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~~28.11.2022~~ 28.11.2022 , 77 %.

For completion by Marker 1 :

Comments: This piece of work makes excellent use of relevant reading material, successfully incorporating it into your discussion in order to present a very in-depth & incredibly well-informed critical analysis of the selected texts. Difficulties with regards to concepts & arguments are tackled head-on (not avoided), presenting a sophisticated & perceptive discussion of problems. And despite the complexity of issues, there is clear & accessible presentation that would be suitable for potential readers of the texts (in relation to the task, as an annotated bibliography).

Marker's signature:

Date:

For completion by Marker 2/Moderator:

Comments:

Marker's Signature:

Date:

AGREED INTERNAL MARK (where necessary):

Comment on process on arriving at agreed mark:

External Examiner's comments (if relevant)

External Examiner's Signature:

Date:

In terms of improvement, the very concept of post-humanism could be considered within your critique and you might consider contextualism as a possible approach to Gettier's problem. Although, this would mean being more selective elsewhere. What you choose to discuss will always be at the expense of something else to a certain extent, & currently as it stands, this is an excellent piece of work. Very well executed, indeed, & enjoyable to read too.

HPPH7010 Knowledge, Reason and Reality

Assignment 1

Derek Linney, Student No. 2218467

Annotated Bibliography

15th November 2022

1. Bostrom, Nick. "Are We Living in a Computer Simulation?", *The Philosophical quarterly* 53, no. 211 (2003): 243-55.

Bostrom's 2003 paper was an attempt to apply a rigorous treatment to the question as to whether we are living in a simulated world. Although there are many potential counterarguments to Bostrom's assumptions and deductions, one can argue that the paper served to start the serious academic debate around simulation.

Bostrom's statement of the structure of his position is unusual in that it is stated in the form that one must believe one of:

the following:

- (1) the human species is very likely to go extinct before reaching a "posthuman" stage
- (2) any posthuman civilization is extremely unlikely to run a significant number of simulations of their evolutionary history
- (3) we are almost certainly living in a computer simulation.

Bostrom initially removes a potential objection regarding consciousness by stating that a computer could, running a suitable program that simulated a human brain, exhibit consciousness. He is therefore dependent upon the theory that consciousness is 'substrate independent'. He then explores the computer processing power required to run a human simulation program and suggests that a sufficiently advanced post-human species would be able to harness the mass of a planet, or some advanced physics unknown to us, to provide the necessary computing resource. He briefly considers the level of granularity of simulation required – from our complete universe being fully modelled at the finest level of granularity through to one where only the immediate environment is fully modelled at the microscopic level and distant objects, for example astronomical bodies, are only simulated in a more macroscopic way. While full simulation would require enormous computing power the alternative of variable granularity could give rise to *glitches* – such as the staple of simulated world movies where the protagonist suddenly comes across an unrendered landscape.¹ Such glitches could be the only evidence that one is living in a simulated world. ✓

¹ This occurs in one of the first simulation novels, *Simulacron-3*, published in 1946. Daniel F. Galouye, *Simulacron-3* (New York: Bantam Books, 1964).

Assuming the human species survives to the post-human stage, then multiple simulations could be run by such a post-human society. He then assumes, barring legislation or ethical restrictions on such simulations, that multiple ancestor-simulations would be conducted which would feature humans at our stage of development. He then shows mathematically that there would be many more simulated humans than physical humans and hence we are statistically more likely to be in a simulation than to be physical humans. Since simulated worlds could themselves contain simulations then there could be an indeterminate number of simulation levels. Each level would have God-like powers over the simulations they run and from this Bostrom suggests that, since we cannot be sure we are in the base level (non-simulated), we would be motivated to behave ethically in order to please the simulators and achieve reward, avoid punishment, or achieve an afterlife.

