Introduction

I want to argue that we can dispel a puzzle springing up from the contemporary thought experiment known as the “Thomson Lamp”. The puzzle is that a very simple thought experiment can generate two diametrical views concerning the nature of the infinite, in fact, two views that contradict each other. One of these views uses the Thomson Lamp as a proof that it is logically possible to perform an infinite sequence of tasks in a finite amount of time. The other view makes use of this same thought experiment but as a proof for the thesis that it is logically impossible to perform an infinite sequence of tasks in a finite amount of time. It is puzzling that the very same thought experiment can be used as evidence in support of these two theses.

There is a temptation to try to dispel this puzzle by suggesting that either one of the thesis is false or that each thesis is about a different thing. However, given the simplicity of the thought experiment involved in this case, I found both suggestions implausible. They both entail an incredible conceptual blindness by some of the participants engaged in this philosophical debate.

In this essay I explore a different approach to this puzzle, one that is more congenial with the conceptual clarity of the philosophers taking sides in the dispute concerning the Thomson Lamp. This approach is based on a combination of two proposals about the nature of thought experiments and about the evidential role that experiments play inside theories: The first proposal is that...
thought experiments should be treated as ordinary experiments, the second, that experiments are not a sort of disguised arguments.

The conceptual virtues of austerity

Since Hermann Weyl (1949) first conjectured an infinity machine, there has been an intense discussion about their nature. These devices are different from ordinary machines in two important respects. First, they do not exist in the way in which an ordinary machine does, that is, they are conceptually possible but physically impossible. The expression "physically impossible" means here that these machines cannot be constructed given the actual physical laws of nature. Secondly, they are able to perform incredible feats related with the infinite, for example, they are capable of writing down all the integers in the decimal expansion of \( \pi \) in a finite amount of time.

In his (1954) article "Tasks and Super-tasks", James Thomson offered one of the most famous examples of these machines. Thomson's first objective was to show that the old idea that it is logically possible to perform an infinite number of tasks in a finite lapse of time, involved a contradiction. Therefore, that the logical possibility of performing an infinite number of tasks in a finite amount of time was only an illusion. His second goal was far more reaching than that, it was an attempt to prove that to perform an infinite number of tasks in an infinite lapse of time is also a logical impossibility.\(^1\)

To prove his point Thomson described one of these peculiar Tasks being performed by using an apparently ordinary reading-lamp. This lamp, like many others, has a single button that when it is pressed turns its light on or off. If the lamp is off and you press

\(^1\) Thomson went as far as to say that the very talk of Super-Tasks is senseless (1954:9). I will not discuss here this stronger contention because, as it was later rightly pointed out by Benacerraf (1962), to take this seriously will undermine Thomson's own explanatory goal of showing such Super-Tasks to be impossible. Thomson's criticism requires at least this much if his effort to show that Super-Tasks are not possible is to make any sense at all.
the button, the light turns on, and if it is on and you press the button again, it turns off. The Super-Task consisted in turning on and off this lamp an infinite number of occasions in a finite amount of time. This is how Thomson, following a suggestion by Bertrand Russell, proposes to accomplish it: make a first push in one minute, a second in half a minute, a third in a fourth of a minute, and so on, in two minutes you will have finished this Super-Task.

However, according to Thomson, even if prima facie we seem perfectly able to conceive this scenario in which the button of a lamp is pushed according to the above mentioned suggestion, the truth is that we are deceiving ourselves in thinking so, for:

After I have completed the whole infinite sequence of jabs, i.e. at the end of two minutes, is the lamp on or off? It seems impossible to answer this question. It cannot be on, because I did not ever turn it on without at once turning it off. It cannot be off, because I did in the first place turn it on, and thereafter I never turned it off without at once turning it on. But the lamp must be either on or off. This is a contradiction. (Thomson, 1954:5)

If Thomson is right in thinking that a contradiction results from the thought experiment just presented, a serious difficulty emerges for the proponents of the view that there is nothing incoherent about completing an infinite number of tasks in a finite amount of time. For, according to this tradition, only a “medical fact” stops us from performing this sort of Super-Tasks. If, indeed, the only possible answer for Thomson's question is the statement of a contradiction, then more than a medical fact is impeding us from performing them.

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2 Russell's “recipe” appears in his essay of (1935-6:143-4).
3 Among other things, this tradition tries to meet what some have thought is the main challenge of Zeno's paradoxes of motion, namely, the possibility of traversing an infinite distance in a finite time, or, to put it in the language of tasks, to complete an infinite number of tasks. See Salmon's (1970) and Grünbaum's (1967) for excellent discussions on this topic.
Before we consider the well-known reply given by Paul Benacerraf (1962) to this question, let us pause for a moment to examine the conceptual setting of the Thomson Lamp thought experiment.

