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Is Lewis's 'Magical Understanding/Magical Relations' Objection Fatal To Quiet Moderate Realism?

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In this paper I shall argue that Lewis's magical understanding objection is, despite its apparent strength, not fatal to Quiet Moderate Realism (hereafter QMR). I shall detail van Inwagen's objection - which shows that if Lewis's objection is sound then we need to reject set theory as well as QMR - before showing why Lewis's argument is flawed.

For the quiet moderate realist, possible worlds are structureless abstract simples or elements. Some of these elements are selected; which ones are selected depends on how things are in the concrete world. If the concrete world selects an element then that element represents how the concrete world is. So, there is one element, such that it is, necessarily, selected if and only if there are talking fish. Selection can thus be understood as a relation that the concrete world bears to the elements it selects. Furthermore, some elements imply other elements. That is, E implies E' if E and E' are such that if the concrete world selects E, then the concrete world selects E'. Certain elements are not implied by any other elements; these are maximal elements. These maximal elements are the possible worlds. As Lewis points out, this is not so much a theory as a theory schema. If Lewis can provide a convincing argument, particularly a fatal one, against QMR, then his own brand of modal realism looks far more attractive. Lewis believes he can, but I shall attempt to show that his argument is flawed.

Lewis's argument against QMR rests on a distinction between internal relations and external relations.[1] An internal relation is one that depends solely on the intrinsic natures of the relata, whereas an external relation is one that does not. For instance, the relation 'has more faces than' is an internal relation, it depends solely on the intrinsic natures of the relata. However, the relation 'is five metres away from' is an external relation since it does not depend on the intrinsic natures of the relata. It is reasonable to ask, then, whether the selection relation is internal or external. We are not asking for definition, merely classification.[2] Unfortunately for the quiet moderate re-

[1]Lewis [2] p. 176.
[2]Ibid. [2].

alist, a dilemma exists: it doesn't matter whether the selection relation is internal or external, it runs into problems either way.

First, suppose that the selection relation is internal. Since the relation is internal it depends on the intrinsic natures of the element selected and the concrete world. At this point then it is fair to ask what the intrinsic properties of the elements are. The problem is, however, that the elements are structureless and abstract. Their structure cannot help us define the selection relation since they don't have one. Similarly we are not acquainted with the intrinsic properties of these non-spatio-temporal objects. Since two objects - x and y - cannot stand in an internal relation R without certain intrinsic properties of x and y being a certain way, grasping this relation surely means being able to pinpoint the intrinsic properties that determine the relation. If we can't determine the intrinsic properties of the objects then we can't determine when and if the relation holds and, therefore, can't be said to grasp the relation in question. Someone who claimed they could grasp the 'has the same number of faces as' relation without understanding what a face was would, rightly, be treated with suspicion and so should the quiet moderate realist who opts for selection as an internal relation. Consequently, the outcome of opting for selection as an internal relation is that any grasp we have of selection appears to be, in the words of Lewis, 'magical'.[3]

Since opting for selection as an internal relation leads to an unacceptable consequence - a 'magical' grasp of the relation - maybe the quiet moderate realist would do better to opt for selection as an external relation. Unfortunately, Lewis has an argument against this stance as well. If the selection relation is external, then it does not depend on the intrinsic properties of the concrete world or the element selected. Since the relation does not depend on the intrinsic properties of the relata we are not justified in asking for an account of these intrinsic properties. The problem this time is that the selection relation is supposed to be a necessary connection and meant to depend on how things are in the concrete world. Necessarily, if a fish talks, then element E is selected. However, selection is also meant to be an external relation and so doesn't depend on the intrinsic natures. This externality implies that the element that represents a fish talking could fail to be selected, but this implication offends against the necessary connection claim. As Lewis says, we can't have it both ways. It looks as though the idea of a necessary external relation is either self-contradictory or deeply mysterious because it requires

[3]Lewis [2].

a 'magical' necessary connection. The quiet moderate realist, however, can give a response at this point. He can argue that there is no offence against externality. A relation is external if two elements stand in that relation but their intrinsic duplicates do not. For instance, A and C are intrinsic duplicates, as are B and D and A stands in R to B but C does not stand in R to D. It can easily be shown that there is no offence against externality in the case of the selection relation if we consider that concrete reality is an intrinsic duplicate of itself and there is no difference in the intrinsic properties of the elements - they are all duplicates. So, element E (the a-fish-swims element) and element F (the a-fish-talks element) are intrinsic duplicates but concrete reality selects element E (a-fish-swims) and does not select element F (a-fish-talks), therefore there is no offence against externality. Unfortunately this reply merely generates a mystery. Why and how does the concrete world select E and not F? Could it not have been the other way round? It seems odd to say that an object's intrinsic properties determine what external relations it stands in. The connection appears to be 'magical'.[4]

Lewis's objection to QMR seems, on the face of it, fatal. A theory that requires acts of 'magic' to understand is not a theory many people would be willing to accept. However, van Inwagen raises an important objection, which casts serious doubt on the fatality of Lewis's argument. van Inwagen argues that Lewis's argument proves too much since his own argument can be applied to the central relation of set theory - 'is a member of'.[5] The 'is a member of' relation (the set membership relation) is external - there can be pairs of duplicates such that one pair stands in the set membership relation and the other pair does not. For instance, suppose that a and a' are duplicates but $a \neq a'$; $\{a\}$ is a duplicate of itself but a is a member of $\{a\}$ and a' is not a member of $\{a\}$. However, it is meant to be that necessarily a is a member of $\{a\}$. So the set membership relation is external and is meant to be a necessary connection, which, as Lewis himself says, would require a 'magical' connection. On Lewis's own grounds then, set theory is also a theory that requires magic. The same reason for suspecting that Lewis's argument was fatal also applies to the set membership relation. Since Lewis's argument applies to set theory we should be able to find something wrong with it. However, van Inwagen accepts that he cannot say what exactly is wrong with Lewis's argument, only that there must be something wrong

[4]Lewis [2].

[5]van Inwagen [3].

with it because it proves too much.[6] If it turns out that there is nothing wrong with Lewis's argument then we have reason to reject the selection relation and we also have reason to reject the set membership relation. Since we do not want to reject the set membership relation we should be able to find something wrong with Lewis's argument. The next section will deal with this.

Jubien argues Lewis's argument is unsound for three reasons.[7] First, Lewis sets down extremely stringent conditions for grasping an internal relation, conditions that make it incredibly difficult to understand some everyday internal relations that we seemingly do understand. Second, Lewis uses a conception of an external relation that differs from his own definition; his argument against externality applies only to this different conception and the case against the original conception relies on the case against internality. Third, Lewis rejects the possibility that selection is a different type of relation but his rejection is not powerful. I shall now deal with each of these issues in Lewis's argument.

First, Lewis says that to grasp an internal relation we need to be able to understand the intrinsic properties that make that relation hold. This condition is extremely stringent; it seems that there are everyday internal relations that we do grasp without understanding the intrinsic properties which make them hold. Consider the relation x bears to y if and only if x is soluble in y. Certainly, whether this relation holds seems to depend on the intrinsic properties of x and y, so it seems that it is an internal relation. Can we grasp this relation? Seemingly we can and do grasp this relation but few of us understand what molecular properties are required for x to be soluble in y. This does not mean that we can fully understand the relation without understanding the properties required of x and y, only that to grasp the relation this knowledge is not required. Therefore, it would appear that we can grasp some internal relations without knowledge of the intrinsic properties of the relata. Now consider the relation that holds between a number x and, say, a town y if and only if x is the number of inhabitants of y. Here is a relation that we definitely do grasp. What sort of relation is it? Unfortunately, this cannot be answered until some fundamental questions about numbers are settled, since the answers to these questions will determine what kind of relation we are

[6] van Inwagen [3] p. 207.

[7] Jubien [1].

talking about.[8] Now we have a relation that we cannot classify but we definitely can grasp. Lewis, however, asks the quiet moderate realist to classify his selection relation before deciding whether he can grasp it. For Lewis, we need to move from classification to grasping but, as we have seen, there are relations that we can grasp without classifying. Can we truly say we don't grasp these relations? I do not think so.

