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Dissecting The Grandfather Paradox

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Section 1: Introduction

Let us say that an individual named Tim gets access to a time machine. Tim loathes his paternal Grandfather. In fact, Tim hates him to the extent that he chooses to use his access to the time machine to go back in time to murder his Grandfather. Determined to seal his Grandfather's fate, Tim travels back in time to 1930, purchases a rifle and spends days practicing his marksmanship. Tim rents a room, in a close vantage point to the walking route taken by his Grandfather every day. He barricades himself in the room, in the hope that he has set up the optimal conditions for his Grandfather's murder, aims the gun and shoots. It appears that Tim has all the abilities necessary to kill his Grandfather, meaning that he *can* commit this action. However, there exists the glaring issue that Tim's Grandfather had lived until 1957 and then passed of natural causes in his sleep. Hence, it seems that the fact that Tim's Grandfather dies of old age in his sleep many years later ensures that Tim *cannot* kill him when he went back into the past with that sole purpose. Indeed, Tim's very existence means that he could not have killed his Grandfather in 1930. The simple fact that Tim is alive presupposes the fact that his Grandfather was not, in fact, killed in 1930, but lived at least until he gave birth to his son, Tim's father. Hence, it appears that a logical contradiction has arisen: Tim can and cannot kill his Grandfather. Time travel seems impossible.

The grandfather paradox is an age-old tale. There is evidence that dates it back as far as the late 1920s. In the famous 1929 novelette, *Paradox*, the author Charles Cloukey, who was only sixteen years old at the time of publishing, outlines several paradoxes of time travel, concluding that backward time travel is, in fact, impossible. Cloukey writes, "the fact that I was present to kill my unfortunate grandfather would show that I had been born. Therefore, I could not have killed my grandfather. It was hopeless." (Cloukey, 123). By detailing the story of a time

traveler who delivers a manuscript into the past, Cloukey concludes that one "will find inconsistencies and paradoxes in any time-traveling or four-dimensional story if you look for them." (Cloukey, 110). Science fiction of the early 20th century too dealt with this paradox, with many examples arising in works such as *Ancestral Voices* by Nathaniel Schachner and *Future Times Three*, authored by René Barjavel in 1943.

In his paper, *The Paradoxes of Time Travel,* eminent philosopher David Lewis explores the grandfather paradox to prove that time travel is truly possible by demonstrating that what once seems paradoxical, may not really be paradoxical at all. This paper will focus on Lewis' defense against the grandfather paradox as well as objections posed by various metaphysicians. The objective is to construct a systematic analysis of time travel and its causal and philosophical implications. By using the grandfather paradox as the main point of focus, this essay will explore the possibility of time travel by addressing metaphysical conceptions of time and space, the existence of multiple universes, causality, and probability. In concluding the thesis, this paper will eventually aim to answer the question of whether Tim can kill Grandfather by comparing and contrasting the two fundamental metaphysical theories posed as responses to Lewis. Ultimately, any answer to this question inevitably leads to the creation of a plethora of new ones.

Section 2: David Lewis' *The Paradoxes of Time Travel*

David Lewis is the earliest philosopher who has been recorded to pose a discussion on the grandfather paradox. Lewis posits a defense for the possibility of time travel by arguing that the grandfather "paradox" is not, in fact, paradoxical at all. Using a four-dimensional model of time, Lewis introduces two different senses of the word 'can' suggesting that an equivocation underlines our intuitions about ability. Lewis argues against the impossibility of time travel by appealing to an explanation about the nature of time, maintaining that it is logically possible to travel through time under a four-dimensional space-time approach. Lewis raises questions regarding a time traveler who both 'can,' and 'cannot' go back into the past to kill his Grandfather. By denying that the claims, 'can,' and 'cannot' are unequivocally true, Lewis explains that a time traveler simultaneously does and does not have the ability to change the past. With an aim to argue for the possibility of time travel against various paradoxes, Lewis uses the grandfather paradox as one example of an instance in time travel which appears paradoxical but does not actually give rise to any apparent logical contradiction.

Lewis' account of the grandfather paradox is based on unbounded and non-branching, four-dimensional time. Lewis begins his argument by explaining what time travel is by distinguishing between personal and external time. In questioning, how "the same two events were separated by two unequal amounts of time," Lewis clarifies the idea of "time itself, external time as I shall also call it, from the personal time of a particular time traveler" (Lewis, 146). When an individual travels back in time twenty years, but this process has only taken five minutes, one can state that twenty years of external time and five minutes of personal time has elapsed.

Consider an individual who drinks a little too much one night and blacks out. He loses all recollection of his memory between 9 PM and midnight. Clearly, in this situation, it seems that

no personal time has elapsed, but a total of three hours of external time has passed. Lewis makes this distinction to highlight the fact that there are no inherent paradoxes that make time travel impossible. One must simply differentiate between time felt personally and real time elapsed. By introducing this systematized method of measuring the time elapsed, and other such metaphysical tools, Lewis demonstrates that time travel is not inherently paradoxical. In fact, Lewis says that these so-called paradoxes are "oddities, [and] not impossibilities" (Lewis, 145). He aims to quash objections related to the nature of time regarding backward causation by differentiating specific temporal conceptions that are involved in the process of time travel.

Lewis maintains that external (or real) time travels only forward. Lewis defines change as the "qualitative difference between different stages – different temporal parts – of some enduring thing" (Lewis, 145). This implies that entities without temporal parts, — such as a particular instant in time, or Grandfather's shooting — cannot truly experience change. Given that change is Lewis' measures of time passing, the direction of time must align with the direction of causation. The grandfather paradox is just one of several that Lewis considers, and his discussion touches upon backward causation and closed causal loops. By highlighting various paradoxical situations inherent in a solely forward moving conception of time, Lewis clarifies his four-dimensional time-travel approach and sets up fundamental ideas for his argument.

Lewis describes a situation wherein an individual teaches his younger self how to build a time machine. It seems that the knowledge required to build a time machine is a logical part of the causal process, but Lewis raises important questions, such as where did this information came from in the first place, or why did the individual even go back in time to teach his younger self. Hence, it seems intuitive to think that later events have the potential to influence earlier ones, therefore raising questions regarding the potential existence of backward causation. Lewis

agrees with this notion, stating, "travel into the past necessarily involves reversed causation" (Lewis, 148). In fact, he believes that causal loops are inherent to the time traveler's strange world. He considers the example of a "time traveler who talks to himself, on the telephone perhaps" and uses this example to raise questions regarding uniform personal identity through changing temporal parts (Lewis, 147). Lewis maintains that the uniting factor for these temporal states is comprised of the familiar mental continuity that unites any individual over a given period of time. Causal inexplicabilities are inherent in situations such as these. "When the orders of personal and external time disagree," there exists "causation that run from later to earlier stages in the order of external time." Lewis concludes that if so, "reversed causation and time travel are not excluded altogether, but can occur only where there are local exceptions to these asymmetries" (Lewis, 148). Lewis defends this fact by stating that individuals are faced with several inexplicabilities on daily basis. Consider the existence of "God, or the Big Bang" — all "uncaused and inexplicable" entities (Lewis, 149). We seem to take these for granted, and as such, one can raise the question: why do the causal loops of time travel seem so foreign? Clearly, Lewis is right that "the time traveler's world would be a most strange one" (Lewis, 148).