In the novel *Simulacron-3* the non-simulated creators of a simulated world actively try to prevent the simulated inhabitants of that world from creating their own simulated world (nested simulations).² They worry that success might cause the Sims, who of course believe they are NonSims, to realise that they could themselves be in a simulation and change their behaviour as a result.³

The way that Bostrom phrases his thesis seems designed to support a narrative style of exposition rather than a deductive argument; resulting in what Agatonović calls disparagingly a “fiction of simulation”⁴. It can be rewritten, more conventionally, as:

If a) the human species is somewhat likely to survive to reach a “post-human” stage

and b) any post-human civilization is somewhat likely to run a significant number of simulations of their evolutionary history

then c) we are almost certainly living in a computer simulation.

Bostrom’s argument is that if a) and b) are true then many simulations will be run and there will be many more simulated humans than real humans. We are statistically more likely to be among the simulated than non-simulated set of humans. Bostrom’s conclusion may well be correct, but there is no justification for accepting either of the premises. The most critical issue with Bostrom’s argument is that

- (i) If we are physical, rather than simulated, then c) is obviously false and there is no need to discuss post-human species or ancestor-simulation

² Galouye.

³ Using Chalmers terminology for simulated and non-simulated intelligent beings. David John Chalmers, *Reality+ : Virtual Worlds and the Problems of Philosophy* (New York, NY: W. W. Norton & Company, 2022).

⁴ Miloš Agatonović, "The Fiction of Simulation: A Critique of Bostrom’s Simulation Argument," *AI & society* (2021).

- (ii) If we are in a simulation then there is no more reason to suppose that the simulation creators are post-human rather than, say, 7-legged spiders living on Alpha Centauri or indeed entities in an entirely different universe, possibly with totally different physical laws than ours. There is no need to appeal to ancestor-simulation to explain why human entities could occur in a simulation.

A more recent argument for us being in a simulation, put forward by Chalmers, is essentially more generic: if the simulation of sentient, intelligent entities is possible at all, given the issue of consciousness and also that of the computer power required, then there are likely to be many simulations in existence and hence, following Bostrom's approach, we are more likely to be Sims than NonSims.⁵

Even if one accepts that any simulation is being done by a post-human species then Bostrom doesn't provide any justification for them running simulations of humans at a much earlier stage of evolution. It would seem more likely they would either run simulations featuring emulations of their contemporary post-human manifestation or simulations of the origins and development of life which are highly unlikely to result in humans as we believe ourselves to be. One can also question whether a civilisation that had the ethical characteristics necessary to survive without going extinct would be one where whole planets would be happily destroyed to provide the energy required for the computation of simulations.

Bostrom's assertion that, even if we are in a simulation, we should behave ethically in order to please the Gods - the simulation originator(s) - also seems optimistic. If our limited experience of simulations through virtual reality and computer games is any guide, then either a propensity to extreme violence or to sexual decadence would seem to be more attractive to the operators / players than moral rectitude.⁶

Although Bostrom's paper has many deficiencies, it is highly important in attempting to move the discussion of simulations from the realms of science fiction towards serious academic consideration.

(Word count, excluding titles & footnotes: 1021 words)

Also, the very
concept of
'post-humanism'
is problematic.

⁵ Chalmers. pp.81-102

⁶ See for example: Regina Lynn, "Second Life without Sex Would Be a Sad Life, Indeed," *Wired*, Jun 22, 2007 (2007), <https://www.wired.com/2007/06/sexdrive-0622/>.

2. Grünbaum, Adolf. "Zeno's Metrical Paradox of Extension." in *Zeno's Paradoxes*. Edited by Wesley C. Salmon. Indianapolis: Hackett, 2001.

In this chapter, originally published in 1967, Grünbaum investigates the apparent paradox implicit in conceiving of an extended line of finite length as containing an infinity of infinitesimal points. The paradox is that if each of the points have zero length then even an infinity of them combined must have zero length, but if they have each a finite, non-zero length then an infinity of them will have infinite length.⁷ A line must therefore be either infinite in length or of zero length. This is the essence of Zeno's Paradox of Extension which is less widely known or addressed than his paradoxes of motion. As Grünbaum himself notes, it is more fundamental than the paradoxes of motion since it is concerned with the foundation of physical space which is a prerequisite to understanding motion.⁸ *This is helpful.*

Grünbaum's approach is to use modern mathematics and philosophical theory to avoid such a paradox. He accepts the view that an infinite number of extended elements each with finite length would result in infinite extension. He therefore sets out to refute the second option: that an infinite number of unextended elements must necessarily have zero length.

