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A Bayesian formulation of the *kalam* cosmological argument

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Abstract: **There has been a trend within natural theology to present arguments for theism deductively, such that at least one of the premises is likely to be extremely controversial. For those arguments with less controversial premises, the conclusion is usually something short of theism. On these grounds, some have employed probabilistic reasoning to revive classical arguments – to use less controversial premises in achieving a conclusion directly relevant to whether theism is true or not. Here, I formulate the *kalam* cosmological argument in Bayesian terms, and argue that doing so renders many objections levelled against it obsolete.**

Introduction

The *kalam* cosmological argument, with roots in early Christian and Islamic thinking, has been revived in recent years, most notably by William Lane Craig. In deductive form, the argument runs:

(P1) Everything that begins to exist has a cause.
(P2) The universe began to exist.
(C) Therefore, the universe has a cause (1,2 universal instantiation).[1]

Auxiliary arguments are provided for both premises in order to warrant the conclusion, and further arguments still are provided to elucidate the nature of the cause of the universe: since the cause created space and time, it must transcend space and time, for example. It must also have been extremely powerful in order to do so. Moreover, Craig provides three additional arguments for why the cause is plausibly personal.[2] The result is warrant for a belief in an immaterial, atemporal, extremely powerful, personal cause of the universe. My aim in this article is not to appraise the success of any of these arguments, but to give the argument its most charitable interpretation by formulating it probabilistically and noting the kinds of

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motivations a proponent of the argument could advance for adopting the probabilistic premises. I will also explain how debate over the premises and arguments might affect the overall inductive force of the argument. One line of objection to the deductive version takes no issue with any of the premises, but with the conclusion: that is, the conclusion is not that God exists. Even when one takes into account the additional arguments for the cause having a particular nature, one is still not left with theism: there is no mention of the moral character of the personal cause, for example. It is thus unclear how the argument contributes to the theistic case – it might be seen as one member of a set of deductive arguments which, in conjunction, show that God exists, or it might be seen as contributing to an inference to the best explanation.

I suggest not only that a Bayesian formulation can easily avoid this difficulty, but that it also shows clearly how other cosmological and non-cosmological arguments can be used in a cumulative case for theism. Thus, so long as the *kalam* cosmological argument is only intended to provide evidence for theism rather than demonstrating theism to be true on its own, neither neo-Humean challenges such as Stephen Law's 'Evil God' challenge (2010), nor the Kantian charge that the argument does not lead to *God*, will damage the argument at all.[3]

Another problem – one affecting all deductive arguments – is with understanding how the probability of the premises affects the probability of the conclusion. Craig seems to maintain that the individual premises' being more likely than not is sufficient to make a deductive argument a good one. This seems plainly false: supposing the individual probabilities of each premise to be 0.6, and supposing those probabilities to be independent, this only guarantees a probability of 0.36 for the conclusion.[4] However, Law's suggestion that the probability of a valid argument's conclusion is the probability of the premises multiplied is also indefensible.[5] Rather, if the premises are sufficient but not necessary to guarantee the conclusion, individual probabilities of 0.6 would show the conclusion to be *at least* 0.36 probable (assuming independence). Either way, this is not a particularly satisfying result. Fortunately, it is one on which a rigorous Bayesian approach sheds a great deal of light.

A Bayesian approach to *kalam*

The Kantian problem can be overcome rather simply: the standard Bayesian approach is to come up with some hypothesis – in this case, that God exists (T) – and then to consider data which confirm or disconfirm it, eventually reaching a posterior (epistemic) probability – $P(T|E_1 \ldots E_n\&k)$ – which should represent our rational credence in the hypothesis. The distinction between $E_1 \ldots E_n$ and k is somewhat arbitrary – $E_1 \ldots E_n$ just represents the evidence currently under consideration, while k represents everything else we know. For the purposes of this essay, k will include tautological and other a priori truths, as well

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as the most general facts about the universe: that a complex physical universe exists and, for those who think we know with a reasonable degree of certainty that it is contingent, that it is contingent. At a later point, I will also modify k to explain how certain observational data ostensibly supporting P1 relate to the argument. In this case, $E_1 \ldots E_n$ will be the proposition that 'the universe began to exist'. This is P2 of the deductive argument, and is typically justified by appeal to philosophical and scientific arguments.[6]

The role of P2 in a Bayesian formulation

The first of these arguments claims that actual infinites cannot exist, and that an infinite temporal regress would be an actual infinite. The second argues that an actual infinite cannot be formed by successive addition, which would be the case if the temporal series of events extended backwards towards infinity.[7] In terms of scientific arguments, Craig argues for a universal origin from both the expansion of the universe and the second law of thermodynamics. These four arguments provide ostensibly overwhelming support for premise 2, and so warrant us in taking it as a datum in our Bayesian schema.[8]