Lewis expands on this discussion by outlining his four-dimensionalist model of time and the universe itself. He explains that the world occupied by the time traveler is encompassed by a "four-dimensional manifold of events" (Lewis, 145). Lewis emphasizes that time occupies only one of these dimensions and enduring entities in time's dimension are time-like streaks, composed of several temporal parts, or stages located at a penumbra of times and places in the four dimensions. Lewis specifically maintains that time remains only one dimensional and the "prevailing laws of nature" and physics inherently discriminate between time-like and space-like dimensions (Lewis, 145). Therefore, one can state that a time traveler, like any other individual, is

a streak through the space-time dimensions, and hence composed of various, supplementary temporal parts that eventually combine to define his identity. Lewis believes that the continuity of personal identity depends on causal continuity and psychological connectedness. The time traveler's streak is unlike the streak of any other individual. It is not a straight line, but rather a zig-zagged streak traveling back and forth, against the linear dimension of time. Lewis explains the graphical representations of various time travelers going back into the past, as well as the future. He also introduces the example of one traveler who travels back and forth simultaneously. These have been illustrated in Figure 1.
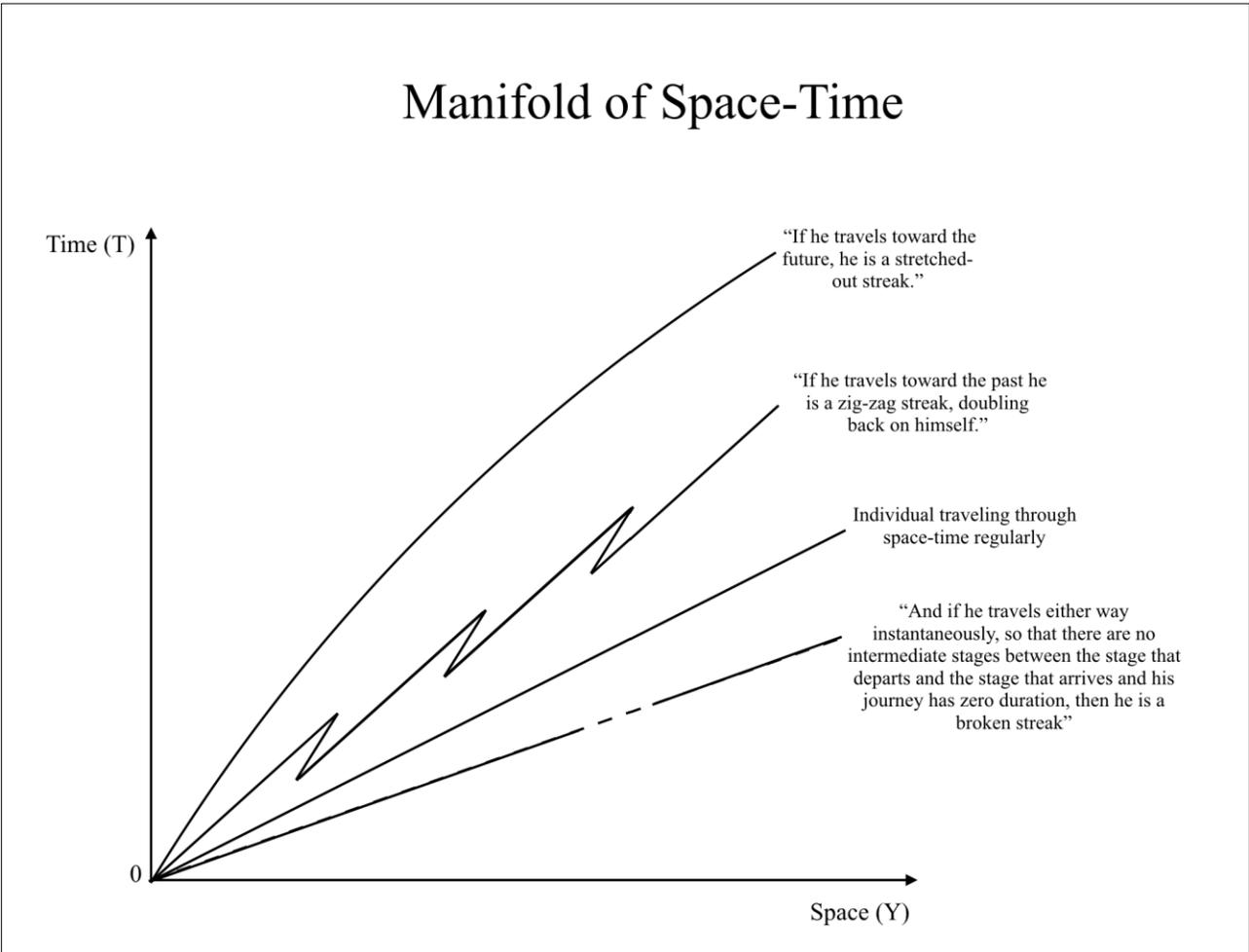
Figure 1: Forward time travel, backward time travel and simultaneous back and forth time travel illustrated on a space-time Cartesian plane (Lewis, 146).

Section 3: The Grandfather Paradox

The grandfather paradox highlights the fact that a time traveler killing his Grandfather eliminates a significant logical component that is essential to his existence. Through the act of killing one's Grandfather, the time traveler has effectively removed his parents and therefore himself from existence. This glaring logical contradiction is the basis of Lewis' paradox - if an individual doesn't exist, how does he travel back in time? This paradoxical example is rooted in the fact that there cannot logically exist an individual visiting the past who is both able and unable to change it. Ergo, the paradox stems from the notion that there seem to exist two conflicting premises, p and not p.

Lewis strives to resolve this paradoxical example by stating that there is no real contradiction at hand. The claims that the time traveler both can and cannot kill his Grandfather appeal to two different senses of the word, 'can.' Lewis explains that the conception of ability in this situation is highly ambiguous. By clarifying that the term 'can' is equivocal, Lewis highlights that both resulting conditions of the grandfather paradox are compatible and logically possible. He writes, "to say that something can happen means that its happening is compossible with certain facts" (Lewis, 150). The idea of compatibility, therefore, is related to logical alignment, wherein certain events only occur when they are in line with a collection of preconceived notions. The facts in question, in this case, are determined by the contextual relations between the event and the corresponding "fixed delineations of the relevant facts" (Lewis, 150). Hence, Lewis is stating that it tends to be difficult to consider which facts are legitimately pertinent to any given question regarding ability.

This argument can be extended by applying the Lewisian conception of compossibility to a contemporary example from daily life. Consider Tom, who both can and cannot speak French.

In this case, maintaining that an individual has the ability, or could commit an action presupposes that he has the capacity, given that certain circumstances are held fixed. Stating that Tom can speak French is in line with his brain's potential to learn another language. We are merely contending that Tom has the intellectual ability to learn French if he chooses to do so. Alternatively, one can state that Tom cannot speak French. In adopting the same linguistic and intellectual capacities, and therefore holding these circumstances as fixed, one can firmly say that Tom does not now know how to speak French — meaning that Tom would be unfit to communicate if he were randomly placed in a rural Parisian village. In this case, we are holding Tom's ability to learn new languages and intellectual capacity as fixed entities. This same line of reasoning can be drawn to past and future events. Stating that the time traveler can and cannot kill his Grandfather, holding fixed the past only equivocates both situations with respect to the definition of 'could.'

Therefore, it holds true that the time traveler can kill his Grandfather due to one set of facts that are compossible with him committing this action - motive, access to a loaded weapon and the appropriate training - thus making the situation conducive for him to commit the murder. Although there exists a collection of facts that are compliant with the time traveler killing his Grandfather, there exists a larger and more concrete set of facts that dictate the alternative result - namely that the time traveler was born to commit this very act. Hence, Lewis says, the time traveler both can and cannot kill Grandfather, "but under different delineations of the relevant facts" (Lewis, 151).

Lewis explains that, for the time traveler, "killing Grandfather is not compossible with another, more inclusive set of facts. There is the simple fact that Grandfather was not killed" (Lewis, 151). Lewis' theory presupposes that the mere fact that the time traveler is even alive to

contemplate killing his Grandfather means that he cannot possibly commit the action. It is illogical for the time traveler to kill his Grandfather regardless of his preparation and skill because he cannot possibly change the past. There exist two possible outcomes that arise from the killing of Grandfather that Lewis urges the reader to choose. It is the lack of an explicit decision between these two alternatives that give rise to a paradox, not the killing of Grandfather itself. He, therefore, demonstrates that what once looked like p and not p, is in fact, p and not q.