Second, Lewis provides two different definitions of an external relation. To begin with he says that an external relation is one that depends not on the intrinsic natures of the relata but on the composite of them.[9] However, when arguing against the externality of the selection relation he says that an external relation holds independently of the intrinsic natures of the relata.[10] These two definitions are clearly at odds with each other and his argument against externality is only an argument against externality in the second sense he provides. Consider the relation x bears to y if x repels y. This relation only holds if x and y have certain intrinsic properties and are situated in a certain way. For instance, x does not repel y if it is on a different planet or if y does not have a particular intrinsic property. This relation is external on Lewis's original definition and intuitively it seems correct to say that this is so.[11] However, this is an external relation in which the intrinsic properties do influence whether the relation holds. Contrary to what Lewis says, it seems that we can have external relations determined by intrinsic properties. Lewis's argument then seems to depend on a feature of external relations that he does not require them to have. Despite this, Lewis does still have a response open to him. He could say that external relations of the first type – those involving intrinsic properties - are merely conjunctions of internal relations and external relations of the second type – those not involving intrinsic properties. Lewis's argument would then apply to the external conjunct making the entire relation 'magical'. This reply seems to shore up Lewis's argument against the externality of the selection relation, but what one should notice is that Lewis's argument against externality is not an argument against any external relation. It is an argument against the selection relation specifically, which means that the argument does not apply to the external conjunct of our new conjunctive relation since the external conjunct is not the selection relation.

[8] Jubien [1].

[9] Lewis [2] p. 62.

[10] Jubien [1].

[11] Ibid. [1].

Could the argument against internality be applied to the internal conjunct of our relation? If it could, our relation would be unintelligible since the argument against internality is an argument against a specific type of internal relation not just against the selection relation, and any conjunction with an unintelligible conjunct is, itself, unintelligible. Unfortunately, the argument against internality fails so our relation still stands.

Third, Lewis rejects the possibility that selection is an extrinsic relation by stating that if it were it would, presumably, be equivalent to an external relation and, therefore, vulnerable to the argument against externality. However, this isn't clearly the case. Consider the relation that x bears to y if an only if x and y are the same shape as z. This seems to be an extrinsic relation yet it is grounded in intrinsic properties. Seemingly the realm of extrinsic relations is more varied than Lewis believes.[12]

In conclusion, Lewis presents a dilemma for the quiet moderate realist: either the selection relation is internal or external. If it is internal, then he cannot understand it; if it is external, then it is a magical relation. On the face of it this objection to QMR seems fatal. However, van Inwagen showed that if this argument is successful it can also be applied to the membership relation of set theory. Fortunately, on closer inspection Lewis's argument appears to have several flaws: he sets down extremely stringent conditions for grasping an internal relation, he uses two different definitions of an external relation, and he ignores the possibility that selection could be an extrinsic relation. Given these flaws, set theory and QMR are safe from Lewis's argument. Lewis's objection is not fatal.

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[12] Jubien [1].

Blue Hats And Black Holes: Why The Raven Paradox Is No Paradox At All

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Introduction

When does evidence confirm a hypothesis? The raven paradox arises out of Carl G. Hempel's attempt to answer this innocent question. Through following our most obvious intuitions about hypotheses, evidence, and confirmation, Hempel arrives at one of philosophy's most famous problems. However, the raven paradox results from psychological error, not fallacious reasoning. As such, the paradox does not warrant the failure of Hempel's programme because its counter-intuitiveness can be traced to human error about the nature of qualitative confirmation.

This paper consists of four sections. In §1, I describe the raven paradox and briefly show how it is derived. In §2, I explain why the paradox might be considered a problem for Hempel's qualitative theory of confirmation, before outlining how Hempel himself attempted to resolve the issue through revision of Nicod confirmation. However, in §3, I go on to argue that the paradox does not necessitate a revision of Nicod confirmation since the paradox arises out of psychological error about the extension of universal quantifiers. Finally, in §4, I explain why the unintuitive features of the raven paradox are a consequence of the nature of the qualitative confirmation theory itself, rather than Hempel's particular formulation. The binary nature of qualitative confirmation is irreconcilable with our common intuitions about scientific confirmation.

1 What is the Raven Paradox?

The raven paradox occurs when we consider what evidence confirms a certain scientific hypothesis. Hempel's approach tries to follow our intuitions about confirmation, arriving at the idea that a hypothesis's positive instances in the real world confirm the hypothesis, also known as Nicod confirmation.[1]

[1]Hempel [4].

For example, the evidence 'here is a black raven' is a positive instance of the hypothesis that 'all ravens are black' and therefore the evidence confirms the hypothesis. Formally, this means that where R(x) is 'x is a raven' and B(x) is 'x is black' then the evidence

$R(a) \wedge B(a)$

confirms the hypothesis

$\forall x(R(x) \rightarrow B(x))$.

The raven paradox is derived when we consider logical equivalents of the hypothesis. As far as syntactical structure is concerned, it should not matter how we formulate our hypothesis, so long as it has the same truth functional value in every model we construct. This idea is known as the equivalence condition.[2] For example

$\forall x(R(x) \rightarrow B(x))$

is logically equivalent to

$\forall x(\neg B(x) \rightarrow \neg R(x))$.

Thus, positive instances of the hypothesis

$\forall x(\neg B(x) \rightarrow \neg R(x))$

should confirm this hypothesis and also its logical equivalent

$\forall x(R(x) \rightarrow B(x))$.

However, positive instances of

$\forall x(\neg B(x) \rightarrow \neg R(x))$

are of the form

$\neg B(a) \wedge \neg R(a)$.

Thus, anything that is 'not black and not a raven' confirms the hypothesis that 'all non-black things are non-ravens' which is logically equivalent to the hypothesis that 'all ravens are black'. This counter-intuitive idea is the raven paradox, also known as the Hempel's paradox.[3]

Furthermore, an additional form of the same paradox, which appears to be

[2]Earman & Salmon [1].

[3]Fetzer [2].

even more counter-intuitive, can be derived in the same manner. The hypothesis

$\forall x(R(x) \rightarrow B(x))$

is also logically equivalent to

$\forall x((R(x) \vee \neg R(x)) \rightarrow (\neg R(x) \vee B(x)))$.

In this example, positive instances of the hypothesis

$\forall x((R(x) \vee \neg R(x)) \rightarrow (\neg R(x) \vee B(x)))$

take the form

$\neg R(a)$.

Therefore anything that is 'non-raven' confirms the hypothesis that 'all ravens are black'.

2 Why is the Raven Paradox a Problem for Hempel's Qualitative Theory of Confirmation?

Examples of Hempel's paradox involving ravens and their colour may seem of little importance, but the same consequences apply to analogous scientific inquiry. For example, the hypothesis that 'all black holes absorb light' is confirmed by the evidence 'here is a blue hat'. The importance lies in the fact that the raven paradox shows us how following our intuitive ideas about logical equivalence and confirmation leads to very counter-intuitive consequences. The notion that the evidence 'here is a blue hat' confirms the hypothesis that 'all black holes absorb light' is assumed by many people to be "absurd".[4]

Accordingly, we might want to revise either the equivalence condition or our notion of Nicod Confirmation in order to avoid the raven paradox. However, this poses a dilemma because revising either of these notions is also counter-intuitive.

Firstly, revising the equivalence condition is problematic because it should not matter how we form our hypothesis so long as it means the same thing. In other words, the relation between evidence and hypothesis should not be sensitive on the (logically equivalent) syntactical construction of either the evidence or hypothesis. Of course, when two hypotheses *do* mean different

[4]Huber [5] p. 2a.

things then the confirming evidence of the one does not necessarily have to be confirming evidence of the other, but so long as hypotheses are logically equivalent, then the evidence that confirms the one should also confirm the other. If this were not the case, whether or not some evidence confirms a hypothesis would be dependent on how the scientist happened to construct their hypothesis.

Secondly, rejecting the Nicod confirmation account is problematic because the idea that a hypothesis is confirmed by its positive instances is clearly intuitive.[5] But suppose the account of Nicod confirmation were wrong. Perhaps our intuitions about evidence, hypotheses, and confirmation could be satisfied by some other principle. Perhaps if we could find a definition of confirmation that were less counter-intuitive than (at least) the raven paradox, then maybe it would be rationally permissible to prefer that definition so long as it does not allow the raven paradox to be derived.

Hempel himself believed that such a definition could be found.[6] In brief, the main idea of Hempel's definition of confirmation is that evidence confirms a hypothesis if the hypothesis holds for the finite number of objects included in the evidence. For example, the evidence

$R(a) \wedge B(a)$

confirms the hypothesis

$\forall x(R(x) \rightarrow B(x))$

because the hypothesis is derivable from a set of sentences each of which is directly confirmed by the evidence. Even if using such a definition of confirmation is less intuitive than using Nicod's definition of confirmation, it leads to more intuitive results. In other words, the slightly more counter-intuitive nature of Hempelian confirmation might be justified because using such a definition avoids the strongly counter-intuitive raven paradox.