Now, suppose that one does not find the premise overall probable, but still takes the scientific arguments to constitute some evidence for it. Then, could we still have some evidence for theism, so long as the rest of the argument is correct? It seems so. Let us suppose, as an example, that Craig is certainly correct in saying that an atheistic universe could not have begun to exist (the principle does not depend on this assumption). In that case, where U represents the proposition that the universe began to exist, $P(U|\sim T\&k) = 0$, while $P(U|T\&k) = j > 0$. And if E represents our scientific data, viz. the expansion of the universe, then $P(E|U\&k) = e_1$, while $P(E|\sim U\&k) = e_2$, and $e_1 > e_2$. This is just to say that E has some evidential force for U&k over $\sim$U&k – that is, it constitutes evidence that the universe began to exist. The only further assumption required for the following equations is that this evidential force is not affected by the truth or falsehood or T: probabilistically, both U and $\sim$U individually screen off T from E. Then:

$$P(E|\sim T\&k) = P(E|\sim T\&U\&k) \cdot P(U|\sim T\&k) + P(E|\sim T\&\sim U\&k) \cdot P(\sim U|\sim T\&k) = e_2$$
$$P(E|T\&k) = P(E|T\&U\&k) \cdot P(U|T\&k) + P(E|T\&\sim U\&k) \cdot P(\sim U|T\&k) = (e_1 - e_2)j + e_2$$

Since the evidential force of E for T over $\sim$T is determined by the ratio of these two results, one can see that the bigger the difference between e_1 and e_2 (i.e. the stronger evidence E constitutes for the universe having a beginning), and the bigger j (the probability of the universe having a beginning on theism), the stronger evidence E constitutes for T over $\sim$T. Indeed, if U is impossible on atheism, then even the bare possibility of U being true on theism means that any evidence for U constitutes evidence for theism. Taking $e_1 = 0.1$, $e_2 = 0.001$, and $j = 0.1$ as an example,

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we get the result that $P(E|T\&k)/P(E|\sim T\&k) = 10.9$, and thus E would demonstrably be moderately strong evidence for theism over atheism.

Of course, there will be disagreement about these probabilities, and whether the rest of the argument is sound. But my point, which I hope to have sufficiently demonstrated, is that we do not need certainty with respect to P2 for the argument to have some inductive force; indeed, P2 can still be embarrassingly improbable and yet an inductive form of the argument can still have force. All that is required, providing the rest of the argument roughly works, is that there exists evidence that the universe began to exist.

This is a classic case of uncertain learning: we may not have learnt for certain that P2 is true, but nevertheless evidence for it can constitute evidence for theism. But what about the philosophical arguments for P2? Since these are a priori, they could plausibly be seen as affecting the prior probability of U rather than as giving confirmation of U. Perhaps this makes U reasonably priorly probable, such that the aforementioned scientific confirmation makes U overwhelmingly posteriorly probable, so that we can simply use U as a reasonably certain datum in our final evaluation of theism: that is, we would be taking $P(T|U\&k)$ to be an estimate of the rational credence we should be putting in T.

But suppose we want to be more precise, and suppose we only want to include more certain data in our conditional probability. Then an interesting problem arises when we consider the philosophical arguments. These arguments purport to establish not only the *actual* beginning of the universe, but the (metaphysical) *necessity* of any universe having a beginning. Suppose Craig's arguments succeed: suppose we accept that it is, indeed, impossible that a universe should exist eternally. But then we would expect the universe to have a beginning whether theism is true or not. Thus, $P(U|T\&k) = P(U|\sim T\&k) = 1$. But in that case, $P(T|U\&k) = P(T|k)$, and so there is no confirmation of theism by U. Might this constitute a serious difficulty for the *kalam* argument as an evidential argument?

There are a few potential escape routes for the *mutakallim* here. One is simply to drop the philosophical arguments as a justification for the beginning of the universe. Then the confirming evidence can come solely from the contingent scientific facts suggestive of a beginning. This seems like a reasonable option, especially for those who are already inclined to put more weight on the scientific arguments.

A second option is to make the entire argument bolder, into a kind of a priori argument, claiming that the existence of anything temporal is metaphysically incompatible with the lack of a personal cause. It is not clear that Craig's argument is too far off this: perhaps the argument requires barely any observational content at all to get going, viz. the existence of anything temporal. In this sense, perhaps the introduction of scientific support for the premises disguises the largely a priori nature of the argument. If this route is taken, it does not matter that the fact that the universe began to exist does not support theism in the traditional

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confirmationist sense, since the argument is based more on modal considerations affecting prior probabilities rather than observational, probabilistic confirmation.