A possible objection to Lewis' grandfather paradox is based on rejecting the fact that an individual traveling back in time truly has the ability to kill his Grandfather. Lewis commits to this by theorizing that the universe will prevent the creation of closed, causal loops. According to Lewis, there must be extenuating circumstances that prevented the time traveler from killing his Grandfather, such as the possible misfiring of the gun. Lewis believes that appealing to compossibility resolves the paradoxical issue at hand, as he demonstrates in highlighting the issue of context dependence. Lewis believes that any individual has the ability to commit an action in a specific context if and only if this individual's actions are consistent with a certain set of facts in that context. Lewis does not elaborate on what this shared ground consists of, but it remains clear that this semantic solution does not truly get to the issue at hand.

Section 4: Impossibility, Improbability and Coincidence

David Lewis' argument for the possibility of time travel entails that the time traveler fails to kill his Grandfather. We can ask: How would this happen? There must be a commonplace reason such as the gun misfiring, someone getting in his way or him slipping on a banana peel before he can take the shot. By explaining that nothing more than ordinary occurrences is required to stop the time traveler from killing his Grandfather, Lewis aims to demonstrate that backward time travel does not necessitate the truth of contradictions and hence, backward time travel is, in fact, not impossible. It seems counter-intuitive to firmly state that an individual going back in time who doesn't kill his Grandfather does not possess the ability to do so. In fact, there exist numerous things that individuals don't do but possess the ability to do and very well could have done. This is a theory posited by Paul Horwich in his paper, *On Some Alleged Paradoxes of Time Travel,* wherein Horwich aims to build in ideas of improbability to resolve issues raised by Lewis. Horwich believes that given the natural human inclination for curiosity, there would undoubtedly be numerous attempts to 'bilk,' or alter the past. Horwich defines bilking attempts as actions on the part of the time traveler to alter what occurred in the past. Examples of such bilking attempts could include auto-infanticide, killing Hitler and even the paradox of killing one's Grandfather. According to Horwich, the "thwarting of such bilking attempts" will entail the occurrence of highly improbable coincidences (Smith, 367). Horwich rejects this notion that the 'commonplace' occurrences that prevent the time traveler from killing his Grandfather are not, in fact, ordinary, but are the active prevention of 'bilking' attempts' on the part of the time traveler.

Horwich argues that the necessary regular prevention of bilking attempts would require an "endless string of improbable coincidences." Thus, he maintains that if time travel into the past occurred, "there would occur certain phenomena that we have empirical reasons to believe

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will not, in fact, occur" (Horwich [1987], p. 123). Therefore, Horwich argues, that time travel into the past is highly improbable as it necessitates an array of highly unlikely moments of pure serendipity. Horwich maintains that backward time travel is not impossible, but highly improbable. The entailment of causal irregularities implied by Horwich is not based on a logical step, but rather "some sort of natural necessity" (Goddu, 562). Horwich never explicitly details the reasoning for 'bilking attempts' to be prevented, but one could suggest that the universe has some varied form of 'conscience,' and actively works to prevent the creation of contradictions. If one considers the possibility that the past pushes back when faced with logical fallacies and temporal contradictions, there is a potential that nature is self-regulating and will always manage to maintain a concrete and chronological structure. It will always aim to intervene and prevent any situation that can give rise to a paradox.

In his argument, Horwich employs what he labels the Principle of V-Correlation (or PVC) which poses a discussion about two events which frequently occur together. Whenever this is empirically observed, one can state that either one event is causing the other, or there is some universal third causal factor. Horwich explains the PVC as such: there "is always a chain of events between them ... or else we find an earlier event of type C that links up with A and B by two such chains of events. What we do not see is ... an inverse fork-in which A and B are connected only with a characteristic subsequent event, but no preceding one" (Horwich [1987], pp. 97-8). For example, suppose that two individuals who work in the same office, go to the bathroom at the same time, in one day. If this happens only once, this is no odd occurrence. But if these two individuals were to go to the bathroom at the same time every day for a whole year, one would assume that there was a common cause or direct causal link between the correlated

events. Perhaps the employees are meeting in the bathroom to plan a revolt, or they have the same scheduled break time — there exists a correlating causal link.

Now apply this to the allegorical situation of Tim who goes back in time to kill his Grandfather. Whenever Tim considers killing his Grandfather, Lewis' theory entails that some-one drops a banana peel in his path (or some other similar preventative measure), causing him to slip and his plan to be foiled. Therefore, it appears that there will generally be a link between Tim's attempts to kill his Grandfather and the occurrence of rogue banana peels that cause him to slip. In this correlation, there exists no direct causal link between the two events, and as demon-strated above, the occurrence of such a non-correlation would be extremely rare. Hence back-ward time travel is as rare as two employees at work randomly going to the bathroom at the exact same time for a whole year.

In his paper, *Bananas Enough for Time Travel*, philosopher Nicholas J. J. Smith main-tains that Horwich's improbability objection does not, in fact, entail the impossibility of back-ward time travel. Smith believes that "backward time travel does not entail an unusual number of improbable coincidences" as argued by Horwich, and that, "even if it did, this would not render time travel impossible" (Smith, 364). At the outset, Smith explains the inherent connection be-tween backward time travel and backward causation. Given any situation of time travel into the past with extenuating causal circumstances, it seems that backward causality is maintained as a basic logical standard. Take the example of the time traveler who drinks a little too much at his time travel farewell celebration and ends up in the past with a hangover — it seems intuitive to accept the fact that events in the present have the ability to affect the past. Simply distinguishing between personal and external time dispels certain glaring logic issues of backward time travel

and causation. Smith maintains that any objection to backward causation necessarily, or *a forti-ori*, entails an objection to the possibility of backward time travel. Hence, Smith explains, one must set aside any preconceptions against backward causation to understand his argument.

It is a given, therefore, that time travelers can easily affect the past, but Smith explains that the question remains: "can they change it?" He maintains that it is impossible to go back into the past with the *sole aim* to prevent or create the occurrence of events that change the course of history. Smith explains that it is this incorrect notion that lays the foundation for what he calls, the "second-time-around fallacy" (Smith, 365). Smith elucidates that there can exist no 'first time round' of events without the time traveler present, followed by a set of exactly identical events wherein the time traveler plays an active role. Hence, it appears that Smith believes that time travel with bilking attempts are inherently contradictory. He explains that "a complete chronicle of events occurring at the time to which" an individual travels explains his "arrival and actions," before the point at which the time traveler has even left for the past (Smith, 366). Smith argues that backward time travel, which inherently entails several improbable coincidences, does not necessarily show that time travel of this sort is improbable. He believes that this only demon-strates that time travel of this kind has not occurred in our temporal vicinity, the six or so million years that our ancestors have been on this Earth. This further demonstrates that backward time travel does not, in fact, lead to the creation of a string of unlikely slips on banana peels and such.

Smith questions the idea that PVC violating coincidences, or any attempts to prevent bilking are even improbable at all. By analyzing Horwich's conception of PVC, Smith demon-strates that Horwich has, in fact, reversed the logical conception of causation. It seems that PVC concerns "simply what has been observed" and thus is "a purely de facto principle" (Smith, 368).

Smith demonstrates that Horwich is relying on the simple fact that it is extremely rare, or 'im-probable' to witness the existence of any PVC violating condition. By analyzing the idea that backward time travel occurs only rarely due to the necessary existence of PVC violating conces-sions, Smith shows that Horwich's reasoning is based on a simple empirical rarity.

Smith dismisses the improbability condition outlined by Horwich. To demonstrate this, Smith employs the parallel example of a busy highway and a mischievous time traveler who is rolling tomatoes down a road. Take the case of Foothill Boulevard in Claremont, CA, which in 1910, was a small street, with a few horse-drawn carts passing through it every so often. In 2017, this small street has become a bustling highway with several high powered automotive vehicles cycling through it constantly. A mischievous time traveler gains access to a time machine and goes back to Foothill Boulevard in 1910, and begins to roll tomatoes down the road.