But why avoid the raven paradox? Hempel's desire to prevent derivation of the paradox comes at the cost of Nicod definition (and it is not even clear that his revised account of qualitative confirmation does avoid the paradox[7]). However, any account of confirmation other than the idea that a hypothesis is confirmed by its positive instances in the real world deviates from our

[5]Earman & Salmon [1].

[6]Hempel [4].

[7]See Sprenger [6].

intuitions. We should, at least, determine why the raven paradox is so problematic before we revise previously accepted principles. A closer examination of the paradox will show us exactly why no such revision is required.

3 Why the Raven Paradox is a Consequence of Human Psychological Error

The raven paradox arises out of the intuition that, for example, the evidence 'here is a blue hat' does not confirm the hypothesis 'all black holes absorb light'. But this intuition arises only because we misunderstand the hypothesis to refer to black holes only. However, the hypothesis does not only refer to black holes, but actually extends to all objects. In other words, the hypothesis 'all black holes absorb light' tells us something about the world in its entirety, not just something about black holes in themselves. The fact that we already have a substantial body of background evidence regarding the world gives rise to this misunderstanding. So when the evidence 'here is a blue hat' confirms the hypothesis 'all black holes absorb light' the reason it appears paradoxical is because we already possess prior information without which the observation of a non-light absorbing non-black hole would indeed provide evidence that all black holes absorb light. If we think about universal quantification in this way then we see that "our impression of a paradoxical situation is not objectively founded; it is a psychological illusion".[8]

What's more, our intuition about the relative *quantitative* strength of an observation in relation to a hypothesis might also illustrate why we find the raven paradox counter-intuitive.[9] For example, when we think about the hypothesis 'all ravens are black' we will habitually attach smaller quantitative confirmation strength to evidence such as 'here is one black raven' than to evidence such as 'here are one million black ravens.' The quantitative confirmation strength of evidence such as 'here is a black raven' pales into insignificance when compared with quantitatively stronger evidence such as 'here are one million black ravens'. Similarly, when we come to consider evidence such as 'here is a blue hat', the evidence pales into even more insignificance because of its negligible quantitative confirmation strength in comparison to the observation 'here are one million ravens.' However, we have to remember that Hempel's programme deals entirely with *qualitative* confirmation

[8]Hempel [4] p. 18.

[9]Good [3].

and does not consider the relative strength or weakness of any individual evidence. In other words, we tend to attach such small quantitative confirmation strength to evidence such as 'here is a blue hat' that its confirmation strength tends to zero. Since its quantitative strength tends to zero, when we try to think of its confirmation value in qualitative terms we incorrectly assign zero confirmation strength. This incorrect translation of quantitatively weak-confirming evidence into qualitatively non-confirming evidence is the origin of our counter-intuitions in the raven paradox. In other words, our human intuitions are not sharp enough to realise that even if an observation has very weak quantitative confirmation strength, it still has a positive value as qualitative confirmation evidence.

4 Why the Nature of Qualitative Confirmation Is Irreconcilable with Human Intuition

If our counter-intuitions about the raven paradox are formed by our inability to correctly translate quantitatively weak-confirming evidence into qualitatively positive-confirming evidence, then it could be argued that the nature of qualitative confirmation theory itself is problematic. In other words, the raven paradox does not compromise Hempel's theory of qualitative confirmation in particular but, instead, it shows us why any theory of qualitative confirmation will be irreconcilable with our intuitions.

Any theory of qualitative confirmation is such that an observation either confirms or disconfirms a hypothesis. This binary nature of qualitative confirmation theory precludes any quantitative measure of the relative strength of individual observations. For example, as far as theories of qualitative confirmation are concerned, the evidence 'here is a black raven' can only be said to either confirm or disconfirm the hypothesis 'all ravens are black'; what cannot be said is to what *extent* this evidence does so. This account of confirmation cannot be reconciled with our intuitive ideas about confirmation because whenever we talk about an observation confirming a hypothesis, we always have some notion of *how much* the observation confirms the hypothesis. Our intuitions about the confirmation of scientific hypotheses are such that an observation only ever quantitatively confirms or disconfirms a hypothesis and, as such, any qualitative account of confirmation will always be counter-intuitive in some respect. The raven paradox, then, is no paradox at all. In fact, the paradox is something to be expected since Hempel's theory is a theory of qualitative, rather than quantitative, confirmation.

5 Conclusion

While revisions of Nicod confirmation may or may not avoid the raven paradox, it is not clear that such revisions are justified or even necessary. The raven paradox is a problem for human psychology and not for Hempel's programme. The paradox arises only out of our inability to think correctly about the true extensions of universal quantifiers and our inability to correctly translate quantitatively weak-confirming evidence into qualitatively positive-confirming evidence. As such, the raven paradox helps us to see why any theory of qualitative confirmation will be counter-intuitive in some respect because theories of qualitative confirmation do not, by definition, take into account the relative degree to which a hypothesis is confirmed by some evidence. If we want a theory of confirmation which reflects our intuitions about relative confirmation strength, then it is to quantitative theories of confirmation that we must look.

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Hume's Scepticism: A Reader's Guide to Gulliver's Travels?

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Jonathan Swift's *Gulliver's Travels* is packed with improbable tales, irony, and questionable testimony which leave the reader scrambling for hard ground. The reader must progress slowly, questioning what to believe at all stages. David Hume's preferred form of scepticism gives us the tools we need to avoid the traps laid for us by Swift. It is only through such hesitancy that we can attain "a proper stability and certainty in our determinations", according to Hume's *Enquiries*.[1] Hume's scepticism teaches us to be critical and wary; exactly the traits needed for safe navigation of *Gulliver's Travels*.

Firstly I must make mention of Hume's epistemology. Georges Dicker summarises this well:

> We acquire all of our ideas from experience, where "experience" is taken as including both sense perception and the introspective awareness of our own states of mind.[2]

Thus Hume believes ideas result from our sensing the external world and this is where scepticism enters the discussion, as Dicker writes:

> Scepticism [...] calls into question the possibility of knowledge. It does so by using certain arguments that are designed to show that our cognitive faculties and powers - our senses, reasoning ability, and memory - are not reliable enough to enable us to distinguish securely between truth and error, appearance and reality, well-grounded belief and mere opinion.[3]

With this basic understanding of scepticism I now move to discuss Hume's own form.

The first 'species of scepticism' which we encounter in Hume is antecedent scepticism, often associated with Descartes.[4]

> It recommends an universal doubt, not only of all our opinions and

[1]Hume [3] p. 150.
[2]Dicker [2] p. 5.
[3]Ibid. [2] p. 7.
[4]Hume [3] p. 149.

> principles, but also of our faculties.[5]

We must question our ability to use reasoning itself in any reliable way before applying reasoning to any task. The origin of the name 'antecedent scepticism' becomes clear – we are sceptical of the reasoning we are about to use. If we were to attain such an intense form of scepticism, writes Hume, it "would be entirely incurable".[6] We would not be able to use reason to escape it as we would doubt that reason itself.

Hume is highly critical of this strong form of antecedent scepticism. Its central problem is that it defeats itself by using reason itself to argue that reason is unreliable. David Fate Norton concisely puts the argument thus:

> If our reason is so dubious a tool [...] then we must be diffident about our reason.[7]

If it is true that reason is wholly unreliable, such a conclusion cannot logically be reached using reason. The conclusion, that we must mistrust reason, brings into question any argument which uses reason, including itself. So if its own basis is in question we must doubt the conclusion. If we doubt the conclusion, then we doubt that reason should be mistrusted.[8] By failing to step out of reasoning to discredit reason itself, it becomes a victim of its own argument. Or, as Hume puts it, antecedent scepticism requires us to apply "those very faculties of which we are supposed to be already diffident".[9] Such strong antecedent scepticism is clearly flawed.

However, if we use a moderate version of antecedent scepticism we benefit as academics. It works as a "necessary preparative to the study of philosophy" in that it helps us remove prejudices and "rash opinions" from our arguments by forcing us to question the basis of any claims being made.[10] Antecedent scepticism in this weak form makes us reflective and critical philosophers, students, and readers.

Next, Hume discusses consequential scepticism, attributed to the Pyrrhonian tradition. We instinctively trust our senses such that we barely, if ever, question the reality of the external world which we believe ourselves to perceive.

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[5]Hume [3] p. 149.

[6]Ibid. [3] p. 150.

[7]Norton [5] p. 376.