He distinguishes 'metrical' distance as conceived in the standard mathematics of n-dimensional Euclidean space⁹ from the set-theoretic aggregation of the zero-dimensional subsets of a finite interval – essentially, in common language, a line containing an infinite number of points.

A finite interval, in set theoretical terms, can be an aggregate of any of the following:

- (1) A set containing only a single point
- (2) A set containing a finite collection of points
- (3) A set containing an infinite countable ('enumerable' in Grünbaum's terminology) set of points
- (4) A set containing an infinite super-countable ('non-enumerable') set of points

The significance of this classification is that if we are dealing with options (3) or (4) we are in the realm of Cantor's theories of infinite sets and in such cases the standard mathematical approach to summation (aggregation) doesn't apply and that we have to apply the concepts of the aggregation of cardinalities (the number of elements in a set). Applying standard mathematics to such a set would indeed result in the paradox of the interval (the line) having zero extension.

⁷ Nick Huggett, *Zeno's Paradoxes*, ed. Edward N. Zalta, *Stanford Encyclopedia of Philosophy* (<https://plato.stanford.edu/archives/win2019/entries/paradox-zeno/>; 2019). Section 2.2-2.3

⁸ Adolf Grünbaum, "Zeno's Metrical Paradox of Extension," in *Zeno's Paradoxes*, ed. Wesley C. Salmon (Indianapolis: Hackett, 2001). pp.197-8

⁹ $d(x, y) = [\sum_{i=1}^n (x_i - y_i)^2]^{\frac{1}{2}}$

Later in the article Grünbaum shows that even under case (3) the paradox still arises. This is significant as it directly refutes various attempts to avoid Zeno's paradox through a process of infinite divisibility of the length down to points; the idea, in simplified terms, being that at each division we know the sequence of the intervals and, hence, we achieve denseness (an infinite number of points) in each interval but we also maintain countability.¹⁰ Grünbaum shows that the assumption of maintaining countability is false and is predicated on ideas such as each point having an adjacent point and there being a next to last point. Grünbaum shows that such infinite division in fact results in a super-countable (un-enumerable) set of points (corresponding to the real numbers in the interval) – i.e. we are in option (4). Applying Cantorian theory to such a set, results in the concept of Infinity x Zero being meaningless (Infinity being the number of members of a super-countable infinite set of points and Zero being the extension of the points). This avoids the paradox.

While declaring the result meaningless may seem like a convenient get-out, what it signifies is that only the metrical calculation of distance, described earlier, is applicable to calculating the length of a finite line and any attempt at infinite divisibility leads into a situation where we simply cannot apply what we would regard as common-sense mathematics. Grünbaum addresses objections to the Cantorian approach by philosophers who reject the *arithmetic* approach in favour of a *geometric* approach which tries to re-assert that the length of a line must be calculatable from the lengths of the elements of which it is composed and hence the paradox remains. Grünbaum's believes that their error arises from our visual perception of extension: we regard the line and its points like a string with beads along its length. ✓ We think of the line as a set of distinct points whereas it is actually a "linear continuum of points" and hence requires set-theoretic approaches rather than mathematical summation. ✓ okay.

Yes, it is very informative indeed ✓
The paper does assume a familiarity with the concepts of set theory and of Cantorian theories and is not for the faint hearted in this respect, although a close reading of it does provide an overview of Grünbaum's approach even for the non-specialist. While a short review like this, to say nothing of this author's limited expertise in Cantorian theory, cannot do full justice to Grünbaum's arguments, the article provides a convincing explanation of why we cannot apply intuition and common-sense to matters related to infinity and infinite sets. Writing in 1991, John McKie describes Grünbaum's approach as "the most successful attempt to deal with this puzzle [Zeno's Paradox of Extension] from the point of view of modern mathematics"¹¹ While one may be able to refute Zeno's paradoxes of motion through appeal to 17th Century differential calculus and theory of limits it is only through late-19th Century set theory that one can address Zeno's Paradox of Extension.