Finally, one might appeal to the distinction between epistemic/doxastic and metaphysical/ontic possibility, and probability. I take x to be epistemically possible iff x is true *for all we know* – that is, if it is not known to be inconsistent with any certain knowledge we have. Metaphysical possibility is harder to define, but roughly corresponds to propositions which are not analytically false, as well as excluding propositions which are not analytically false, but which nevertheless do not seem possible in any sense: 'Clark Kent is not Superman' and 'it is not the case that water is H_2O' are two common examples. So there are propositions which can be epistemically, but not metaphysically, possible. False mathematical conjectures are metaphysically impossible, but epistemically possible (if they had been proven false, they would no longer be conjectures, strictly speaking).[9]

There is a probabilistic analogue for this modal distinction, grounded in Leibniz's view that probability is mere graded possibility – a proportion of possible worlds, in contemporary speak. Even if one rejects this view, it is reasonable to view different kinds of probability as having different requirements for assignments of probability 0.[10] This is based on the normality axiom – that necessarily true propositions have probability 1 (it follows from normality and additivity that impossible propositions have probability 0). So if x is epistemically possible but metaphysically impossible, x may have a non-zero epistemic probability while still having a metaphysical probability of 0.[11] After all, we may be mistaken in our judgements about what is possible and what is not. So perhaps, even if we are inclined to agree with Craig that a beginningless universe is metaphysically impossible and with a metaphysical probability of 0, we may not be wholly certain that this is so, and thus we might give it a non-zero epistemic probability. This allows us to assign a non-zero probability to some of the relevant terms (and most importantly, to $P(\sim U|\sim T\&k)$).

There are two ways one might subsequently motivate the claim that $P(U|T\&k) > P(U|\sim T\&k)$. One would be to say that the compossibility of $\sim T$ and $\sim U$ is more plausible than the compossibility of T and $\sim U$, but it is very hard to see how this might be argued. Another way would be to admit a certain degree of epistemic probability to both compossibilities and then to say that, given the possibility of $\sim U$, we would expect $\sim U$ much more on atheism than on theism (for reasons discussed later in the argument).

However, this tactic depends on the overwhelming success of later parts of the argument, since for strong confirmation we need $P(U|\sim T\&k)$ to be quite low, not just lower than 1. Even if $P(U|\sim T\&k)$ were 0.5, for example, the Bayes factor would be 2 at most. So for the argument really to have much force, $P(U|\sim T\&k)$ should be much less than 1. But for us to hold that a probably metaphysically necessary proposition is actually epistemically *improbable* given some other propositions suggests a very peculiar set of circumstances. In this case, it requires that the later

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parts of the argument be enormously persuasive, such that the incompossibility of a temporal universe and atheism is significantly more plausible than the impossibility of a beginningless universe. Given how plausible Craig thinks the impossibility of a beginningless universe is, this requirement would constitute a significant burden for the *kalam* argument.

The relevance of P1

Let us return to using P2 as our datum for the argument, for simplicity's sake. In this case, the *mutakallim* will want to argue that $P(U|T\&k) > P(U|\sim T\&k)$ – that is, that the probability of a universe beginning to exist given theism and that a complex physical universe exists is greater than the probability of a universe beginning to exist given atheism and that a complex physical universe exists. I have supposed that k includes the fact that a complex physical universe exists, though this is not necessary. If one feels that the cosmological arguments are best presented all at once, one could update directly from P(T) to P(T|U&k) by comparing P(U&k|T) with P(U&k|∼T). Or one could split U&k into its various components (the existence of a contingent object, the existence of a physical universe, the existence of a complex physical universe, the existence of a temporally bounded universe) and update multiple times through the various different cosmological arguments. In that case, it is clear how cosmological arguments can be used together as part of a cumulative case for theism, and it is clear how other natural theological arguments can be added – by adding their data later, to update the epistemic probability of theism several more times. For the purposes of this essay, I will assume we have already updated on k.