Thomson's example and his ensuing challenge are both as straightforward as anything in the philosophical literature that employs thought experiments can be. The conceptual scenario is quite ordinary. Up to the moment in which the velocity of the pushings goes beyond our normal "medical" capacities the scenario is even mundane. As opposed to other popular thought experiments, this one does not start by demanding a planet with all its features identical to ours with the sole exception of the molecular composition of water, or a man locked in a room having a successful linguistic exchange in Chinese without having a clue of what he is saying. Compared to such conceptually baroque scenarios the Thomson Lamp's initial conditions have the air of triviality.

The single crucial conceptual demand from this thought experiment is the need to combine the high velocity required by the pushings with the physical composition of the materials involved in it. That is, if we are able to imagine a setting in which the actual limits of moving objects go well beyond the speed of light and if we can also stretch the known molecular properties of lamps and fingers, nothing obvious seems to preclude us from conceptually performing the experiment.

It looks as if the only requirement is to quantitatively and not qualitatively change the present constraints imposed by our physical laws. This is not so difficult. It is easy to imagine the velocity of light being double what in fact is or to conceive stronger molecular bindings than the ones we actually have.

Thomson was well aware of the advantages of having produced an unadorned thought experiment. It readily permits his audience to locate all the important features involved in a case related to a Super-Task. In fact, his question obtains all its rhetorical force precisely from this: if the setting is so simple why
can we not say right away if the lamp is on or off? The absurdity of not being able to respond to this question, he forcibly argues, is even more stunning if we try to apply another "conceptual recipe" that seems to work perfectly well in more ordinary cases. This recipe is also quite simple:

If the lamp was originally off, and you pressed the button an odd number of times, the lamp is on, and if you pressed the button an even number of times the lamp is off. (Thomson, 1954:5)

Thus, if we know the original state of the lamp—something we clearly do—we should be able to tell whether it is on or off. But, surprisingly, we can not tell. We seem to have as many reasons for saying that it is on than for saying that it is off!

For Thomson this is logically unacceptable: if we have the same reasons to think that the lamp is on as for thinking that it is off, something is logically flawed with those reasons. It is here where Thomson thinks that he has proved something interesting with his example. For Thomson, the reason why we cannot answer his question without running into a contradiction is that the conceived state of affairs in fact is inconceivable. We have been deceived by our imagination and by our desire to "experience the infinite", end of the story. Unfortunately for Thomson's objectives this was actually the beginning of a long story, one that curiously enough contains a single consensus: that it was Thomson who made a logical mistake in inferring a contradiction where there was nothing of the sort to be inferred.4

For our purposes, however, one should notice how most of the intuitions involved in the Thomson Lamp are triggered by the austerity of the thought experiment. It is because of its simplicity that a problem like the conceivability of Super-Tasks presents itself as a paradigmatic philosophical problem. Since the imagined Super-Task is apparently only a quantitative extension of a more ordinary task, the same criteria of understanding and prediction

4 Thomson himself has accepted his mistake, see his (1970).
should be applied in both cases. The problem is that once we apply this criteria we are faced with a strange epistemic impasse absent in the normal case. It is hard to explain why this occurs. Even a philosopher like Alfred Grünbaum, one of Thomson's strictest critics, recognizes his perplexity about not being able to say what the state of the lamp is at the end of the Super-Task:

I must acknowledge [that] ... The Thomson process appears unresolvedly problematical to me in regard to the question "What is the state of the lamp at time t1?" (Grünbaum, 1967:94)

In what follows I will not try to answer Thomson's question, rather, I will address the worry concerning the coming into existence of the impasse itself: what is it about this thought experiment that despite its simplicity generates this state of affairs.

More than a non sequitur

Thomson's proposal that the lamp in his example generates a contradiction and, therefore, that the idea of a Super-Task is incoherent, was soon to be refuted by Benacerraf (1962). What Benacerraf basically did was to show that Thomson's straightforward question presupposes a non sequitur: from the information given by Thomson about the state of the lamp before the task ends, nothing seems to follow concerning the state of the lamp after the task has been completed.

In particular, it does not follow that the lamp must be on and off as he stated. For all we know, the lamp might have disappeared after the task was performed, nobody can tell. What we certainly can tell is that because the task performed does not establish anything about what is going to happen after the task is performed, Thomson is inferring something that good reasoning does not allow.