[8]Ibid. [5] p. 372.

[9]Hume [3] p. 150.

[10]Ibid. [3] p. 150.

We are convinced that if we were to die this world outside of us would continue, for we are confident that this world is more than our imagination: it is real and exists independently of us. As Hume writes of the world:

> Our presence bestows not being on it: our absence does not annihilate it.[11]

The problem raised is made clear by Hume's example of a table which we perceive:

> [The table] seems to diminish, as we remove farther from it: but the real table, which exists independent of us, suffers no alteration.[12]

Our perception can not be said "to present external objects to us directly".[13] Only the image of the table is known to us: the real table remains a mystery. This leaves us doubting our link to the external world: our reason "can never find any convincing argument from experience to prove, that the perceptions are connected with any external objects".[14]

Hume's counter argument to this position is that "no durable good can ever result from it; while it remains in its full force and vigour".[15] Furthermore, such scepticism is unable to interfere with our natural survival instincts and our day-to-day living. Hume writes:

> But a Pyrrhonian [...] must acknowledge, if he will acknowledge anything, that all human life must perish, were his principles universally and steadily to prevail. All discourse, all action would immediately cease; and men remain in a total lethargy, till the necessities of nature, unsatisfied, put an end to their miserable existence.[16]

Hume does not consider it worthwhile worrying about such scepticism as "Nature is always too strong for principle".[17] Nature is always too strong a force for reason and philosophy. We are compelled by nature to act in contradiction to the scepticism we may have reasonably arrived at. Such scepticism poses no threat to our existence, nor offers anything of use to us in its current state. However in a mitigated state it does provide something

[11]Hume [3] p. 152.

[12]Ibid. [3].

[13]Norton [5] p. 373.

[14]Hume [3] p. 154.

[15]Ibid. [3] p. 159.

[16]Ibid. [3] p. 160.

[17]Ibid. [3].

of value. So much so that Hume heralds it.

If we take the moderate Pyrrhonian inclination to doubt and apply it to our own lives and work then it helps us to achieve greater results. Certainly in academic practice it aids us towards 'truth'. It gives us a "degree of doubt, and caution, and modesty, which, in all kinds of scrutiny and decision ought forever to accompany a just reasoner".[18] It helps us to remember that we may be mistaken in our arguments and to remember our very real fallibility. Hume describes this form of good academic, or mitigated consequent, scepticism as encouraging us:

> To begin with clear and self-evident principles, to advance by timorous and sure steps, to review frequently our conclusions, and examine accurately all their consequences; though by these means we shall make both a slow and a short progress in our systems; are the only methods, by which we can ever hope to reach truth, and attain a proper stability and certainty in our determinations.[19]

What we are left with here is an account of Hume's mitigated scepticism, and how it may help us as academics. What I intend to argue now is that Swift wishes us to use this same approach of scepticism when reading *Gulliver's Travels*. We must slowly move over the text, picking it apart, only taking at face value what we must, considering and exposing what is left ambiguous, and asking why it might be so.

I posit that Swift, as with Hume, advocates a moderate antecedent scepticism. This is done by his presentation of Gulliver as not necessarily dependable in his account of events and facts. Swift achieves this position of doubt in two ways. Firstly, we are given an account of his veracity. Before the start of *Gulliver's Travels* proper, a letter is printed from the publisher to the reader. Here, Richard Sympson, the fictitious publisher writes:

> There is an air of truth apparent through the whole; and indeed the author was so distinguished for his veracity, that it became a sort of proverb among his neighbours at Redriff, when any one affirmed a thing; to say it was as true as if Mr. Gulliver had spoke it.[20]

The joke here is at the expense of Gulliver's reliability; Gulliver's 'true story'

[18]Hume [3] p. 162.

[19]Ibid. [3] p. 150.

[20]Swift [6] p. 6.

is entirely unbelievable. To compound the irony further, Gulliver himself writes of his distaste for travel writers who manipulate the truth for the sake of writing an exciting story. Indeed he claims to have followed the maxim "that I would strictly adhere to the truth"[21] whilst writing his journal. My argument here is that Swift deliberately protests too much. If less of a claim to truth had been made it would not jar so much with the reader. Curiously, by testifying to his reliability so soon and so often, Swift may in fact be reminding us to question Gulliver's account. Because we now dispute the veracity of Gulliver we approach anything he says with an antecedent scepticism. We are now alert to the possibility that he can be doubted and apply this to our reading of the text. Indeed, in our antecedent questioning of the narrator we can question his name which alludes to his possible gullibility. Indeed, in our antecedent questioning of the narrator we can question his name: the first part, 'Gulli', alludes to his possible gullibility. So Gulliver may convey his knowledge in good faith but his veracity is still wide open to doubt.

However, if we were to apply strong, unmitigated antecedent scepticism, as good Pyrrhonians, we would claim that there is no possibility of knowledge being reliably passed on to us from any narrator. In effect this means that we would be unable to derive any knowledge from the narrator's words. The purpose of reading the text would be nil for a Pyrrhonian. There are no grounds in my reading of the text to suggest that this is how we should approach it. Indeed, returning to an etymological analysis, the second part of Gulliver's name, 'ver', may allude to his veracity. Thus arguably along with supporting moderate antecedent scepticism by portraying Gulliver as gullible, *Gulliver's Travels* denounces strong antecedent scepticism by also suggesting that he is in part veracious and thus worth listening to. We should therefore treat Gulliver's testimony critically but not disregard it as useless. As an advocate of moderate antecedent scepticism and a critic of unmitigated antecedent scepticism, *Gulliver's Travels* has clear parallels with Hume's account of scepticism.

I move now to Swift and consequential scepticism. Here I argue that Swift advocates a moderate form of consequential scepticism. It is possible for us to know things, but any claims to knowledge must be made modestly. I take this line based largely on Swift's representation of modesty in Part IV of *Gulliver's Travels*.

[21] Swift [6] p. 323.

At the very start of Part IV Gulliver refers to a sailor, Captain Pocock of Bristol:

> He was an honest man, and a good sailor, but a little too positive in his own opinions, which was the cause of his destruction, as it hath been for several others.[22]

I argue that Swift here is setting up a comparison to be made between Pocock's lack of modesty, and the Houyhnhnms' similar lack of modesty.

The Houyhnhnms, on the face of it, constitute a utopian society for Gulliver. He is at his happiest there and regrets so deeply his return to life with Yahoos that he attempts suicide on Pedro de Mendez's boat.[23] But there are a number of possible signifiers that demonstrate that there is something unappealing about Houyhnhnm society, which is of course based on pure, excessive reason. For example, the way in which the dead are mourned is contemptible. So too is the way in which they dogmatically fail to distinguish between Yahoos and Gulliver. Also their breeding program and hierarchical structure of society can be criticized. Though Gulliver is clearly an avid supporter of such a society, the reader is encouraged to doubt Gulliver's sanity and therefore his account of said society. By having him talk to his horses when he returns to England, Swift commits a sort of character assassination. Based, amongst other reasons, on an *ad hominem* attack on Gulliver, we are left doubting the virtuousness of Houyhnhnm culture, and questioning deeply whether we would endorse such a society.

This can be extended further. The Houyhnhnm's utter lack of modesty in their own knowledge and judgement leaves no room for appeals to be made against their decision. By Gulliver's account of their wisdom it seems inconceivable that they could be wrong. As Gulliver notes, "if the inhabitants of this country were endued with such a proportionable degree of reason, they must needs be the wisest people upon earth".[24] But by taking a more sceptical view, and including the lesson of Captain Pocock, it is arguable that Swift here is showing both that Gulliver is biased, thus not reasonable or reliable on the matter, and that there is a serious flaw in the Houyhnhnm's reason-based society. This is indicated, at least in part, by the Houyhnhnm's claim that 'one ought never to lie' being undermined through the act of not telling Gul-

[22]Swift [6] p. 243.

[23]Ibid. [6] p. 318.

[24]Ibid. [6] p. 248.

liver about the decision made by the general assembly to expel him.[25] This reading requires a critical mind, utilizing some of the ideas discussed with Hume previously, and is only possible if the reader is sceptical and questions frequently what to believe and what not to believe. Such a reading, based on principles of Hume's scepticism, allows for greater depth of understanding of *Gulliver's Travels*. I argue, therefore, that Swift would endorse such a Humean reading of his text. James Clifford agrees to an extent with this reading, arguing that Swift viewed humanity as having at least enough reason to understand "the falsity of too much pride".[26]

Thus, with regard to moderate consequential scepticism, there are clear parallels between Swift and Hume. Readers should approach *Gulliver's Travels* as moderate sceptics, doubting, though not incurably, the things that we are being told. We must also make modest claims to knowledge, as readers, and as virtuous characters. Along this line, Hume defines a fool as "all those who reason or believe any thing certainly".[27] This brings me back to the lack of modesty shown by the deceased Captain Pocock and the non-self-reflective Houyhnhnms: lack of modesty is not shown in a coherent way as being virtuous, instead the reverse is true.