So, how will we compare P(U|T&k) and P(U|∼T&k)? One method is to elaborate on one of these probabilities, exhausting the probability space under it. For example:

$$P(U|\sim T\&k) = P(U|\sim T\&\sim C\&k) \cdot P(\sim C|\sim T\&k) + P(U|\sim T\&C\&k) \cdot P(C|\sim T\&k)$$

where C represents the proposition that 'the universe has a cause'. $P(U|\sim T\&C\&k)$ can be further broken down into $P(U|\sim T\&C\&\sim P\&k)\cdot P(\sim P|\sim T\&C\&k) + P(U|\sim T\&C\&P\&k)\cdot P(P|\sim T\&C\&k)$, where P represents the proposition that 'there exists a person logically prior to the universe, who is capable of creating a universe'. Thus:

$$\begin{aligned} P(U|\sim T\&k) = {} & P(U|\sim T\&\sim C\&k) \cdot P(\sim C|\sim T\&k) + \\ & [P(U|\sim T\&C\&\sim P\&k) \cdot P(\sim P|\sim T\&C\&k) + \\ & P(U|\sim T\&C\&P\&k) \cdot P(P|\sim T\&C\&k)] \cdot P(C|\sim T\&k) \end{aligned}$$

$P(U|\sim T\&\sim C\&k)$ is the probability that the universe began to exist given atheism, and that it has no cause, while $P(\sim C|\sim T\&k)$ is the probability that the universe does not have a cause, given atheism. Note that $P(U|\sim T\&\sim C\&k)\cdot P(\sim C|\sim T\&k)$ is low if *either* $P(U|\sim T\&\sim C\&k)$ or $P(\sim C|\sim T\&k)$ are low: and it is far lower if they are both low.

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Leibnizians will be inclined to think that $P(\sim C|\sim T\&k)$ is close to 0, and one could make arguments that the universe must have a cause (aside from any *kalam* considerations) here. This is not required, however: all that is needed to think that $P(\sim C|\sim T\&k)$ is low is to accept that the universe existing causelessly has some prior implausibility. One might therefore defend a low probability here by appealing to Leibnizian, inductive, or other considerations. One possible line of argument which would be sufficient here would be to argue that, unless there is something special about the universe which makes it less likely a priori to have a cause, we should expect *any* given object to have a cause. Indeed, those who object to the *kalam* argument by asserting that there is also abundant support for the proposition that *everything* has a cause should feel compelled to assign to $P(\sim C|\sim T\&k)$ a very low value, if we include our relevant inductive knowledge about the world in k.

$P(U|\sim T\&\sim C\&k)$ is where P1 becomes relevant, and this probability can be explored by considering the probability of its complement:

$$P(\sim U|\sim T\&\sim C\&k) = P(\sim U|\sim T\&\sim C\&P1\&k) \cdot P(P1|\sim T\&\sim C\&k) + P(\sim U|\sim T\&\sim C\&\sim P1\&k) \cdot P(\sim P1|\sim T\&\sim C\&k)$$

Since P1 and $\sim C$ jointly entail $\sim U$, it follows that $P(\sim U|\sim T\&\sim C\&P1\&k) = 1$ and thus that $P(\sim U|\sim T\&\sim C\&k) \geqslant P(P1|\sim T\&\sim C\&k)$. So whatever we think of P1 given the evidence available, we should note that $P(\sim U|\sim T\&\sim C\&k)$ is actually even higher than $P(P1|\sim T\&\sim C\&k)$. So even if we don't think P1 is exceptionally plausible, it is worth noting that $P(\sim U|\sim T\&\sim C\&k)$ may still be very high. The point is that holding $P(U|\sim T\&\sim C\&k)$ to be low does not depend crucially on the plausibility of P1, and assigning a low value to this probability can be defended independently.

Since this part of the argument no longer relies on the premise that *everything* that begins to exist has a cause, as the deductive form does, the premise should have more prior plausibility. All the argument needs to show here is that, given an uncaused universe and atheism, it is unlikely that the universe should have begun to exist – or in other words, that if we knew that an uncaused universe existed, we would confidently suspect that it had existed from infinity.

What motivations might one have for assigning a low value to $P(U|\sim T\&\sim C\&k)$? If one is inclined to think that the beginning of the universe provides additional reason to think it has a cause – that there is some kind of improbability in the conjunction of something beginning to exist and its having no cause – then one might want to assign a low value here. One argument might be that we should expect any given object which began to exist to have a cause – or that we would expect any object which *didn't* have a cause to have existed eternally. This a relatively modest claim, illustrating the fact that the argument does not require the kind of ambitious proof or certainty which many, correctly or not, perceive in Craig's presentation.