In 1910, it would be intuitive to state that most tomatoes would roll down the road with-out being run over, and hence it is coincidental if one tomato did not reach the other end of the road. In 2017, given the existence of urbanization, the prevalence of automobiles and the mere fact that Foothill Boulevard has developed into a busy highway, it seems intuitive to state that tomato squashings are no longer coincidental. Here, Smith argues that improbability is a neces-sary condition for coincidence. Therefore, one can state that in the present day, the squashing of tomatoes is no longer coincidental, as it is no longer improbable.

By substituting the occurrence of backward causation for the increase in number of cars and bilking attempts for tomato rolling, Smith exemplifies that to assume that because something occurs rarely, the fact that it must be improbable is not a logical necessity. Smith explains that PVC violating phenomena "will only ever be encountered extremely rarely" — for such phe-

nomena might be logically inexplicable (Smith, 370). Essentially, one cannot conclude that backward time travel necessitates improbable coincidences because the conception of improbability is entirely relative to our perceived, empirical world of coincidences. It may be simple to state, at this current junction in the space-time plane that backward time travel necessitates improbable coincidences, but this may very well change given advancements in technology, science and our understanding of space-time.

Smith proceeds to completely deny the fact that time travel entails unusual coincidences by reversing the causation through retrospective forms of reasoning. He argues that to assume that it is a string of coincidences that prevents a time traveler from changing the past is a "backward way of putting the matter" (Smith, 375). He explains that instead of questioning what must occur to prevent a time traveler from killing his Grandfather, one should look at what actually did occur. Clearly, whatever the time traveler sets out to do has already been done. If the Grandfather survives to birth the time traveler's father, it appears that this is because the time traveler failed to murder him. Smith essentially maintains that it is getting things "back to front to say that the time traveler's attempts to murder" his Grandfather "must fail — and that therefore they entail the occurrence of coincidences that they do fail" — simply because we know the fact that Grandfather continued to live and died a death of natural causes in his sleep many years later (Smith, 374). Smith explains that the presence of the time traveler guarantees that Grandfather does not die, but only because he got lucky and the time traveler suffered a fail bilking attempt.

Smith argues that Horwich's understanding of improbable consequences relies on highly illogical and counterintuitive reasoning. He contends that causal coincidences contribute to an individual's identity rather than one's identity requiring an array of improbable coincidences. To demonstrate this, he utilizes the event of his birth and explains that "the only sense in which the

identity requires the coincidences is the back to front sense in which my birth requires my ancestors not to have died childless" (Smith, 376). By flipping the entire argument on its head, Smith maintains that it is wrong to hold fixed an event without analyzing the events which both precede and succeed it. If one analyses an event 'back to front,' it seems that the creation of coincidences becomes very simple. This is analogous to the case of the grandfather paradox. By holding the existence of a time traveler fixed, without any contextual reference one is simply looking for any event that may appear coincidental. By demonstrating that the very nature of coincidence is entirely relative, Smith strengthens his argument that backward time travel does not entail strings of improbable coincidences.

Smith explains that any argument that aims to derive improbable coincidences as its output should, in addition to backward time travel itself, utilize a collection of equally as rare and unlikely inputs. Hence, Smith argues that to derive "large numbers of output coincidences," such as those improbable events described by Horwich, "the objections need to stipulate the occurrence of large number of input coincidences." (Smith, 381). In short, Smith explains that the only worlds in which backward time travel and bilking attempts exist are those where such a large number of coincidences cannot be considered 'improbable.' By demonstrating this, Smith aims to highlight that an objection similar to that of Horwich's only shows that backward time travel will not occur in our close, temporal future. It does not manage, however, to demonstrate the improbability of certain events, that can be construed as coincidences. Using two counterfactuals relating to a specific case of a travelers attempt to change the past, Smith shows that Horwich's objection essentially explains nothing about the nature of time travel.

Philosopher G. C. Goddu argues along a similar line of reasoning to Smith in his paper, *Banana Peels and Time Travel*, but aims to illustrate that Smith's reasons for rejecting the claim

that time travel entails unusual numbers of coincidences is inadequate. He demonstrates that "debate over the consequences of the coincidences of time travel cannot be avoided by denying" these coincidences themselves (Goddu, 559). Goddu highlights that Smith fails to demonstrate sufficient reason as to why time travel entails an unusual number of coincidences. In his argument, Goddu lays out sufficient reasoning to both accept and deny the possibility that a time traveler can alter the past. Given that a time traveler is successful, there arises an implicit contradiction as demonstrated by Lewis. If we assume that the time traveler fails, we imply the existence of a collection of highly improbable consequences. Goddu maintains that repeated failure is the result of these odd coincidences, and hence worlds, where time travel exist, are, "at the very least, most strange and odd worlds" (Goddu, 561).

By demonstrating how Smith's reasons for doubting the premise "Time travel, of the sort philosophers are primarily interested in, entails unusual numbers of coincidences" are inadequate, Goddu highlights that the debate over its consequences cannot be so easily avoided. (Goddu, 559). For the purpose of analysis, Goddu lays out Smith's argument in series of numbered steps. He proceeds to state that all that is required to prove this argument ineffective is to prove Smith's initial premise false.

The first premise of Smith's argument is as follows: "Time travel, of the sort philosophers are primarily interested in, entails unusual numbers of coincidences" (Goddu, 559). To arrive at this, Smith employs this line of reasoning:

1.   a. "Regular, local, etc., time travel into the past involves serious bilking attempts

        and,

        b. Serious bilking attempts generate improbable strings of coincidences" (Goddu, 562).

2.   "Time travel, of the sort philosophers are primarily interested in, entails unusual numbers

of coincidences" (Goddu, 559).

Goddu explains that the line of reasoning for Smith's initial premise must be scrutinized as it lays the logical foundation for the rest of Smith's argument. According to Smith, backward time travel itself does not entail a large number of output coincidences, but rather, it is the existence of such rare and improbable inputs that permit their existence. Smith essentially explains that to derive a large number of output coincidences, one must consider a proportional, and therefore, a substantial number of input coincidences. Hence, Goddu explains that Smith is basically arguing that, "Time travel, of the sort philosophers are primarily interested in, entails unusual numbers of output coincidences only if large numbers of input coincidences are assumed" (Goddu, 563). It follows that all that is required according to Smith's strategy is to demonstrate a clear case with an odd number of output coincidences without any assumption of input cases. Essentially, Smith is arguing that any output coincidence is a result of an improbable amount of fallacious reasoning, and therefore any case of time travel which generates improbable output coincidences will have similarly impossible inputs. Hence, one can state that Smith is arguing for the following premise: "Regular, local, etc., time travel into the past involves serious bilking attempts, only if improbable coincidences (at the very least improbable amounts of fallacious reasoning) are assumed" (Goddu, 565).

When one aims to reconcile this conception of 'fallacious reasoning' with the earlier premise that "bilking attempts generate improbable strings of coincidences (1b)," it appears that Smith's appeal to the reasonability of claims falls short of an answer. Goddu explains that "assuming that regular time travel and fallacious reasoning are not necessarily connected," allows for the possibility of backward time travel without the need for such fallacious reasoning. But if

bilking attempts really do require fallacious reasoning as Smith maintains, there could be attempts at backward time travel without bilking, and hence premise 1a has been rendered false. Furthermore, appealing to this reasoning that bilking attempts are necessary for the existence of coincidences, Goddu states that lack of bilking attempts will entail the existence of absolutely no coincidences, and hence demonstrates how premise 1 is false in itself. Hence, Goddu maintains that "local… time travel does not, by itself, entail long strings of coincidences" (Goddu, 565).