As Hume might argue, it would be pointless to apply extreme consequential scepticism as a reader. Not only would we take nothing from the text, but we would struggle to find any motive for reading the text at all, based on this nihilistic approach to knowledge. In terms of content also, Swift seems to be critical of an over-application of reason such that it ceases to be appropriate. I make this claim based on the already mentioned portrayal of Houyhnhnm society as deeply undesirable. The application of reasoning should be limited to allow for humanity in a society, in the form of compassion, warmth and sympathy. This, arguably, is demonstrated in the character of Pedro de Mendez who literally acts as a middleman between the staunch, excessive reason of the Houyhnhnms and the far less reasonable, much more animal, Yahoo culture of western Europe. By taking Gulliver from one to the other with compassion and kindness, though not so much as to be irrational and self-destructive, De Mendez is arguably a moderate amalgam of both reason and animal. He is both rational and animal. This is demonstrated by Gulliver treating De Mendez, as the Houyhnhnms had done so to him, "like an ani-

[25] Swift [6] p. 302.

[26] Clifford [1] p. 40.

[27] Hume [3] p. 270.

mal which had some little portion of reason".[28] De Mendez embodies Swift's criticism of excessive reasoning but in such a way as to break the dichotomy between reason and animal. Moderation in both animal and rational aspects of the subject, I argue, is what Swift is endorsing. Thus he, like Hume, is not in favour of extreme consequential scepticism.

To conclude, I have demonstrated that both Hume and Swift endorse moderate, mitigated antecedent and consequential scepticism, and are critical of extreme antecedent and consequential scepticism. Though Hume also discusses scepticism, albeit in a more academic fashion, undoubtedly Swift staked out this position first. *Gulliver's Travels* can be understood as a literary precursor to Hume's epistemological scepticism. More interesting though is the startling similarity between their positions. Such comparison, I believe, has not been made before. There is not much that has not been said about Hume and Swift in the 250 years or so since their works were published; I hope to have presented enough reason to justify further comparative study that may reveal yet more substantial similarities.

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Quantum Mechanics and the Bundle Theory of Individuation

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Introduction

The principle of the identity of indiscernibles - henceforth PII - has its formal analogue in the sentence:

$$\forall \mathrm{F}\ (\mathrm{F}(a) \leftrightarrow \mathrm{F}(b)) \rightarrow a{=}b \qquad (\mathrm{PII_f})$$

Taking the domain of quantification to be all predicates it can be shown that $\mathrm{PII_f}$ is a theorem of classical first order logic with identity, which for some philosophers marks the end of the discussion; the identity of indiscernibles is simply a logic truth.[1] Nowadays, philosophers who want to take ontology seriously are unlikely to be so hasty. A distinction is drawn between logical and metaphysical necessity, with the importance of the former generally being down played when it comes to substantial ontological issues.[2] For the principle to be illuminating then we will need to consider more carefully the domain of quantification in $\mathrm{PII_f}$. It may be a metaphysical truth for example that $\mathrm{PII_f}$ is true for some limited domain of predicates. What seems to be at stake are two views about the ontological constituents of individual objects. What is it that grounds their identity and diversity? On one view objects consist of properties, plus some apparently mysterious additional element which grounds the individuality of the object. Locke's substratum[3] and Armstrong's thin particulars[4] are variants of this type of ontological devise. On the other hand there is the view that objects are individuated by the diversity of their properties, and are nothing more than bundles of properties. Allowing identity involving predicates like '$\ldots$ is identical to a' into the domain of $\mathrm{PII_f}$ amounts to endorsing the existence of primitive identities, irreducible to properties an object may have, which clearly flies in the face of the bundle conception. It seems then that the bundle theorist will

[1] Brody [4] pp. 3-20.

[2] See Lowe [18].

[3] Locke [17] pp. 117-129.

[4] Armstrong [2] pp. 95-113.

need to claim that PII_f is a metaphysical truth for some more limited domain of predicates, corresponding to properties which can adequately distinguish their bundles from each other.

A number of philosophers of physics have suggested that on a plausible interpretation of what properties can be attributed to particles in a quantum mechanical system, all interesting forms of the identity of indiscernibles fail. There is certainly some controversy here but I will argue that this picture is essentially correct. This would seem to be a strong case against a bundle conception of individual objects. It is not clear that matters are this simple however, as it is open to dispute whether quantum mechanical particles can rightly be considered individual objects. If, as some authors have suggested, they should be considered modes of a quantum field rather than individuals then PII will simply be inapplicable to quantum mechanical systems rather than false. Quantum mechanics does not straightforwardly resolve the debate between the substratum and bundle accounts of individuation then, but it does place some limits on how each ontology can account for results in fundamental physics.

1 The Metaphysics of Properties

Predicates are semantic entities. Properties on the other hand are supposed to be ontic entities; they have some robust form of existence. Traditionally the concepts are related to each other by the thought that properties are the truthmakers of predication sentences. The simplest way of cashing out this idea would be a one-to-one correspondence between true predications and properties -'a is F' is true if the individual a has property F. Again, taking ontology seriously this looks too quick. If this were the case the truth of '$a=a$' would force us to admit the existence of the property of being identical with a. Primitive identity properties of this kind are generally considered to be a direct consequence of a substratum approach to individuality, and are consequently far from metaphysically innocent. An alternative, which has been explored in some depth by Heil, is the view that 'a is F' can be made true by some complex of properties.[5] This view would allow us to say that the sentence '$a=b$' is made true by the sameness of a complete set of properties attributed to the names a and b, eliminating the need for primitive identity properties. This is exactly the kind of metaphysical project the

[5]Heil [15] pp. 61-73.

bundle account of individual objects is pursuing. But how are we to know what properties an object has if we deny one-to-one correspondence with predicates? Ontological systems are designed to explain the way the world is and the way our language relates to it, as opposed to simply being read off the grammatical form of our language. Properties are posited as entities with an explanatory role. This perspective makes good sense of the dispute between our two ontologies of objects. The bundle theorist feels that primitive identity properties lack any explanatory value due to their lack of empirical consequences, and seeks to reduce objects to properties which are in some sense qualitative. The motivation for this view is largely empirical then and has some intuitive force. The substratum theorist believes that primitive identities are a necessary explanatory postulate. At least one reason for thinking this is the failure of the identity of indiscernibles, though there are certainly others. The important point is that the dispute is, in the end, about the explanatory power of different sort of properties.

With an end to explaining various philosophical problems, metaphysicians divide properties up into distinct types. Setting aside disputes about the nature of these types, I want to make just two distinctions here which are relevant to the status of PII and are, at least in the way I shall treat them, relatively metaphysically innocent. The first is between intrinsic and relational properties. An object has relational properties, such as the property of being a mother and being 100m from Big Ben, in virtue of the way it stands with regards to other things and classes. Its intrinsic properties, if it has any, are supposed to be non-relational; those properties it would have regardless of relations it has to other things. An object's shape seems to be a good candidate, though there are in fact few uncontroversial examples of intrinsic properties. The second distinction is between qualitative and non-qualitative properties. Adams gives the classic exposition of this proposed dichotomy:

> a property is purely qualitative [...] if and only if it could be expressed, in a language [...] without the aid of such referential devices as proper names [...] indexical expressions, and referential uses of definite description.[6]

In short then, non-qualitative properties, if there are any, are properties an object has in virtue of its relation to distinct individuals; they are a subset of relational properties. Being 100m from Big Ben is a non-qualitative prop-

[6] Adams [1] p. 7.

erty, where being 100m from a clock tower is qualitative in this terminology. More importantly being identical with a is non-qualitative, which suggests the reason for introducing this distinction. Consider the famous objection raised against the identity of indiscernibles by Black [3]. We are asked to imagine a universe consisting of two exactly similar spheres a fixed distance of 1 mile apart. If we arbitrarily label these spheres a and b they can be distinguished by predicates like '...is 1 mile from a' since this can only be truly predicated of b. According to our above distinction these predicates will correspond to non-qualitative properties however, and it is usually admitted that such properties cannot be used to distinguish objects if PII is to serve a substantial ontological purpose. Non-qualitative properties obtain in relation to an individual, so to use them to analyse the notion of individuality would be a circular exercise. Note that this is a metaphysical rather than logical objection - non-qualitative properties are excluded simply because allowing them to ground an object's individuality would not amount to the kind of ontological reduction that the bundle theorist is interested in.