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Support for P1 would still strengthen the argument, of course. The justification Craig cites for P1 is, first, the principle of *ex nihilo nihil fit* – 'out of nothing, nothing comes'. Something beginning to exist is taken as an example of something 'coming into being', and the principle is invoked to imply that this 'coming into being' is impossible in the absence of some (logically) prior cause. Second, the apparent arbitrariness of *only* a universe coming into being from nothing (or existing without a cause) seems implausible. 'Why is it only universes that can come into being from nothing? What makes nothingness so discriminatory?' Craig asks.[12] If things could begin to exist without a cause, surely we would expect far more than just universes to come into being, causeless? And why, then, should horses and plates not suddenly begin to exist within our universe? Finally, Craig takes our everyday experience to count inductively in favour of the premise. For Craig, our constant experience of things beginning to exist having causes gives overwhelming a posteriori support for P1, such that '[s]cientific naturalists thus have the strongest of motivations to accept it'.[13]

How might this work, probabilistically? Again, I make no appraisal of the soundness of these arguments: I am only demonstrating how the argument might work for those who are in some way inclined to accept the relevant premises. Presumably the first justification, *ex nihilo nihil fit*, is supposed to provide some a priori plausibility for $P(U|\sim T\&\sim C\&k)$ being low. Again, this ought to be easier to justify than the proposition that *everything* that begins to exist has a cause – at the moment, all we are doing is maintaining that it is a priori improbable, though perhaps possible, that the universe should begin to exist without a cause.

I suggest that the latter two justifications are best seen as a posteriori, inductive justifications. Thus, k can be modified to include two more sets of observational data: first, that we do not observe things beginning to exist without a cause, and second, that we seem to observe that everything which does begin to exist does have a cause. It seems clear that these two sets of observations (if veridical, a matter on which I shall not comment here) would be very probable if things which began to exist generally had a cause, and very improbable otherwise.

Finally, it is pertinent that one does not even have to appeal to Craig's reasons here. For example, one might think that something having a temporal boundary makes it in some way less simple and consequently endorse a simplicity-based argument, à la Swinburne, for thinking that the existence of a temporally bounded, causeless universe has a low probability. Similarly, one might appeal to the history of objections to the cosmological argument. One of the classic objections to cosmological arguments (typically Thomistic) is that the universe may have existed forever – indeed, this is one of the primary points made by those who object to P2. This might suggest that they, too, recognize some intuitive implausibility or complexity about the universe existing finitely but causelessly. Certainly, there seems to be some sort of completeness and simplicity in an eternal universe that resists explanation, which is not present in a finite universe.

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If one finds any of these arguments compelling, they are likely to agree that $P(U|{\sim}T\&{\sim}C\&k)$ is low, even if not 0. Thus, whether for Leibnizian, *kalam*, or other reasons, many are likely to accept that $P(U|{\sim}T\&{\sim}C\&k)\cdot P({\sim}C|{\sim}T\&k)$ is very low. If this is the case, then we can treat it as negligible and reach the new approximation:

$$P(U|{\sim}T\&k) \approx [P(U|{\sim}T\&C\&{\sim}P\&k)\cdot P({\sim}P|{\sim}T\&C\&k) + P(U|{\sim}T\&C\&P\&k)\cdot P(P|{\sim}T\&C\&k)]\cdot P(C|{\sim}T\&k)$$

Arguments for the nature of the cause

Most *mutakallimiin* would argue that $P({\sim}C|{\sim}T\&k)$ is low, such that $P(C|{\sim}T\&k)$ is roughly 1. This appraisal is not necessary for *kalam* reasoning, but we can assume that $P(C|{\sim}T\&k)$ is 1 for the sake of the argument – at this point, this is being generous to the sceptic's case. Thus:

$$P(U|{\sim}T\&k) \approx P(U|{\sim}T\&C\&{\sim}P\&k)\cdot P({\sim}P|{\sim}T\&C\&k) + P(U|{\sim}T\&C\&P\&k)\cdot P(P|{\sim}T\&C\&k)$$

Let us deal with the latter conjunct, $P(U|{\sim}T\&C\&P\&k)\cdot P(P|{\sim}T\&C\&k)$, first. This is the probability that the universe began to exist given atheism, that the universe has a cause, and that a person exists logically prior to the universe, multiplied by the probability that a person exists logically prior to the universe, given atheism and that the universe has a cause.

$P(U|{\sim}T\&C\&P\&k)$ – the probability that a universe began to exist given some non-divine person's existence prior to the universe – seems to be difficult to assess. There is nothing in the standard *kalam* argument that precludes some other person from creating a universe which began to exist. Suggestions that we have no reason to think a non-divine person would create a universe at all are irrelevant to this particular probability, since we already have the background knowledge k, which says that a universe exists. Perhaps we have some reason why a divine person would specifically create a *temporally bounded* universe (maybe even for some meta-reason, such as the fact that it would probably lead to some sort of *kalam* argument to warrant belief in it), but no comparable reason to think that a non-divine person would create a *temporally bounded* universe. However, I can think of no such reason with much probative force, and so I will suggest that $P(U|{\sim}T\&C\&P\&k) \approx P(U|T\&k)$.