As Goddu points out, the crux of Smith's argument lies in the claim that "the generation of repeated attempts to bilk the past requires an improbable amount of fallacious reasoning" (Goddu, 565). Goddu explains that Smith does not develop this premise correctly. He emphasizes that "bilking the past requires an improbable amount of fallacious reasoning and if the output coincidences can only come about as the result of bilking attempts, then time travel will not generate the output coincidences without an improbable amount of fallacious reasoning" (Goddu, 565). In dismissing Smith's argument, Goddu employs an example that demonstrates an improbable collection of outputs without sufficient improbable input. Suppose that scientists have gained access to a time machine, and it is a commonplace belief to think that changing the past is physically impossible. It is maintained that one crucial aspect of the scientific method hinges on the natural curiosity of human beings and is the confirmation of specific theories in science. It seems intuitive then, to assume that these scientists would go back in time to alter the past, simply as a process to scientifically test the theory. Suppose now, that scientists run a barrage of experiments to gain information about the nature of temporal constraints in changing the past. When these experiments are run, there is a continuous cycle of failure and success which inevitably leads to the creation of what we previously thought of as, 'improbable consequences.' In this scenario, it seems we have backward time travel with the intent to change the past, no fallacious

reasoning, but yet a sequence of seemingly improbable coincidences. At this junction, any de-fender of Smith's theory will argue that unlike many other cases, it is *obvious* that changing the past is impossible. Under this assumption, the supposition whether the past can change remains an entirely open question that itself is highly improbable. Hence, it's true that bilking requires an un-proportionate amount of fallacious reasoning, not because of the simple logical impossibility of changing the past, but rather because it is so obvious that changing the past is logically impos-sible. (Goddu, 569).

It appears that Goddu's real worry stems from the logical impossibility of changing the past due to the improbable amount of fallacious reasoning required to encourage time travelers to indulge in bilking behavior in the first place. People attempt the impossible all the time. Goddu maintains that the mere fact that, by hypothesis, "changing the past is impossible, is not itself sufficient reason to maintain that getting time travelers to try to change the past would require unusual amounts of fallacious reasoning" (Goddu, 568). He explains that there exist several in-stances where individuals have tried to attempt what is seemingly impossible. Furthermore, Goddu rejects the fact that changing the past is obviously logically impossible. His argument against the logical impossibility of changing the past begins with an allegorical example of time travel. By demonstrating that once 'obvious' contradictions of time travel require a collection of empirical observation regarding the nature of time, Goddu argues that there are "consistent tem-poral structures on which the past changes," and so the presumingly obvious claim that one can change the past is no longer as obvious as it seems, but "turns out is false" (Goddu, 570).

Ultimately, Goddu rejects Smith's notion for denying the fact that time travel into the past does not entail a long string of improbable coincidences. Smith's reasoning depends on the

logical impossibility of changing the past and obviousness of this notion. Both these are weaknesses that Goddu attacks in his argument. By highlighting the existence of improbable outputs in a given case, while demonstrating that there exists no fallacious reasoning or improbable inputs, Goddu demonstrates that Smith fails to show that time travel worlds do not involve bilking attempts that result in unusual coincidences.

Smith's analysis of the seemingly paradoxical situation of Tim killing his Grandfather has sparked a number of philosophical questions regarding causality, probability and reasonability. This is just one line of argument that has been employed in response to Lewis. A collection of other philosophers and scientists have pursued an alternate, yet equally engaging possibility.

Section 5: The Multiverse Thesis

It has been theorized that issues relating to causality in Lewis' grandfather paradox can be resolved by adopting a theory of multiple universes. The multiverse consideration utilizes the idea of a collection of infinite and identical branching universes to resolve the paradoxical issues at hand. In this theory, rather than a time traveler journeying into the past of his universe, he travels to an entirely alternative, yet numerically and qualitatively identical universe. Thus, when viewed from a multiverse lens, it can be stated that Tim travels back from the year 2001 in universe A, leaving his universe and time, not into 1950A as he intended, but the year 1950 of an entirely alternate universe B, or the year 1950B. Any advocate of the multiverse believes that an action undertaken by an individual after traveling into the past occurs in an alternative universe and therefore has no potential to affect, and thus, contradict the events of his own, original universe. Lewis believes that adopting the theory of the multiverse is merely a method to evade the real metaphysical and causal question at hand. By introducing the multiverse consideration, Lewis believes that one is changing the nature of the paradox entirely. When Grandfather lives in one branch and dies in another — it seems intuitive to label this as universe travel as opposed to time travel. With the nature of the question changed entirely, it is obvious to assume that the answers will vary greatly too.

Several metaphysicians have worked to resolve Lewis' infamous paradox by appealing to the multiverse thesis. Scientists David Deutsch and Michael Lockwood argue in their work, *The Quantum Physics of Time Travel* that the laws of physics and quantum mechanics do not prevent the creation of closed causal loops such as those arising in the grandfather paradox. Deutsch and Lockwood argue that any attempt to alter the past leads to the creation of 'closed timelike curves' (or CTCs). If one were to follow these curves all the way around, the authors explain,

one would bump into their earlier self and get pushed aside. Effectively, Deutsch and Lockwood maintain that by following these CTCs along their temporal routes, we possess the ability to return to the past and participate in events that occurred there — thereby implying that one could shake hands with his younger self or even kill his Grandfather if one so pleased.

Deutsch and Lockwood contend that the existence of CTCs is entirely dependent on various quantum mechanical theories regarding the possible formation of these curves. In fact, they explain that "quantum mechanics may necessitate the presence of" CTCs, even at possibly subatomic scales (Deutsch and Lockwood, 72). Hence, the issue at hand is how one can use the theories of quantum mechanics to resolve the paradoxes of time travel. Deutsch and Lockwood explain that the "grandfather paradox, for one, simply does not arise" when viewed through the analytical lens of quantum mechanics. They explain that if one's classical conception of the space-time plan contains CTCs, then according to the laws of quantum mechanics, the universes that exist in the multiverse "must be linked up in an unusual way," effectively creating a "singled convoluted space-time consisting of many connected universes." Therefore, Deutsch and Lockwood explain that these links force a time traveler to 'hop' to an identical universe right until "the instant of her arrival … but that is thereafter different because of her presence" (Deutsch and Lockwood, 73). The scientists are effectively defending the view of the multiverse. By positing the existence of multiple, identical universes, Deutsch and Lockwood are avoiding theoretical paradoxes of time travel by appealing to the ideals of quantum mechanics.

Thus, any time traveler going into the past is not constrained in what he chooses to do, and in fact, according to the laws of quantum mechanics, the simple idea of constraining this is impossible. Deutsch and Lockwood maintain that however "convoluted" the plans of the time traveler, the laws of quantum mechanics dictate that all these pre-existing identical universes

"link up in such a way" that a time traveler can carry out his plans in a consistent logical fashion. This means that Tim can travel back into an alternate universe and effectively kill an alternate, yet identical version of his Grandfather (Deutsch and Lockwood, 73). The authors understand that the multiverse consideration proposed by them is not the typical one of parallel universes posed in classic science fiction, but rather, an analysis of the "logic circuits" that presuppose the existence of CTCs, and the ways through which information is passed through them (Deutsch and Lockwood, 74).

John Abbruzzese utilizes the multiverse consideration raised by Deutsch and Lockwood to consider potential philosophical objections that arise when one resorts to a theory of multiple, parallel universes in solving the paradoxes of time travel. Abbruzzese explains that at least, "prima facie," adopting a theory of multiple universes allows "for the reality of tense" (Abbruzzese, 36). In demonstrating as to why the multiverse theory does not provide a sufficient answer to the grandfather paradox, Abbruzzese stresses that multiverse travel and time travel vary greatly.

In analyzing the multiverse thesis, John Abbruzzese maintains that one principle must be held true by all accounts. He explains that "for every time t, there exists a universe w, such that the present time in w is t" (Abbruzzese, 36). Abbruzzese stresses that for multiverse time travel in an A-series, as outlined by McTaggart, there must be for every time, a universe at which that time is present. This premise implies the existence of infinite and possibly, multiple possible universes and attempts to resolve the grandfather paradox by appealing to the concept of universe travel. Even though one can question whether past and future instances for a given particular universe even truly exist, Abbruzzese maintains that these times do exist relative to the time traveler's personal conception of time, at least "in the sense that every time which is past or future in his universe is present in some other" (Abbruzzese, 37).