Returning to the status of PII, we should note that denying a one-to-one correspondence between predicates and properties should not complicate the restriction of the domain of $\mathrm{PII_f}$. Not every predicate will be true in virtue of a single property, but some will, since if an object a has property P we can obviously truly say 'a has property P'. Such predicates might be called simple, in so far as they directly correspond to a property an object has. From what we have said it seems that for bundle theory to be vindicated $\mathrm{PII_f}$ will need to be a metaphysical truth in a domain of simple predicates corresponding to qualitative properties. We now move on to discuss how this project fares in the context of modern physics.

2 Properties in Classical and Quantum Physics

How can properties be attributed to objects on the basis of physical theory? This is not a trivial question, and potentially has a different answer for classical and quantum physics. The usual assumption is that physical properties correspond to predicates formed from observable quantities which occur in physics. The distinction between intrinsic and relational properties is apparently mirrored in the distinction between state dependent and state independent quantities in mechanics. In classical mechanics the state of a system is represented by a vector in phase space which attributes momenta and spatial position to the particles of the system. In quantum mechanics the state of a

system is represented by a vector in Hilbert space which assigns probability distributions to measurements of the system. There are a small number of quantities which must be specified for particles in a system independently of this state's representation, namely mass, charge and, in the quantum domain, spin and flavour quantum numbers. These are usually taken to correspond to intrinsic physical properties, such as having mass 1kg. Accepting this interpretation, it becomes clear that limiting the domain of PII_f to intrinsic properties produces a false principle for physical objects.[7] It is very common for both classical and quantum models of physical systems to consist of a number of distinct particles with the same state independent quantities. In the standard model of quantum field theory, exact similarity of a small range of state independent quantities is prescribed in defining a discrete number of particle kinds including electrons. State independent quantities, then, seem to be the only hope for grounding a suitable form of PII for physical systems. These too are taken to correspond to physical properties, but it seems they must be relational. The states of a system in both forms of mechanics are specified relative to a frame of reference, defined with respect to a collection of particles, or perhaps, if you believe in such a thing, substantive space-time. Either way they are clearly relational with respect to some object. Our question is then: does physics provide us with state dependent quantities sufficient to ground a realistic form of PII?

In classical mechanics the bundle theorist appears to be in luck. The phase space vector assigns a spatio-temporal trajectory to each particle in the system - a position in space corresponding to each point in time. If we assume that particles are impenetrable and cannot occupy the same point in space at the same time then these trajectories will be unique, and so will provide spatio-temporal relational properties that distinguish particles at all times. There do seem to be qualitative properties that distinguish classical particles, and the prospects look promising for PII.[8][9] This is a little hasty for a number of reasons. Firstly the impenetrability assumption is a metaphysical stipulation; there is nothing about the formalism of mechanics which prevents particles occupying the same space outright. At face value it seems empirically plausible, but might there not be possible worlds in which it fails? If so, PII will not be true necessarily, but, at best, contingently. Secondly, Black's coun-

[7]French & Krause [11] pp. 40-51.

[8]Ibid. [11] pp. 65-81 for a more in depth discussion of PII in classical mechanics.

[9]thtyyutyutyutyt

terexample briefly outlined above concerns classical objects, so it is not the case that PII is without its problems in the classical domain. Nonetheless, it is widely agreed that classical mechanics in itself does not provide us with any reason to doubt PII, and the prospect of unique spatio-temporal trajectories gives some support to the bundle theory.

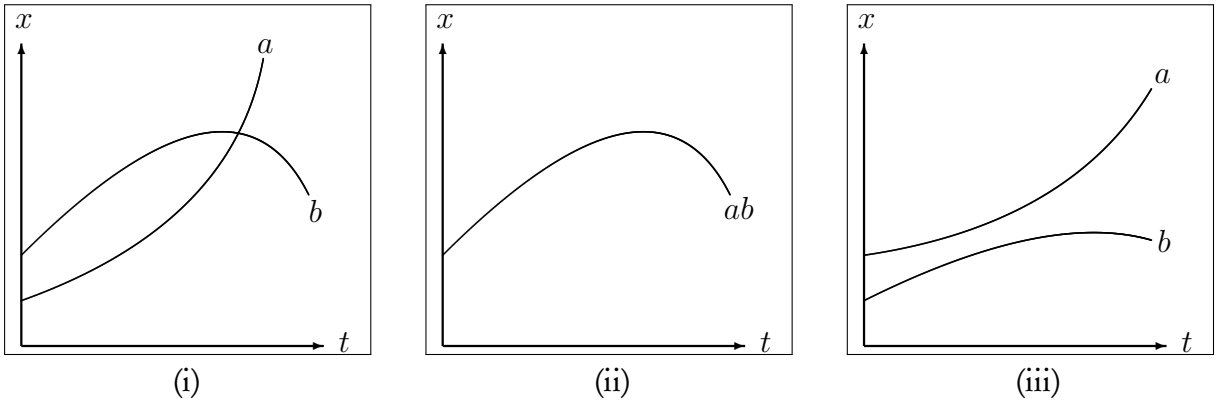

Figure 1: These images represent three possible trajectories of two particles a and b in a single special dimension x. Where impenetrability is not assumed, trajectories are permitted to cross as in (i), and even completely conjoin as in (ii). Where impenetrability is assumed, (i) and (ii) are ruled out, and trajectories must be unique as in (iii).

Attributing properties to particles on the basis of their Hilbert space representation is complicated by ontological controversies in the quantum domain. I will outline a standard view here, before discussing how variant approaches might have some bearing on the status of PII. In quantum mechanics, the state of a single particle system (often called a pure state) is represented by a unit vector $|\Psi\rangle$ which is an element of a Hilbert space H. Observable quantities, such as position, correspond to Hermitian operators on the space, where possible values of the quantity are eigenvalues of the operator.[10] If we have an observable A, with a spectrum $\{\Lambda_j\}$ and corresponding eigenvectors $\{\Phi_j\}$, the probability of a measurement of A returning a value Λ_j, $\mathrm{P}^{|\Psi\rangle}(\mathrm{A}=\Lambda_j)$, is $|\langle\Phi_j|\Psi\rangle|^2$. Retaining our assumption that physical properties correspond to predicates formed from observable quantities, the relevant predicates will be of the form '...has probability P of actualising Λ_j when measuring A'. These probabilistic properties, sometimes called *actualisation potentials*[11], are not attributions of determinate values to observable quantities, but they could potentially still distinguish quantum particles.

The question is further complicated when we move to systems of many parti-

[10]To simplify formal demonstrations we limit ourselves to operators with discrete spectra.

[11]French & Krause [11] p. 155.

cles. The orthodox formalism - what Teller [26] calls the labelled tensor product formalism (LTPF) - describes such systems in the following way. Suppose we have an electron with a state $|\Psi_a\rangle$ in a Hilbert space H_a, and a proton with a state $|\Psi_b\rangle$ in a Hilbert space H_b. The state of the system is then described by a vector $|\Psi_a\rangle \otimes |\Psi_b\rangle$ in the Hilbert space $\mathrm{H}_a \otimes \mathrm{H}_b$. From the point of view of PII we are interested in systems of the same type of particle, which cannot be distinguished by state independent quantities. Such systems are traditionally described in the same way, only in this case H_a and H_b will be the same Hilbert space. However, well known results in quantum statistics place limits on the states of aggregates of particles of the same type. The easiest way to see these restrictions is in the simplest possible 2 x 2 tensor product space for such a two particle system, though these results can of course be generalised. We suppose that two particles of the same type, arbitrarily labelled a and b, can be in one of two pure states, $|\mathrm{s}_1\rangle$ and $|\mathrm{s}_2\rangle$, which are the only eigenstates of an operator S on the space H, the obvious physical interpretation being the spin operator.[12] The tensor product space $\mathrm{H} \otimes \mathrm{H}$ will be a four dimensional Hilbert space, but the possible states of the system are restricted to one of two subspaces corresponding to the set of tensor product states which are symmetric and anti-symmetric under an exchange of particle labels. The symmetrical subspace corresponds to Bose-Einstein statistical behaviour for aggregate systems; the anti-symmetric subspace to Fermi-Dirac statistics. The other states in the $\mathrm{H} \otimes \mathrm{H}$ correspond to so called parastatistical behaviour which has never been empirically observed, and it is usually concluded that there are two distinct classes of particle, bosons and fermions, which are limited to the symmetric and anti-symmetric subspaces respectively.[13] In our four-dimensional scenario bosonic particles will be limited to the states in the subspace:

$$|\mathrm{s}_1(a)\rangle \otimes |\mathrm{s}_1(b)\rangle \tag{1}$$

$$|\mathrm{s}_2(a)\rangle \otimes |\mathrm{s}_2(b)\rangle \tag{2}$$

$$1/\sqrt{2}(|\mathrm{s}_1(a)\rangle \otimes |\mathrm{s}_2(b)\rangle + |\mathrm{s}_2(a)\rangle \otimes |\mathrm{s}_1(b)\rangle) \tag{3}$$

Fermions are restricted to the only possible anti-symmetric state (4):

$$1/\sqrt{2}(|\mathrm{s}_1(a)\rangle \otimes |\mathrm{s}_2(b)\rangle - |\mathrm{s}_2(a)\rangle \otimes |\mathrm{s}_1(b)\rangle) \tag{4}$$

[12] Teller [26] pp. 23-25.