$P(P|{\sim}T\&C\&k)$, on the other hand, will likely be extremely low on the atheist's view, for this is the probability that a personal being exists prior to the universe, given atheism, and that the universe exists and has a cause. For most atheists, at least, their belief that the probability of God's existence is low (or extremely low) is fundamentally tied up with their (usual) belief that the existence of extra-universal persons (especially those capable of creating the universe, which is the only relevant type here) is implausible. Craig himself notes that 'it is a strange form

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of atheism, one not worth the name, that admits that there is a beginningless, uncaused, spaceless, timeless, immaterial, enormously powerful, Personal Creator of the universe'.[14] And, though not all atheists will reject extra-universal persons, it is plausible to suppose that most do, and that the perceived implausibility of such persons is inextricably linked to their lack of belief in God. After all, if the atheist is prepared to accept that P(P|∼T&C&k) is moderate, why not accept that the prior probability of theism is moderate? And if they think that P(P|∼T&C&k) is low but not *that* low, would a similarly moderate prior probability of theism plus some average-strength evidence for theism not compel them to believe in God? Thus, I think the large majority of people to whom the *kalam* argument is intended to address, viz. the large majority of atheists, ought to assign P(P|∼T&C&k) a low value.[15]

For those who think that P(P|∼T&C&k) is relatively high, I note first that this seems to commit them to a high prior probability of theism – and so they are unlikely to need much evidence (perhaps from other natural theological arguments, or from revealed theology) to be persuaded of its truth. Indeed, for reasons of simplicity (e.g. that a divine person is simpler than a non-divine person, à la Swinburne) or from evidence considered in k (e.g. that the existence of a contingent or complex universe is much more likely given *theism* than given ∼T&P), it seems reasonable for such a person to ascribe a *higher* prior probability to theism than to P. If such a person deems these prior reasons insufficient for belief in theism over ∼T&P, she may yet be convinced by data considered later (for example, teleological or moral arguments, or arguments pertaining to revealed theology). But the general audience of the *kalam* argument is likely to concede that P(P|∼T&C&k) is low. On the argument of these few paragraphs, then, we may suggest that:

$$P(U|\sim T\&C\&P\&k) \cdot P(P|\sim T\&C\&k) \approx P(U|T\&k) \cdot F$$

where F is some low, perhaps negligible value. We are then left with the approximation:

$$P(U|\sim T\&k) \approx P(U|\sim T\&C\&\sim P\&k) \cdot P(\sim P|\sim T\&C\&k) + P(U|T\&k) \cdot F$$

And if we suppose that F is negligible, then it follows that:

$$P(U|\sim T\&k) \approx P(U|\sim T\&C\&\sim P\&k) \cdot P(\sim P|\sim T\&C\&k)$$

Finally, then, we consider $P(U|\sim T\&C\&\sim P\&k)\cdot P(\sim P|\sim T\&C\&k)$. $P(\sim P|\sim T\&C\&k)$ is the probability that there is not a non-divine person (capable of creating universes) logically prior to the universe, given atheism, and given that there is a cause of the universe. If the arguments in the previous section are correct, this will be close to 1. Indeed, a value of 1 would help the atheist most here, so there is little danger of this being an uncharitable ascription. So $P(U|\sim T\&k) \approx P(U|\sim T\&C\&\sim P\&k)$. This is the probability that the universe began to exist given atheism, and that the universe exists and has a cause, and that there is no non-divine person (capable of creating universes)

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logically prior to the universe. It is here where Craig's arguments for the personhood of the cause are pertinent.

Craig offers three such arguments. The first is typically construed as a disjunctive syllogism: the only plausible extra-universal (and therefore immaterial and atemporal) causes are abstract objects and immaterial minds. But, according to Craig, abstract objects are acausal – and so cannot be a cause of the universe. This leaves an immaterial mind as the only plausible candidate. Second, only freedom (specifically through the Islamic Principle of Determination) can properly account for a temporally bounded, changing universe arising from an atemporal (and therefore changeless) cause. This is because, if the necessary and sufficient *mechanistic* conditions for the existence of a universe have been present 'from eternity' (in an atemporal sense), it should make sense that the universe should also exist 'from eternity' (in an infinite sense, since a universe is essentially temporal) – this, according to Craig, is the nature of mechanistic causation. But, since the universe has not existed for an infinite amount of time, there cannot be a mechanistic cause – and so the cause is most plausibly a person exercising free will, which has the unique power to cause one state of affairs over another when external factors are inconclusive. Third, Craig appeals to Swinburne's distinction between personal explanation and scientific explanation. In this account, scientific explanation works by citing initial conditions and laws which make a latter state of affairs probable. But if, as Craig argues, there is no moment of time prior to the beginning of the universe, this kind of explanation is impossible, since there are no temporally prior initial conditions for scientific laws to act on. Thus, again, we are left with a personal explanation.