The multiverse theory presupposes the existence of infinite iterations of similar universes, with infinite universes at which a given time is considered present. Abbruzzese accepts that there is an infinite number of identical universes that predate the time traveler's journey and hence when a time traveler goes back in the past to an alternate universe, he does not effectively create a new universe but occupies a pre-existing one. Abbruzzese explains that this idea of universe travel is not inherently similar to that of time travel, and in fact, one can consider an individual traveling across universes as opposed to back in time. Hence, it would seem intuitive to assume that universe and time travel vary greatly, and on many accounts, but this is not the focus of this paper.

In accepting that the time traveler has the ability to affect the past if he travels from universe A to universe B, Abbruzzese agrees that this conception of time travel is profoundly different from that of Lewis. He suggests that instead of thinking about it as an individual traveling back into past A, he is, in fact, traveling across universes and occupying an entirely separate dimension of time and space. It is also critical to note that the time traveler going back in time to universe B does not align with Lewis' conception of time travel. Instead of traveling into the past of universe A, the time traveler is traveling into an almost identical past in universe B. Abbruzzese maintains that, in this case, the exact similarity of conditions, events, and circumstances does not presuppose identity. He explains that to defend a genuine account of backward time travel, proponents of the multiverse must "endorse a principle about the identity of times across universes" and simply put, such a principle is not available to defenders of the multiverse (Abbruzzese, 37). It remains that year 2000 in universe A, and universe B is inherently different. Hence, exact similarity falls short of simple numerical or qualitative identity, and the multiverse does not seem to provide an adequate solution to the logical contradictions of the grandfather paradox.

There are many instances of exact similarity which do not entail identity. Consider a large piece of bronze, used to construct a statue. The bronze is worked at for years, by different artists and sculptors and eventually placed in the city square. Before and after the sculpting process, the bronze is still made up of the same collection of atoms, yet its physical form has changed entirely. In this case, the similarity of the atomic structure of the chunk of bronze and statue in the city square does not entail a consistent identity, but in fact, demonstrates change and growth. But the question arises: If the physical (and therefore qualitative) identity of the bronze has changed, is this truly a case of exact similarity? Therefore, an individual defending the multiverse theory must rest his argument on the crux that times across multiple universes are identical. Needless to say, this is a large and potentially dangerous assumption to make, and Abbruzzese utilizes it to highlight the core weakness of the multiverse theory.

In highlighting the distinct differences in time and universe travel that arise due to the above notions, Abbruzzese accepts the fact that the multiverse theory cannot provide a sufficient solution to the grandfather paradox, and believes that adopting a solution of infinite and identical universes changes the nature of the question entirely. Essentially, Abbruzzese concludes by accepting that the multiverse theory offers a weak solution to the grandfather paradox and resorts to altering the nature of time to resolve the identity issue he raises. Ultimately, he maintains that while the multiverse solution may, "saddle the defender of time travel with commitments to causal loops and oddities that burgeon from the tales of science fiction," it provides no relief from the "greater sin of ontological glut" of considering the multiverse as a legitimate solution to the grandfather paradox (Abbruzzese, 38).

In his paper, *An unwelcome consequence of the Multiverse Thesis*, philosopher Nick Effingham pursues these ideas further and poses several reasons to reject any conception of time

travel in the multiverse. By expanding on the notion that extended objects cannot travel in time, Effingham raises a prominent cause for concern. He aims to address questions of identity and similarity by introducing the idea of "fission counterparts." Effingham postulates that when an object splits in two, it is intuitive to state that both counterparts were needed in the formation of the initial object. Hence, these counterparts remain distinct, yet similar and "appropriately connected" (Effingham, 377). By appealing to this idea, Effingham outlines the case of a time traveler who goes back into target time t and causes the universe to fission, such that both universes and their separate contents share every temporal part until that given time, t. Hence, it can be stated that every instant in universe A counts as being the same instant in every other universe - entailing that an instantaneous new universe was created through fission. This is in line with Abbruzzese's conception of identity and is a major crux in Effingham's defense.

Effingham's conception aims to transform the multiverse theory into one that considers branching timelines to prove its impossibility. By expanding on the idea of "appropriate connection" between alternate universes, Effingham outlines his core theory that when an individual travels back into time from universe A to B, these universes are appropriately connected through an overlap in the events that occurred right up to time t, when the time traveler arrives (Effingham, 379). To highlight the unwelcome consequence that he is describing, Effingham demonstrates a case where the time traveler enters a universe without the appropriate connection of temporal parts. In doing this, he explains that if the region of space where the time traveler "ends up … has radically different physical properties" from his original universe, one can state that this does not count as time travel (Effingham, 380). Say a traveler goes back into time but arrives at an alternate universe where the Nazis have won the second world war. Hence, one can state that these universes share an appropriate connection until the war was won in 1945. Thus, any

instance of multiverse time travel is not aligned with Lewis' conceptions of time travel or backward causation. Clearly, Effingham is obstinate that the Multiverse theory does not reconcile any paradoxical issues raised by the grandfather paradox.

Effingham proceeds to demonstrate why the multiverse theory renders time travel completely impossible by demonstrating the fatal risks of universe travel. He maintains that generally accepted scientific opinions dictate that time travel must entail travel through a specific region of spacetime, a region which connects the past to the future. This is in alignment with Lewis' conception of space and time as four-dimensional manifold. The second generally accepted scientific fact about time travel outlines that time travel through a gateway occupies a given portion of time. This implies that any specific gateway has the potential to send an individual back x years into time. To avoid the issues of 'universe hopping' outlined by Abbruzzese, Effingham effectively utilizes concepts of fission and appropriate similarity with an objective to show why the multiverse thesis is a weak attempt to answer the grandfather paradox. By applying a conception of branching time, Effingham demonstrates that the multiverse thesis is false, as it encounters grave metaphysical consequences. Effingham maintains that the multiverse thesis is not a viable metaphysical response to Lewis by presenting an array of reasons as to why it is illogical, practically impossible and potentially dangerous.

The 'unwelcome consequence' discussed by Effingham is known as the slicing objection. By applying a multiverse conception, Effingham intends to demonstrate an alternative logical contradiction concerned with the very nature of time travel. To begin this argument, Effingham introduces the Interval Hypothesis, which explains that there exists some interval such that if three individuals decide to travel to their chosen target time, and they are not separated by an interval greater than five seconds, they will all travel to the same universe. If these individuals

were to time travel at any interval greater than five seconds, they end up in an alternative universe. For the sake of understanding, consider the example of time travelers, Andrew (A), Bernadette (B) and Charlie (C), all of who stumble across a time machine and decide to travel to the year 1969 to see Jimi Hendrix at Woodstock. All the time travelers understand the Interval Hypothesis and enter the machine five seconds after each other, ensuring that they end up in the same universe. Thus, A, B, and C all end up in the year 1969 in universe A. If they were to travel at any interval greater than five seconds, and say that for the sake of argument, C trips while entering the time machine, they would end up different universes. Thus, if C travels six seconds after B, C would end up in the year 1969, in a completely different universe from A or B.

If one was to change the interval of time between which A, B, and C traveled back into the past to three seconds, and applied the same interval constraint of five seconds as earlier, it seems that the Interval Hypothesis runs into a problem. Given that B traveled back into time three seconds after A, and C traveled back into the past three seconds after B, we have an interval of six seconds between A and C, but they arrive in an identical universe. It seems that we have incurred a logical impossibility. The Interval Hypothesis aims to ensure that time travelers who want to travel to the same universe possess the ability to do so. But in the example above, it appears that the last traveler has arrived in the same universe as the initial traveler in sequence while exceeding the predetermined interval. Even though C left more than five seconds after A, they arrived in the same universe. Let us say that time between any two individuals entering the time machine can be demonstrated as X-Y. Hence, one can state that the time travel proceeds as follows: A-B and B-C. This given interval (demonstrated by -) is the maximum amount of time travelers should take before entering the machine to ensure that they arrive in the same universe. The sum of the intervals between A-B and B-C is greater than the overall interval between A-C,

implying that A and C do not end up in the same universe. This was the problem which the Interval Hypothesis was initially avoiding, and therefore by *reductio*, Effingham concludes that the Interval Hypothesis must be false.