[13] Ibid. [26] for a more in depth discussion of parastatistics.

Notice that (3) and (4) do not assign a unique pure state to either particle a or b. This type of description of a many particle system is referred to as a mixed state for this reason.

There is a tradition amongst interpreters of quantum mechanics to claim that the LTPF implies some form of PII is true for fermions, since (4) prevents two fermions from being in the same pure state in a similar way to the impenetrability assumption. This way of arguing is certainly too quick, and probably fallacious, since, as I have just said (3) and (4) are mixed states and cannot be viewed as assigning determinate pure states to either particle. Massimi has argued that there is no sensible way of interpreting the mixed states (3) and (4) as attributing properties to either particle at all; each particle in some sense partake in both states and this is thought to be incompatible with the metaphysical concept of a property.[14] Far from easily verifying PII then, the LTPF tends to be viewed as an extremely problematic starting point for any kind of bundle theory in the contemporary literature. Teller has suggested that the introduction of arbitrary labels into the LTPF amounts to a commitment to the primitive identity of the particles.[15] If this is the case we must abandon the bundle theory of individuation just to make sense of a two particle system, and any form of PII obviously fails to be metaphysically relevant. Suppose we overlook these problems and try to give the benefit of the doubt to the bundle theory of individuation. The following argument from French and Redhead is designed to show that, even on the most charitable interpretation of how properties are attributed to quantum mechanical particles, PII is a false principle.

3 The French-Redhead Argument

Giving the bundle theorist the benefit of the doubt then, how might we read LTPF in terms of property attribution? If we follow our approach for a single particle system it is obvious that the properties of each particle must be linked to the probability distributions of hermitian operators corresponding to observables on the tensor product space. French and Redhead have suggested the following construction to extend this idea to the two particle system. We assume, as above, that an operator A, with a spectrum $\{ \Lambda_i \}$ and eigenvectors $\{ \Phi_i \}$, corresponds to a general observable quantity of a single particle. The

[14] Massimi [19].

[15] Teller [26] pp. 21-36.

operators A $\otimes$ I and I $\otimes$ A on the H $\otimes$ H space, where I is the identity operator, will have the effect of measuring A of particle a and leaving b unchanged, and measuring A of particle b and leaving a unchanged respectively. We call these operators A_a and A_b. There are questionable features of these supposed observables. The so called indistinguishability postulate for particles of the same type, which is again a result of quantum statistics, ensures that measurements of A_a and A_b cannot be used to determine experimentally which particle is which - formally this is achieved by limiting operators that correspond to observables to those that commute with operators that permute the particle labels a and b. The idea is that even though simultaneous measurements of A_a and A_b cannot correspond to experimental situations which would actually distinguish the particles empirically, differences in the probability distributions, interpreted as actualisation potentials associated with A_a and A_b might still distinguish the particles metaphysically.[16] (Empiricists may baulk at this idea, but remember that we are trying to give the bundle theory as much of a chance as possible within the LTPF). What kind of predicates can be expressed in terms of these operators? We have the monadic predicate $\mathrm{P}(\mathrm{A}_a{=}\Lambda_j)$, but in a two particle system we also have the possibility of 2-place predicates captured by the conditional probability $P^{|\Psi>}(A_a{=}\Lambda_j/A_b{=}\Lambda_k)$. A is a general observable so these two predicates are taken, by French and Redhead, to correspond to all of the state dependent properties that could ground a form of PII. They can be calculated for particles a and b in our two particle scenario by computing the joint probability $P^{|\Psi>}(A_a{=}\Lambda_j \;\&\; A_b{=}\Lambda_k)$ and obtaining the marginal probabilities. For the most contentious state (4) we have:

$$
\begin{aligned}
&\mathrm{P}^{|\Psi>}(\mathrm{A}_a{=}\Lambda_j \;\&\; \mathrm{A}_b{=}\Lambda_k) \\
&= |\langle\Phi_j|\langle\Phi_k|\,|\Psi\rangle|^2 \\
&= \tfrac{1}{2}|\langle\Phi_j|\mathrm{s}_1(a)\rangle|^2\,|\langle\Phi_k|\mathrm{s}_2(b)\rangle|^2 \\
&- \;\tfrac{1}{2}|\langle\Phi_j|\mathrm{s}_1(b)\rangle|^2\,|\langle\Phi_k|\mathrm{s}_2(a)\rangle|^2 \\
&+ Re\langle\mathrm{s}_1(a)|\Phi_j\rangle\langle\Phi_j|\mathrm{s}_2(b)\rangle\langle\mathrm{s}_2(b)|\Phi_k\rangle\langle\Phi_k|\mathrm{s}_1(a)\rangle
\end{aligned}
\qquad (5)
$$

Summing over j and k to attain the marginal properties, using the fact that the eigenvectors $\{\,\Phi_i\,\}$ of a hermitian operator satisfy the completeness relation $\sum|\Phi_i\rangle\langle\Phi_i| = \mathrm{I}$, and $|s_1>$ and $|s_2>$ are orthonormal vectors, we can

[16] French & Redhead [10].

deduce that:

$$\mathrm{P}^{|\Psi\rangle}(\mathrm{A}_a{=}\Lambda_j) = \mathrm{P}^{|\Psi\rangle}(\mathrm{A}_b{=}\Lambda_j) \tag{6}$$

and:

$$\mathrm{P}^{|\Psi\rangle}(\mathrm{A}_a{=}\Lambda_j/\mathrm{A}_b{=}\Lambda_k) = \mathrm{P}^{|\Psi\rangle}(\mathrm{A}_b{=}\Lambda_j/\mathrm{A}_a{=}\Lambda_k) \tag{7}$$

Similar results follow trivially for bosons. In states (1) and (2) bosons can be in the same pure state and so obviously have different actualisation potentials. A similar calculation to the one above, establishes exact similarity of monadic and 2-place probability values for the mixed state (3).[17]

It follows that the state dependent properties of any two particles of the same type in a two particle system are exactly alike and PII fails. We now discuss two prominent strategies for resisting this conclusion.

4 Two Possible Defences

4.1 Weak Discernibility

Some authors have accepted the French-Redhead view of property attribution in the LTPF but deny that the monadic and two-place predicates above are the only predicates that can be formed on this construction which might distinguish the particles. This defence springs from Quine's conception of different logical grades of discernibility. According to Quine, two objects are weakly discernible if there is a symmetric, irreflexive, two-place predicate which holds for both objects.[18] This can be easily illustrated in the case of Black's spheres; the two-place predicate'...is 1 mile from ...' holds symmetrically for both spheres but is irreflexive because neither sphere is 1 mile from itself. The irreflexivity of the weakly discerning predicate ensures that there are in fact two, and not one, object, which, in Quine's view, is a minimal condition for discernibility. Saunders [24] points out that this condition is met for fermions, since (4) requires that particles a and b cannot be in the same eigenstates of the operator S, which we said earlier can be conveniently thought to correspond to the particles' spin. Thus there is a two place predicate '...has opposite direction of each component of spin to ...', which holds between the two fermions and weekly distinguishes them. Muller and Seevinck [20] have recently extended this approach, arguing that

[17] Ibid. [10] for a more in complete presentation of the same demonstration.