(Word count, excluding titles & footnotes: 864 words)

¹⁰ Grünbaum explicitly dismisses Russell's approach at using denseness ('compactness') in this regard. Grünbaum, in *Zeno's Paradoxes*, p.198

¹¹ John R. McKie, "Zeno's Paradox of Extension," *The Southern journal of philosophy* 29, no. 1 (1991). p.69

3. Grünbaum, Adolf. "Can an Infinitude of Operations Be Performed in a Finite Time?," *The British journal for the philosophy of science* 20, no. 3 (1969): 203-18.

In this paper, based upon a lecture originally given at the University of Chicago in 1968, Grünbaum discusses a specific objection often raised against purely mathematical refutations of Zeno's paradoxes of motion. Hermann Weyl had posed the question "Is it kinematically feasible that a machine carry out an infinite sequence of distinct operations in a finite time?"¹² If a theoretical machine could not carry out such operations in a finite time then Zeno's paradoxes of motion remained unresolved, despite the best efforts of mathematicians to apply their knowledge of infinite sequences, since Zeno maintains that Achilles is required to perform an infinite number of tasks in traversing a finite space. ✓

Grünbaum explores the topic through consideration of both a standard Zenonian runner, for example Achilles, which he names the *Legato* runner, and a runner that performs a series of runs with each run being followed by a pause and which he names the *Staccato* runner. Grünbaum shows, that within certain restrictions as to what constitutes a 'task', then it is possible for a machine, in this case the runner, to perform an infinite sequence of distinct operations (tasks) within a finite time. As a result, Zeno's paradoxes of motion can be resolved not just mathematically but physically as well. The restriction on the type of task that can be performed does mean that while traversing the infinite sequence of intervals is possible in a finite time it would not be possible for the runner to complete tasks such as planting a flag at the end of each interval. This analysis is also briefly discussed with regard to *infinity machines* in general and the characteristics that make such machines kinematically feasible or not. Grünbaum, in a later work, expanded this discussion by analysing in more depth the feasibility of a specific set of proposed infinity machines.¹³

The comprehensive discussion of the Legato and Staccato runners can only be briefly summarised here. Grünbaum's discussion of the Legato runner, whose motion is continuous, can be shown by a consideration of the limits of infinite sequences of diminishing distance and of time to be completed in a finite interval. This analysis is similar to many well-known mathematical approaches to refuting Zeno's paradoxes of motion. Grünbaum believes that the reason that Zeno's paradox appears problematical to many people is that when expressed in the form of the runner needing to perform an infinite number of tasks – running each segment (covering $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ etc of the distance) – that psychologically we have in mind a minimum, finite duration for a task and hence think it must take an infinite time to perform an infinite number of tasks.¹⁴ ✓

¹² Adolf Grünbaum, "Can an Infinitude of Operations Be Performed in a Finite Time?," *The British journal for the philosophy of science* 20, no. 3 (1969). P.203

¹³ Grünbaum, "Modern Science and Zeno's Paradoxes of Motion," in *Zeno's Paradoxes*.pp.218-244 ✓

¹⁴ Grünbaum, "Can an Infinitude of Operations Be Performed in a Finite Time?." p.206

In order to extend the discussion to consider the feasibility of infinity-machines and also to demonstrate a stronger argument regarding the performance of an infinite number of tasks within a finite time Grünbaum introduces the Staccato Runner. This runner runs twice as fast as the Legato runner for each segment ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ etc of the distance) but then pauses for the Legato runner to catch up. Grünbaum shows that the Staccato runner completes the overall distance in the same time as the Legato runner; but if one considers the pauses to be distinct tasks – since they are discontinuous – then the Staccato runner has clearly performed an infinite number of tasks in finite time. Grünbaum does exclude any action within the pause, such as planting a flag, which involves a minimum finite movement of the runner, as this would infringe the laws of physics by requiring a velocity of his limbs greater than the speed of light given the reducing time intervals involved.

