T. S. (2000): *Thought Experiment: On the Powers and Limits of Imaginary Cases*. New York – London: Routledge.

GETTIER, E. (1963): Is Justified True Belief Knowledge? *Analysis* 23, pp. 121-123.

JACKSON, F. (2009): Thought Experiments and Possibilities. *Analysis Review* 69, No. 1, pp. 100-109.

KUHN, T. (1977): A Function of Thought Experiments. In: *The Essential Tension: Selected Studies in Scientific Tradition and Change*. Chicago: University of Chicago Press, pp. 240-265.

MACHERY, E. (2011): Thought Experiments and Philosophical Knowledge. *Metaphilosophy* 42, No. 3, pp. 191-214.

NORTON, J. D. (1991): Thought Experiments in Einstein's Work. In: Horowitz – Massey: ..., 129-148.

NORTON, J. D. (1996): Are Thought Experiments Just What You Thought? *Canadian Journal of Philosophy* 26, No. 3, pp. 333-366.

NORTON, J. D. (2004a): On Thought Experiments: Is There More to the Argument? *Philosophy of Science* 71, pp. 1139-1151.

NORTON, J. D. (2004b): Why Thought Experiments Do Not Transcend Empiricism? In: Hitchcock, Ch. (ed.): *Contemporary Debates in Philosophy of Science*. Blackwell-Publishing, pp. 44-66.

SEARLE, J. R. (1997): *The Mystery of Consciousness*. A New York Review Book.

SORENSEN, R. A. (1992): *Thought Experiments*. New York – Oxford: Oxford University Press.
THOMSON, J. J. (1971): A Defence of Abortion. *Philosophy and Public Affairs* 1, No. 1, pp. 47-66.
WILLIAMSON, T. (2007): *The Philosophy of Philosophy*. Blackwell Publishing.