5 Other philosophers have gone as far as answering Thomson's question. For instance, G. C. Berresford (1981) has argued that the lamp must be on after the Super-Task is completed!
The received view is that Benacerraf's reply shows conclusively that Thomson was wrong. However, we are still discussing and taking sides in the dispute of what exactly is going on with this lamp. If Benacerraf has shown that the whole purpose of this thought experiment is based on a logically faulty assumption, why keep talking about it? Specifically, why keep taking sides on the issue whether a Super-Task has been accomplished based on what the Thomson Lamp experiment shows?

Benacerraf, to take a particularly revealing case, has argued that even if he proved that Thomson was wrong in concluding that a contradiction obtains, this does not mean that he has proved that infinity machines are conceptually possible. In fact, according to him, Thomson is after all right in thinking that such machines cannot possibly exist. Instead of appealing to a contradiction, Benacerraf then talks about a “conceptual mismatch” hidden in the idea itself of a Super-Task (1962:783).

An important thing to notice, is that both philosophers developed their proposals as if the Thomson Lamp itself is an argument about the feasibility of Super-Tasks. Thomson thought that a contradiction obtained from such argument and Benacerraf disagreed. But this picture is misleading, for to make any sense of it, one has to explain at least the following three things:

First, how is it possible to read off from the experiment the alleged argument, that is to say, how are we to establish its premises, its conclusion and the logical structure that binds them according to the rules of good reasoning.

Second, why some of the able commentators are missing altogether the relevant formal features involved in this apparently simple case (Thomson himself being one of them).

And, third, why a thought experiment was necessary at all: why construct it and discuss it when a simple argument would do?

It seems that if we want to avoid saying that some of the participants are quite blind to some sort of embedded argument or that the occurrence of thought experiments only plays a pedagogical function that facilitates the grasping of the arguments
involved, we better suppose that this "argumentative" picture of thought experiments is in this case inappropriate.

An alternative view that is worth exploring consists in seeing all thought experiments as what their name takes them to be, that is, literally as experiments. According to this perspective, the difference between an ordinary experiment and a thought experiment, is that the latter "is an experiment that purports to achieve its aim without the benefit of execution." (Sorensen 1992:205). The basic idea is to consider thought experiments as conceptual devices that compel the audience to believe something by the mere contemplation of the experimental design.

This characterization of thought experiments opens the possibility for developing a different understanding of what is going on in cases like the one I have been discussing. In fact, it fits nicely with both the simplicity of the conceptual setting proposed by the Thomson Lamp and with the strikingly different reactions found in the literature.

Actually, if the simplicity of the Thomson Lamp is a burden to the approach that equates it with an argument, to the account that considers it an experiment, such austerity turns out to be a merit. In the same way in which we take an ordinary experiment to be good and elegant if it shows economy in its resources and fertility in its implications, a thought experiment gains in epistemic worth if it is able to explain a lot with a little. So, not only its simplicity is not a problem but, indeed, it is a mark of its strength.

In this respect, it is worth mentioning that some philosophers troubled precisely with the straightforwardness of the Thomson Lamp experiment, have defended the idea that "information was missing" and that therefore the case was undecidable. Again, this looks like a mistake. Everything relevant that has to be shown concerning one class of Super-Tasks is already present in the

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6 In much of what I say about the approach to thought experiments as extensions of ordinary experiments, I rely on recent work on this subject done by Roy A. Sorensen; e.g. in (1992).
7 C. Chihara (1965) takes this view.
Thomson Lamp. Indeed, the problem arises because of the information that we already have.

The temptation to talk about “lacking information” in the case of thought experiments seems to arise also from considering them as disguised arguments, for instance, as abbreviated formulations of arguments in which the conclusion or premises are not fully expressed.

The typical and mistaken demand is then for filling in the argumentative gaps with some “missing” premises or conclusion. Once again, the suggested experimental approach to thought experiments does not have to face this sort of difficulty.

Perhaps the most attractive feature of considering thought experiments in this alternative way, is that it leaves enough room for a substantial disagreement about the implications of one and the same thought experiment. The explanation of how this disagreement can occur is simple. If experiments do not have propositional character, then they cannot be evaluated in terms of truth or falsity. Thus, if truth values are absent in the experiments themselves, nothing precludes their being used to generate hypothesis that may contradict each other.

Experiments are tools to prove some proposition as true or false but they themselves are not true or false. So, if thought experiments function very much like normal experiments do, nothing stops them from being used to prove different things.