This approach is then applied to discuss the feasibility of a specific, proposed infinity-machine – the π -machine – which prints out all the digits of pi in a finite time. Grünbaum identifies the characteristics of the printing process – essentially that the physical time taken can be made to converge to zero - that would be required to make such a machine kinematically feasible. Grünbaum advises against trying to visual what such an operation looks like and also that we must avoid trying to think about the ‘last letter’ printed as this is meaningless given the infinite sequence.

If there is a weakness in Grünbaum’s analyses it is that he doesn’t explicitly explain the distinctions between *kinematically*, *physically*, and *dynamically* feasible.¹⁵ This, despite the mathematics, does leave a question mark in the reader’s mind regarding the conclusions of the analysis. ✓ Good point.

Grünbaum succeeds in drawing our attention to the main problem we encounter with Zeno’s paradoxes of motion. Intuitively we know that Achilles can complete the run but intuitively, because of our inherent ‘duration-threshold of time awareness’, we cannot visualise an infinity of tasks being completed in finite time. Zeno’s paradox is thus, ultimately, a psychological conundrum rather than a metaphysical one. ✓ Indeed, Grünbaum explicitly holds this responsible for what he calls “the intellectual havoc” in recent literature on Zeno.¹⁶ ✓

(Word count, excluding titles & footnotes: 820 words)

¹⁵ Caws makes this criticism in Peter Caws, "Adolf Grünbaum. Modern Science and Zeno's Paradoxes . Middletown, Connecticut: Wesleyan University Press, 1967. X + 148 Pp. \$6.50," *Philosophy of Science* 36, no. 1 (1969). p.107

¹⁶ Grünbaum, "Can an Infinitude of Operations Be Performed in a Finite Time?." p.209

4. Gettier, E. L. "Is Justified True Belief Knowledge?", *Analysis* (Oxford) 23, no. 6 (1963): 121-23.

Gettier's paper, despite being only 2½ pages long, was a disruptive interjection into the theory of knowledge; in particular it challenged the orthodoxy that Justified, True, Belief (JTB) is Knowledge. Gettier introduces examples of a type, subsequently to be known as *Gettier Examples*, that appear to be cases of JTB – being justified and true and beliefs – but which shouldn't be regarded as examples of genuine knowledge. In general, these examples would actually be false rather than true were it not for a lucky coincidence. Knowledge shouldn't be a matter of luck. Through his examples Gettier claims that while JTB is necessary for knowledge it is not sufficient.

In the first case given by Gettier: two people, Smith and Jones, apply for a job and Smith knows that Jones has ten coins in his pocket and also knows that Jones will get the job. His JTB is that "the person who gets the job will have ten coins in his pocket". Contrary to his belief Smith himself gets the job but coincidentally, and unknown to him, he also has ten coins in his own pocket and hence his belief that 'the person who will get the job will have ten coins in his pocket' is true. Therefore, Smith's original belief is true but despite being justified and true it doesn't seem to count as a case of knowledge.

In the second example (simplified for convenience) Smith, has strong evidence that Jones owns a Ford. He is therefore justified in believing that: "Either Jones owns a Ford, or Brown, another friend, is in Boston". But he is mistaken in believing that Jones owns a Ford and hence the truth of his belief that "Either Jones owns a Ford, or Brown is in Boston" depends upon Brown being in Boston. If Brown, coincidentally does happen to be in Boston, then Smith's belief is true. It is true and justified but hardly seems to constitute an example of knowledge since Brown could have been anywhere and it is purely luck that he happens to be in Boston.

There are a number of ways of addressing the challenge introduced by Gettier, of which the simplest are:

- a) Challenging whether the belief in each case is really justified and hence maintaining JTB as being Knowledge
- b) Modifying the JTB doctrine by adding an exclusion that the truth shouldn't be the result of luck.