These three arguments all make enormous assumptions, and I have no time to appraise them properly here. For example, the first assumes that the disjunction is reasonably exhaustive, and that an immaterial, atemporal mind is any more intelligible than other atemporal causes excluded on the grounds of absurdity. The second seems to assume the principle of sufficient reason, and seems to raise the difficult questions of, first, whether God's choosing that a universe should exist is sufficient for it to exist, and second, whether that will can be said to have been present from 'eternity'. That is, it is not clear how freedom escapes Craig's problem with mechanistic explanations in a way that some other indeterministic process (perhaps related to quantum theory) could not also utilize. Nevertheless, for these reasons or others, the *mutakallim* will want to maintain that $P(U|\sim T\&C\&\sim P\&k)$ is very low, and if any of the arguments are compelling, then this provides good reason to give $P(U|\sim T\&C\&\sim P\&k)$ a low value, even if we are not confident enough in the arguments to give it a probability of 0.

One can think about it a different way. To appraise $P(U|\sim T\&C\&\sim P\&k)$, one will have to think about which causes one has most independent reason to believe in, given $\sim T\&\sim P\&k$. Provided the arguments for personhood have even some force, people are likely to agree that it would have to be some very special kind of cause

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which exists atemporally and immaterially, and which nevertheless manages to give rise to a temporal, changing universe with an early temporal boundary. It seems, then, that the range and mundanity of possible causes of a universe which would lead us to expect an eternally existing universe, coupled with the extremely special (and thus *a priori* improbable) nature of any cause which could create a temporally bounded universe, should lead us to expect that, if there were some non-personal cause of the universe, we would by far expect the universe to have existed eternally, and not to have had a beginning. This would provide good reason to give $P(U|\sim T\&C\&\sim P\&k)$ a low value. In that case, the *mutakallim* will also think that $P(U|\sim T\&C\&\sim P\&k)$ is negligible or, in any case, significantly lower than $P(U|T\&k)$, such that, supposing the argument so far has generally been correct, $P(U|T\&k) >> P(U|\sim T\&k)$. Thus, U confirms T over $\sim$T, and constitutes evidence for theism.[16]

Conclusion

I have demonstrated that generic arguments against natural theological arguments, such as the Kantian charge and the challenge of parody gods, fail when natural theological arguments are subjected to Bayesian analysis. For these reasons and others, I have sought to present the *kalam* cosmological argument in its most plausible formulation. This has led me to detail the motivations a *kalam* proponent might have for appraising the following probability:

$$P(U|\sim T\&k) = P(U|\sim T\&\sim C\&k) \cdot P(\sim C|\sim T\&k) + [P(U|\sim T\&C\&\sim P\&k) \cdot P(\sim P|\sim T\&C\&k) + P(U|\sim T\&C\&P\&k) \cdot P(P|\sim T\&C\&k)] \cdot P(C|\sim T\&k)$$

The magnitude of $P(U|T\&k)/P(U|\sim T\&k)$ determines the evidential force of U for T. So the smaller $P(U|\sim T\&k)$ is, the stronger evidence U will be for T. It therefore follows that the smaller the probabilities on the right hand side, the more T is confirmed. I have given reasons a *kalam* proponent might have for thinking that many of the relevant probabilities are low, and explained how these impact on the overall argument. If an argument is to be rejected, it ought to be rejected in its strongest form. I hope to have contributed to that formulation.[17]