Effingham proceeds to state that given that the Interval Hypothesis has been proven false, one should endorse, what he very clearly labels, the 'Slicing Thesis.' This hypothesis assumes that if two time travelers exist in the same universe, and one of these individuals chooses to travel back to target time t, and the other travels to an alternate target time, t', the first traveler ends up in a universe, completely different to the second. For the first traveler, the universe in which he lands shares all the temporal parts of the original universe until time t, and for the second traveler, the destination universe shares all the temporal parts of the original universe until time, t'.

Given these two scientific presuppositions, Effingham explains his Slicing Hypothesis. Since Effingham has proven that the Interval Hypothesis is impossible, by way of *reductio* he demonstrates why multiverse hopping is potentially fatal. When an individual enters a spacetime gateway, there is a given proportion of time difference between the first and the last part of the body entering the gateway. Whether this difference is a few seconds or even milliseconds, there still exists a separation between any temporal parts of an individual. Hence, Effingham explains that when an individual travels through a gateway, his physical body is sliced into an infinite number of two-dimensional slices as the first part of his body exits the gateway before the last part. In this case, each slice of the individual corresponds to the two-dimensional part of him that entered the gateway at any given instant of time.

Effingham's argument can be understood as such:

1. If the Interval Hypothesis is false, the Slicing Thesis is correct.

2. The Interval Hypothesis reads: There is some interval such that if

(i) an individual (x) travels to any target time (t),

(ii) and another individual (y) travels to the same time in an alternate universe, (t'),

(iii) t and t' are not separated by an interval greater than i,

(iv) then x and y travel to the same universe

(v) if the interval is greater than i, they travel to diff universes

3. If there are, in fact, three travelers, x, y and z who are all separated by a gap of i, x and z would be separated by a gap of 2i, implying that they, in fact, did not arrive at the same universe

4. The Interval Hypothesis is false

5. The Slicing Thesis is correct.

6. Any attempt to time travel will result in an individual being divided up into an infinite collection of temporal parts and scattered across infinite, yet identical universes.

Thus, Effingham maintains that when an individual enters a gateway to travel through time, infinite two-dimensional slices of his body are placed in infinite, alternative universes. Therefore, given the multiverse thesis, extended objects do not have the ability to travel through time. Any attempt to do this will result in these objects being 'sliced' into an infinite number of two-dimensional pieces and scattered through infinite, alternate universes in the manifold of space-time. Effingham fittingly states, "Gateways are not time machines, but are instead the ultimate slicing machines" (Effingham, 382). In his argument of the grandfather paradox, Lewis does not elaborate on the nature of time travel. Therefore, it is difficult to analyze Effingham's argument through Lewis' lens. Without any information regarding the nature of travel into the past, the machine Lewis describes, or the existence of particular spacetime gateways, it is extremely difficult to contend the Slicing Thesis with any philosophical argument that Lewis poses.

It remains though that any attempt at reconciling the multiverse thesis with Lewis' conception of time travel does not prove successful. Universe travel is *simply not* the same as time travel and cannot be philosophically treated as such.

Section 6: Conclusion

David Lewis' pivotal work on this seemingly rudimentary case of backward time travel sparked a barrage of impassioned responses from scientists and philosophers alike. It is evident that Lewis' discussion of the grandfather paradox raises several fundamentally interesting philosophical questions regarding the logical and causal irregularities of changing the past. His core focus on context dependence set the tone for the objections and analyses to come. Effectively, Lewis uses the case of Tim killing his Grandfather to resolve competing claims in dismissing the paradoxical nature of backward time travel. Clearly, Lewis' response to the paradox was unsatisfactory. The goal of this paper was to analyze why. In considering multiple philosophical viewpoints, I have set out to dissect Lewis' defense for time travel completely. In the analysis, my goal as a philosopher was to examine the paradox in such a way that I highlighted plaguing philosophical issues that Lewis' defense faces.

Two alternative solutions to the grandfather paradox were discussed in this paper. The first is a result of Horwich's reply to Lewis and aims to pit the Lewisian conception of compatibility against Horwich's improbability defense. Proposed by Smith and Goddu, this theory explains that any attempt at backward time travel will lead to the creation of long strings of improbable coincidences. This section of the thesis was targeted at clarifying the nature of context reliance in cases of impossible, or even improbable coincidence. An alternative thesis of the multiverse was also discussed, wherein it was proposed that instead of traveling into his past, the time traveler enters an alternate, yet completely identical universe. The multiverse thesis did not stand up to any philosophical critique and was harshly critiqued by Effingham and Abbruzzese, who came to the agreement that it changes the nature of the question entirely. Therefore, the question remains: Which theory provides a more robust answer to the grandfather paradox?

Both theories aim to target Lewis' key defense for time travel by answering the question as to whether Tim can truly affect his past. I believe that the thesis posed by Horwich, Smith, and Goddu is stronger than the multiverse thesis, and exists as a more plausible explanation for the grandfather paradox. Alternatively, the multiverse thesis is a weak attempt at answering the real philosophical questions raised by the grandfather paradox. While the multiverse thesis poses a philosophically reasonable alternative to Lewis' solution, any application of the thesis ultimately leads to the creation of a barrage of new philosophical questions.

Firstly, the discussion posed by Horwich, Smith, and Goddu regarding improbability and coincidence directly targets Lewis' conception of compossibility. By applying Lewis' conceptions of ability and impossibility against him, Horwich sets up a foundational base for Smith and Goddu to argue. Furthermore, all these authors utilize a Lewisian conception of coincidence to show that what once seemed impossible is truly not. In introducing probability as a key motivating factor, Horwich allows Smith and Goddu to show that any attempt at backward time travel does not, in fact, lead to a long string of improbable coincidences. The extent of 'improbability' in this case is the facet of Smith's argument that lacks enough expansion. Once again, this is an issue of context dependence and is highlighted by Smith. In his example of tomatoes being rolled down the highway, Smith aims to demonstrate that what may seem improbable is truly not. By stating that improbability is a factor of exposure and relative to our understanding of the universe, Smith works to strengthen his argument.

Smith's argument effectually works to elaborate on the Lewisian conception of context dependence in dismissing the notion of 'compossibility' from which it initially stemmed. Coincidence is the core concept being applied in this case and seems to be highly relevant in a discussion of backward time travel. Smith and Goddu agree on the core principle that time travel into

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the past does not entail a long string of coincidences, and I'm inclined to agree with this notion. Ultimately, Smith uses the obviousness of impossibility to demonstrate his reasoning, but Goddu questions this premise, highlighting circumstances where improbable outputs are a result of completely logical inputs. Goddu maintains that Smith's reason for defending his concept of 'fallacious reasoning' is incomplete.

Yet, the question of what can be concluded from these strange coincidences of time travel still render this discussion incomplete. And further, will these strange coincidences truly stop Tim from killing his Grandfather? It remains unclear to me whether Horwich's 'bilking' defense truly poses a threat to Lewis, but I can definitively say that Smith's application of Horwich's principle (PVC) highlights the important problem of reversing causality in cases of backward time travel. In reversing the causality for the event of his birth, Smith highlighted the inconsistencies in Horwich's argument. It seems intuitive, therefore, to conclude that coincidences, such as attempts to prevent bilking, are not impossible in a world like ours, but rather, improbable.

While the focus on improbability and coincidence directly interact with some of Lewis' initial points, the multiverse thesis distracts from the key philosophical questions at hand. Instead of questioning the idea of ability, the multiverse thesis poses a several questions regarding the similarity of universes, nature of travel through gateways and body slicing. Needless to say, none of these were concepts were tackled by Lewis' initial argument, and I believe this is for good reason. By simplifying the nature of travel through time to include only one universe, no temporal gateways and a specific distinction between personal and external time, I believe that Lewis bases his argument on a simplified nature of time travel to target the key philosophical question of ability at hand. The multiverse thesis simply distracts from this. Evidently, any attempt to reconcile the multiverse thesis with backward time travel is ultimately fruitless.