In the job example, one can argue that Smith's belief as to who will get the job, which turned out to be faulty, was not, in this case justified. Similarly, in the second example, his belief that Jones owned a Ford was not justified. To use this counter argument does, however, lead to a position where one restricts justified belief to those situations where there can be no doubt of the truth of the belief, i.e. one demands certainty, and then equating JTB with knowledge is either tautological or leads one to scepticism.¹⁷ If one relaxes the condition of there being no doubt and only demand that Smith has true

¹⁷ For example, see: Peter Unger, "A Defense of Skepticism," *The Philosophical review* 80, no. 2 (1971).

evidence to back his belief then the Gettier counter-examples to the sufficiency of JTB being knowledge still hold.¹⁸

Adding a requirement that the belief should not be true simply through coincidence, i.e. by luck, is a more promising way of restoring the essence of JTB. However, one of the challenges to the addition of a luck exclusion is to define what is meant by 'luck'. This is extensively explored by Pritchard who requires some 150 pages to define and characterise *epistemic luck*.¹⁹ While impossible to distil into a few words, there are two aspects of luck that are relevant to Gettier Examples. Firstly, consider the class of possible worlds nearest to the actual world and which have the same initial conditions as the actual world. Then, if the event occurs within the actual world but not in these possible worlds then one can consider the event to be lucky.²⁰ Secondly, there needs to be a lack of control, by the agent affected by the luck, over the event's outcome.²¹

Zagzebski describes a general way of creating Gettier Examples²²: Start with a case of justified belief but where the belief, despite having sufficient justification to qualify for JTB, would actually be false as a consequence of part of its justification being false. The falsity is due to some degree of luck (bad luck). This is then countered by some lucky coincidence (good luck) which reinstates the truth of the belief. We therefore have JTB but not Knowledge. A condition of it being a Gettier Example is that the good and bad luck are independent of each other.

While most Gettier Examples use unlikely, lucky events to result in the truth of the belief, the event does not necessarily need to be unlikely. Consider Smith seeing what he takes to be a sheep in a field and forming the justified belief that there is a sheep in the field.²³ The object he sees is actually a dog that looks like a sheep. His belief is false. However, suppose the field is part of a farm then from his justified belief that there is a sheep in the field it logically follows that he is justified in believing there is at least one sheep on the farm of which that field is part. If there are sheep in other fields, not visible to Smith, then his derived belief - that there is at least one sheep on the farm - is true. So, this belief is JTB. His original belief is false and hence not knowledge, but the derived belief is true and if JTB is knowledge then the derived belief is knowledge. Yet, we would not consider it to be knowledge since it arises from a lucky event: there being sheep in other, non-visible, fields on the farm. But, if Smith is in sheep farming country, then the probability of there being sheep in the other fields is high. The truth

¹⁸ This is explored in Richard Feldman, "An Alleged Defect in Gettier Counter-Examples," *Australasian Journal of Philosophy* 52, no. 1 (1974/05/01 1974).

¹⁹ Duncan Pritchard, *Epistemic Luck* (Oxford: Clarendon, 2005).

²⁰ Pritchard, p.129.

²¹ Pritchard, p.131.

²² L. Zagzebski, "The Inescapability of Gettier Problems," *The Philosophical quarterly* 44, no. 174 (1994). p.69

²³ This is a variation on an example proposed by Chisholm. Roderick M. Chisholm, *Theory of Knowledge* (Englewood Cliffs: Prentice-Hall, 1966).

of his derived belief is therefore due to luck and hence is not knowledge, but the lucky event is not unlikely.

The lack of adequate counters to Gettier Examples means that one either has to accept the qualification of adding luck to JTB to establish sufficiency for knowledge or risk a descent into scepticism. The significance of Gettier's paper can be summarised by the introduction to a volume dedicated to a discussion of Gettier's approach:

*"The contributions to this volume reflect and deepen the Gettier Problem's impact on epistemology and on philosophical methodology. Fifty-four years ago, in his three-page paper, Edmund Gettier taught us that the generally accepted account of factual knowledge was defective because there are cases of true justified beliefs that are not knowledge."*²⁴

Surprisingly, Gettier himself published little, if any, follow up to his original paper. It is as though having thrown the proverbial cat among the pigeons he stood back to watch the ensuing chaos.

(Word count, excluding titles & footnotes: 1155words)

²⁴ Rodrigo Borges, Claudio de Almeida, and Peter D. Klein (Eds), Explaining Knowledge: New Essays on the Gettier Problem (Oxford University Press, 2017). Abstract.

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