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Notes

1. E.g. Craig & Sinclair (2009), 102.
2. *Ibid.*, 191–194.
3. A related objection is that the argument does not prove the God of Christianity, even if it demonstrates theism to be true. This is a complete red herring. For Christianity to be true, its essential doctrines ought to be true, theism being one of these. The question of 'the Christian God's' existence presumably depends on some essential properties of the 'Christian God' which are dissimilar to other conceptions of God. But Christianity has traditionally emphasized what God has done in history, and used this ostensible action as the basis for other theological doctrines. So let us concede for the sake of argument that the question of whether the Christian God exists is a meaningful one, separate from the question of whether God exists. Such a being's essential properties will then presumably include, for example, the property of becoming incarnate in Jesus of Nazareth and raising him from the dead. In this case, it will be clear how the *kalam* cosmological argument, if sound, contributes to the Christian case. This is because the probability of God becoming incarnate in Jesus, and raising Jesus from the dead, is far greater given theism than given atheism. Thus, any arguments providing strong evidence for theism generally will serve to make Christianity significantly more probable. Whatever one's assessment of Christianity and of whether belief in these doctrines is warranted, then, one should nevertheless agree that this objection – that the *kalam* argument, even if sound, cannot strengthen the Christian's case – is clearly mistaken.
4. Lottery paradoxes and other related examples can easily be adduced to support this point. A valid argument whose premises are all probably true can still lead to a conclusion which is far from warranted, perhaps even impossible. For example, consider an argument whose premises are that: (1) this roll of a die will not result in a 1; (2) this roll of a die will not result in a 2; . . . (6) this roll of a die will not result in a 6. All the premises of such an argument will have a probability of 5/6, but a deductively valid conjunction of the premises will suggest that the die roll will not result in any number from 1 to 6. This is, of course, absurd, and makes clear that a valid argument with probably true premises is not, in itself, sufficient to warrant belief in the conclusion. A more extensive discussion of this point is available in McGrew & DePoe (2013).
5. Law (2011) writes: 'With, say, just five required basic premises of 80% probability each, the probability that your conclusion is true drops to just 32%. That's to say, the probability that your conclusion is FALSE is nearly 70%.'
6. It will be noted that this only brings us to the probability of theism given that a complex universe exists, and that it had a beginning. This means that even if *kalam* principles strongly favour theism, it may be that other considerations (such as the problem of evil, or other natural theological arguments) disconfirm theism, or at least weigh more forcibly in favour of alternative hypotheses discussed here. This is no concern of the present discussion; all I am offering is a charitable explanation of how *kalam* principles might favour theism. Debate about the confirmatory power of other arguments may, and does, take place elsewhere.
7. This, more than any other sub-argument, depends critically on the truth of the A-theory of time, which Craig defends independently in Craig (2000).
8. Of course, one major problem here is that Craig takes 'beginning to exist' to entail tensedness – that is, the argument presupposes an A-theory of time. It is easy enough to make an A-theory-independent argument of this sort: one could simply take as one's datum a universe with an 'early' temporal boundary – this is largely accepted by both A-theorists and B-theorists. But since this change could be made just as easily to the deductive form, I will not devote much time to developing this point here – I will only note that the Bayesian formulation can be modified accordingly, and so my datum U should be understood in the A-theory-independent sense explicated above.
9. Boris Kment's *Stanford Encyclopedia of Philosophy* entry on 'Varieties of Modality' (2012) provides a good, brief introduction to the distinction between epistemic and metaphysical modality, as does the

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Introduction in Gendler & Hawthorne (2002). Saul Kripke's work on modality introduces a variety of examples of a posteriori (and therefore not epistemically necessary, to many subjects) truths which are nevertheless metaphysically necessary. See Kripke (1980).

10. It is a frustrating feature of the philosophy of probability that most writers form quite different categorizations of kinds of probability. Nevertheless, Antony Eagle does a good job of surveying different kinds of probability in Eagle (2011). In particular, what I am calling epistemic probability is roughly similar to what he describes as evidential probability – 'a measure of how good the reasons to believe a hypothesis provided by the evidence are' (*ibid*., 281).
11. I write 'may', since the regularity axiom, which states that impossibilities have probability 0, is controversial. Assuming that infinitesimal probabilities are not possible and assuming countable additivity, it can be shown that some possible events have probability 0 (*ibid*., 10; see 20 for an argument that even infinitesimals do not preserve regularity).
12. Craig & Sinclair (2009), 186.
13. *Ibid*., 187.
14. Craig (2011).
15. Of course, arguments are not only for convincing detractors of a particular position; they are also for substantiating the proponent's beliefs. I am primarily dealing with the *kalam* argument as a persuasive argument rather than as a substantiating argument, but I note that it may also have force for those theists who think that P(P|∼T&C&k) is low. For both atheists and theists who think that P(P|∼T&C&k) is moderate, the argument will have much less persuasive and substantiating force.
16. This does assume that P(U|T&k) is itself moderate, which, if one holds that Craig's argument against a mechanistic cause is correct, will depend partly on how well theism escapes this problem. While I cannot think of any particular reason why God should choose a temporally bounded universe over an eternally existing universe, it does not seem to me that there is a problem with U given T, at least not one commensurate with the ostensible problems for U given ∼T. Thus, although we may not be able to say that P(U|T&k) is particularly high (indeed, in view of the simplicity of an eternal universe, I would be inclined to say that it is less than 0.5), if theism avoids the putative difficulties for U being true on atheism, and if the *mutakallim*'s arguments for P(U|∼T&k) being very low are thought to be persuasive, then P(U|T&k) should be appraised as much higher than P(U|∼T&k).
17. I am very grateful to Wes Morriston, John DePoe, and an anonymous reviewer for *Religious Studies* for their generous comments on earlier drafts of this article.

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