Notice that this does not yet give us a complete account of how it is possible for one experiment to be used as a tool to justify different or even contradictory sets of propositions. That is, we do not yet have an explanation of the type of methodological constraints that an experiment must have if it is to be used in an epistemically nonarbitrary way. After all, an experiment does not prove everything. But, for the purposes of this discussion, we do not have to offer this set of constraints. It is enough to show that
nothing incoherent emerges from the fact that one and the same conceptual tool can be put to very different explanatory uses.  

The epistemological versatility of experiments can be accounted for by reflecting on the non-propositional nature of tools. Since the only limits set on a tool are given by its ability or inability to carry on a desired function, that is, since only by using the tool we can figure out the scope of its usefulness, nothing in the tool itself seems to preclude a priori its being used in many different ways. So, even if it is surprising to run into a conceptual device that is used to illustrate two different hypothesis, there is nothing incoherent in this possibility, even when these hypothesis contradict each other.

Perhaps I can make this view more palatable by drawing an analogy between an account of the observation of a single phenomenon like the swinging of a stone and the contemplation of a thought experiment like the Thomson Lamp.

Imagine two physicists looking at the oscillatory movement of a stone. One is an Aristotelian physicist and the other a Galilean. Due to their theoretical commitments it looks as if they are seeing two different things: the Aristotelian a body falling with difficulty, and the Galilean a sort of pendular motion. However, even if these two different accounts are given, there is still room for a basic agreement between the two scientists. Although it may seem that

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8 All sorts of interesting issues emerge here. If, as Sorensen has said, "the depth of the impossibility [of conceiving thought experiments] is proportional to how different the world would have to be for the procedure to be executed" (1992:201), the question about how far we are prepared to go with our thought experiments hinges on how much we are willing to change our conceptual scheme to accommodate the experiment in question. In this sense, how much our world will have to change for the Thomson Lamp to take place, is an open question intimately related to our conceptual framework, a much stronger thesis than the one I am defending in this paper. G. Massey (1991) has developed some of these ideas in a different direction but still very relevant to what I have said here. His main suggestion is that underneath many thought experiments, there lies the much feared (pace Quine) distinction between the analytic and the synthetic.

9 I got the stone example from Longino (1990:54) who in turn took it from Kuhn (1970:120).
their different theoretical backgrounds stop them from reaching an easy agreement as to what exactly they are seeing, the phenomenon itself seems to be the place where an agreement or even a disagreement is possible. In fact, a more productive understanding of the possibility of disagreement, locates the sources of the disagreements in the objects contemplated rather than in the theoretical differences of the contemplators. There is an essential “aspectual” element involved in the contemplation of an object or an experiment. Thus, it is the consideration of different aspects that explains many of the different hypothesis concerning a single phenomenon. By introducing the notion of an aspect, Helen Longino is able to give this plausible analysis of the two scientists:

... they are seeing the same thing but attending to different aspects of it. It is true that the aspects singled out become the focus of explanation and can be used as evidence for the differing hypotheses about the motion of the swinging stone, but there is no need to suppose that the Galilean or the Aristotelian must fail to see aspects that interest the other, nor to suppose that there is no description of the situation that both could accept and that would then form the basis for discussion of differences. (Longino, 1990:54)

By the same token, the disputants about the nature of Super-Tasks need not accuse the other side of missing the obvious. The other side could perfectly well be attending to different aspects of the Thomson Lamp experiment and using them to justify a complete different set of beliefs. This leaves room for an agreement or a disagreement as to what is going on in the experiment. An agreement or a disagreement that, just as in the case of the oscillatory movement of the stone, opens the door for a rational exchange concerning the best hypothesis accounting for the contemplated phenomena.

Incidentally, this is why a scientist can be first an Aristotelian and later a Galilean without any sort of schizophrenia being involved: he will recognize the pendular motion of the stone as the very same oscillatory movement of his Aristotelian old days.
In other words, this allows us to see the Thomson Lamp as a conceptual device that because its ability to capture the relevant features of Super-Tasks, is able to trigger different intuitions depending on what aspect is stressed.

To conclude, I take this approach to the epistemic puzzle surrounding the Thomson Lamp to be more promising than the competing alternatives. It readily explains why the disagreement is real, why nothing is wrong with the logical abilities of the disputants, and, furthermore, it moves the old ground of the dispute from the terrain of mere conceivability into the more fertile one of aspectual epistemological relevance.

BIBLIOGRAPHY