At its core, the multiverse thesis changes Lewis' question entirely. By taking the case of universe hopping as opposed to time travel, an exploration of the grandfather paradox through a multiverse lens simply alters the nature of the case at hand. Instead of discussing the extent of Tim's ability when he travels back in time, the multiverse thesis draws away from this discussion and instead focusses on the similarity between universes and similar irrelevant philosophical considerations. At best, the multiverse thesis poses a weak suggestion as to why closed causal loops cannot be created in *our* universe. By suggesting that any attempt at time travel leads to jumping between universes, the multiverse theory evades the true nature of the 'paradox' at hand. As a response to Lewis, the multiverse thesis is at best, satisfactory. The multiverse theory is an easy alternative to adopt, but it is philosophically weak. While it may resolve the paradox, the multiverse thesis is only a satisfactory answer if a number of preconceived conditions are adopted. For any acceptable concept of infinite universes to be applicable, one must posit a theory of times between universes, the nature of temporal gateways and the like. These are just some examples of the many philosophical assumptions regarding the nature of time and our universe necessitated by the multiverse thesis that I would prefer not to make.

While considering a four-dimensional conception of time and space, this discussion of time travel fails to take into account questions of determinism, fatalism or free will in its analysis of causality. Taking a fatalist approach to this situation, entirely re-imagines the grandfather paradox. Fatalists operate under the assumption that there are concrete truths about an individual's future actions and outcomes are predetermined. Lewis' theory leaves this entirely open to speculation. A fatalist would consider it a fundamental truth that Grandfather lived, as Tim is even alive to consider killing him. Raising questions about his ability is rendered pointless, as any ac-

tion he was going to commit has been written into the timeline of history. The fatalist would contend that any attempt to alter the past is fundamentally doomed to fail. Lewis' defense against fatalism is weak. He asserts that any fatalistic response uses information from future events to dictate relevant facts about the past, and resorts to the same argument of equivocality. I believe this is an incomplete response.

Time travel into the past can lead to potential concerns regarding the fatalistic nature of the universe. In defending the regular thwarting of bilking attempts, one could suggest that the universe possesses its own 'fatalistic consciousness.' This would be a deterministic view that aligns with Horwich's improbability defense and arrives at the same conclusions he does through alternate reasoning. One could argue that the regular thwarting of bilking attempts exists as the universe almost, 'pushing back' when faced when closed causal loops and logical or temporal contradictions. In this circumstance, the presence of rogue banana peels and the regular prevention of attempts to change the past implies that the past is self-regulating and will always manage to maintain a concrete and chronological structure. It will always aim to intervene and prevent any situation that can give rise to a paradox — at least in a world similar to ours.

Einstein's special theory of relativity required the existence of an unprecedented notion — that physical objects occupy time-like dimensions, wherein gargantuan bodies with massive gravitational pulls (like stars and the Sun) have the ability to warp our understanding of space-time. This is how gravity was discovered. The nature of time travel may very well be similar to this. Hundreds of years from now, in a world that may possibly not be like ours at all, there is a potential that thousands of individuals are traveling through time on a regular basis. I will maintain that it is possible to kill one's Grandfather in a world like this. But in our world, where our

abilities are constricted by the very laws of physics, I maintain that Tim would come into contact with too many banana peels to ever be successful.

Acknowledgements

I have always been fascinated by the idea of traveling through time. Theoretically, the act of changing the past has the ability to alter preconceived fundamental truths about the nature of our universe. This is a notion that excites me greatly. I sat through years of Physics classes where my teachers emphatically stressed that there exist given facts about our universe, physical world and time that will forever remain unquestioned. The study of metaphysics changed all this. Suddenly, the underlying notions that dictated my understanding of time, space and causality were in question. This is the core reason as to why I chose to focus this thesis on the grandfather paradox — the case seems so simple, yet the philosophical questions raised are boundless and threaten to debilitate our conception of time its

elf.

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Appendix

A Fatalistic Approach to the Grandfather Paradox

By Ishan Jawa

In "The Paradoxes of Time Travel" David Lewis posits a theory about time travel by using a four-dimensional model of time to explain the "Grandfather Paradox." Through an analysis of the nature of time, Lewis focuses his discussion on the possibilities of time travel through a one-dimensional plane. He defends the view that it is logically possible to travel through time under a four-dimensional space-time approach. Lewis is correct in stating that a time traveler cannot change his past through denying that the claims, 'can' and cannot' are unequivocally true, but applying a fatalist viewpoint to the argument eliminates worries raised by the paradox.

Lewis introduces the example of an individual who has gained access to a time machine. This individual chooses to go back into to the past to kill his grandfather. He has in effect removed his parents, and therefore himself from existence. This glaring logical contradiction is the basis of Lewis's paradox - if an individual doesn't exist, how does he travel back into time? He assumes that if a time traveler visiting the past is both able and unable to change it, there cannot possibly exist such an individual.

Lewis aims to resolve this problem by stating that there is no real contradiction but both conclusions hold true. He clarifies that because "can" is an equivocal or ambiguous term, both situations are compatible and logically possible. Lewis explains, "to say that something can happen means that it happening is compossible with certain facts" (Lewis, 149). The facts in question are determined by contextual relations between the event and the "corresponding fixed delineation of the relevant facts" (Lewis, 149). Therefore, Lewis explains that it's difficult to con-

sider which facts are indeed pertinent in any particular situation. It holds true that the time traveler can kill his grandfather due to the set of facts that are compossible with him committing this action - motive, access to a loaded weapon and the appropriate training - thus making the situation conducive for him to commit the murder. Therefore, although there is a collection of facts that is compliant with the time traveler killing his grandfather, there exists a larger and more concrete set of facts that dictate an alternate result. An individual cannot accept the conclusion that the time traveler is both able and unable to kill his grandfather and 45make the claim that due to this contradiction, time travel is impossible.

Taking a fatalist approach to this situation would eradicate some of the worries raised by the paradox. A fatalist operates under the assumption that there are concrete truths about an individual's future actions and outcomes are predetermined. Lewis's theory presupposes that the mere fact that the time traveler is even alive to contemplate killing his grandfather means that he cannot possibly commit the action. It is illogical for the time traveler to kill his grandfather regardless of his preparation and skill because he cannot possibly change events in the past. Lewis explains that change is "the qualitative difference between different stages – different temporal parts – of some enduring thing" (Lewis, 145). This implies that the event of any moment in time - such as committing an act of murder - exists without temporal parts and hence cannot experience change.

Time travel into the past can lead to potential worries regarding the fatalistic nature of the universe. One could suggest that the universe has some varied form of 'conscience,' and actively works to prevent the creation of contradictions. According to Lewis, there must be an extenuating circumstance that prevented the time traveler from killing his grandfather. There is the potential that the past pushes back when faced with logical fallacies and temporal contradictions.

There is a potential that nature is self-regulating and will always manage to maintain a concrete and chronological structure. It will always aim to intervene and prevent any situation that can give rise to a paradox.

Lewis proposes a paradox of time travel that results in the time traveler eliminating a significant component that is essential to their existence. If a fatalist approach is applied to the situation, a logical contradiction arises when an individual attempts to change the past. Due to the self-consistent nature of the universe, there will always be a set of predetermined actions that are adhered to. A fatalist would state that every in the past has occurred a certain way and it is impossible for an alternate course of events to occur. Therefore it would be impossible for the time traveler to kill his grandfather. Lewis makes a mistake in assuming that time travel is possible. Finding a paradox relating to it only proves that the initial assumption is potentially flawed. The most pragmatic solution to this paradox is to reject the possibility of time travel altogether, or consider the existence of multiple universes.

Works Cited

Lewis, David. "The Paradoxes of Time Travel." Philosophical Papers Volume II (1987): 145-51.
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