[18] Quine [22].

even bosons are distinguishable along Quinian lines if we introduce an even weaker variety of discernibility, probabilistic discernibility. The specifics of this approach are highly technical; I mention it only to indicate that there is the possibility of using this notion of weak discernibility to give a general account of particle individuality in the LTPF. Whether bosons are weakly distinguishable or not however, I suspect that as a response to the French-Redhead argument this defence is misguided.

It seems clear that the weak discernibility of particles in LTPF cannot motivate a reduction of primitive identity properties to qualitative properties. The reason for this is that to distinguish an object from another via a weakly discerning relation must appeal to the individuality of the related object. As Ladyman and Bigaj [16] point out this is particularly evident in the case of Black's spheres:

> The object that supposedly discerns the spheres via the relation of being 1 mile apart is none other than one of the spheres [...] we should ask which of these two spheres the required object is. However, there is no way to answer this question in a non-circular way, thanks to the assumption that the spheres are absolutely indiscernible.[19]

How might weak discernibility aid PII? Simply adding that a and $b|$ must not be weakly discernible to $\mathrm{PII}_{\mathrm{f}}$ clearly will not support a bundle ontology even if it is a true principle. But if weakly discerning relations are taken to correspond to properties then these will be non-qualitative properties, since the distinguishing predicates must be of the form '... is 1 mile from a' where a is an arbitrary label. I have already noted that appealing to such properties will not amount to a form of PII of any metaphysical consequence, so the weak discernibility of fermions, and potentially bosons, cannot re-establish PII within the context of the LTPF. Saunders and Muller [24] overlook this point, I think, because they fail to make the distinction between PII as a trivial logical principle and as a metaphysical reductive principle. Under the influence of Quine - who holds a very restricted notion of the relationship between ontology and logic, and has no time for properties at all - they conflate properties with predicates in the descriptive language available to the LTPF, and presume that since weakly discerning relations imply the numeric diversity of two objects they can ground a form of PII as an ontological principle.

[19] Ladyman & Bigaj [16] pp. 127-128.

What is at issue is not just the predicates available to the LTPF, but what properties make them true. Weak discernibility does not establish, as PII_f limited to a domain of simple predicates corresponding to qualitative properties would, that primitive identity properties are not needed to ground the truth of identity statements.

4.2 Variant Approaches to Properties in Quantum Mechanics

The other strategy for resisting the French-Redhead argument is to question the assumption that the state dependent properties of the system must correspond to observables on the Hilbert space. This kind of response typically arises when an ontological account of the quantum domain is developed to help resolve the measurement problem which gives grounds to posit properties outside of the scope of the LTPF.

It has been suggested that on a modal interpretation of measurement in quantum mechanics a form of PII can be recovered for fermions at least. Modal interpretations resolve the measurement problem by drawing an ontological distinction between the so called 'dynamic state' of the system, which is deterministic and governed by Schrödinger's equation, and the 'value state' which is, roughly speaking, an assignment of values to observable quantities at all times which change unpredictably within some limits set by the dynamic state.[20] The basic idea here is that while two fermions in a superposition will have the same dynamic state it is possible to specify different value states for the particles, so that their properties will not be exactly similar. However, it is difficult to see how this approach can be thought to save PII taken as a reductive principle of individuation. Firstly, this trick will only work for fermions, because in a properly worked out modal interpretation bosons in the same state are taken to have the same dynamic and value states. It is surely undesirable to give different ontological accounts of these two types of particle, so it does not seem this form of PII can provide a general account of particle individuality. In any case, it is not clear that the kind of properties the modal interpretation provides give a metaphysically substantial form of PII. The differing value state properties, while they are presumably supposed to be explanatory in so far as they help resolve the measurement problem, are said to be "empirically superfluous".[21] The two particles are equivalent from

[20]See van Fraassen [28] pp. 275-277.

[21]Ibid. [28].

the point of view of any tests that can be applied to the system. It is hard to see how distinguishing particles in this way is any better than primitive identity properties. So while this form of PII might not be equivalent to a substratum view of individuality, it does not seem to amount to any viable form of bundle theory either.

Hidden variable solutions to the measurement problem might be thought to recover a form of PII. As is well known, Bohm takes quantum particles to have spatio-temporal trajectories between measurements, invisible to standard formalism of quantum mechanics, influenced by pilot waves governed by the Schrödinger equation. Hence, if we assume the impenetrability of particles we can recover the form of PII we said looked plausible for classical particles in terms of unique trajectories.[22] This strategy looks more plausible than the modal response because although the hidden trajectories cannot currently be observed it might be held that they could become epistemically accessible to future science, unlike the value states which are purely conceptual by stipulation. On the other hand it is not clear that one can simply force a classical metaphysical picture into the quantum formalism. The ontological status of the pilot-wave is troublesome because it can sometimes appear more natural to talk of spatio-temporal properties as being attributed to the waves themselves rather than the particles.[23] While this isn't a knock down argument against a defence of PII along Bohmian lines, it just so happens that supporters of hidden variables interpretations tend to take particle individuality as being primitive without appealing to any form of PII.

5 Metaphysical Consequences

The bundle theory of individuation remains attractive amongst metaphysicians despite the problems with PII. Primitive identity properties and substrata are suspicious ontological devices, particularly for philosophers of an empirical persuasion. Consequently, even philosophers who have been convinced of the failure of PII in Black's hypothetical possible world have sometimes wanted to claim that PII is a contingent truth which can account for the individuality of objects viewed as property bundles in all possible worlds close to our own.[24] It has been suggested that the French-Redhead argu-

[22]Brown [5].

[23]For example, in the case of interpreting interference phenomena (see Brown [5]).

[24]Casullo [6].

ment stands against this strategy as they represent failures of PII in the actual world.[25] This consequence will follow, if I am right about the French-Redhead argument, only if we accept an assumption which has been frequently challenged throughout the history of quantum mechanics: that quantum particles can be considered individuals at all. Many philosophers and physicists have argued that differences between quantum and classical statistics imply that particles in the former cannot rightly be considered individuals. Teller has argued that we should do away with the LTPF entirely and move all of our descriptions of many particle systems to the fock space formalism which eschews particle labels in favour of density operators. In the context of this formalism particles might be viewed not as individual objects but modes of an all pervading quantum field, in which case PII would be entirely inapplicable to quantum particles rather than false. The metaphysical implications of French-Redhead argument are, to an extent, contingent upon our choice of a particle or field ontology of the quantum realm then. It is not clear that a field ontology will be greatly comforting to supporters of the bundle theory, however, since he will then be confronted with the perplexing question of how classical individuals might arise from a substantial quantum field. Quantum mechanics associates different ontological costs with the choice between a bundle and substratum ontology of individual objects, rather than providing decisive grounds for adopting one or the other. The issue is left open, then, as a possible area of fruitful collaboration between philosophers of physics and metaphysicians.

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The Substantivalist's Razor: Cutting Geometry from Space

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Contemporary metaphysics seems to have reached an impasse between relationism and substantivalism about space. The basic conceptions these terms represent are so fundamentally opposed, and their defences so complex, that it seems unlikely that proponents of either view will seek a position of compromise, let alone be receptive to defection. Relationism claims for itself a less cumbersome ontology than substantivalism, using the principle of Occam's razor to cut space from existence. For that reason, this investigation is structured as an interrogation of a staunch relationist position, and pursues one particular argument (concerning geometric relations) to its logical conclusions. By the paper's close, I hope to have demonstrated that the relationist's position necessarily entails logical fallacies, which in turn make its ontology the more cumbersome of the two. I will open with a brief (and rather generalised) synopsis of the two opposing philosophies, before detailing the argument I am advancing. I will endeavour to be as concise as possible in explicating that which is likely to be familiar to the reader, and correspondingly expansive in examining the more esoteric areas of the discussion which I feel have been significantly overlooked.

Substantivalism tells us that the existence of space is non-contingent upon the existence of objects interior to it. For the substantivalist, objects have an absolute location, and the spatial relation between two objects can be expressed in such terms. The relationist, however, believes that space is simply the spatial relations that hold between objects - the existence of space is solely entailed by the existence of those objects. According to the relationist, space exists only in terms of relations, and has no ontological status. The distance between two objects is the irreducible fact of the matter, and no explanatory mediation to a third entity (space) is necessary. These simple opposing propositions produce some surprisingly complex consequences. One difficulty for relationism is that the very terms of language presuppose the substantivalist's position: we think and talk about points of space, moving through it, increasing it, as if it were a substance. Indeed since Aristotle's 'abhorred vacuum', orthodox metaphysics has largely served to reinforce such presuppositions, as have many prominent figures in the field of psychics, most notably Newton and Einstein. This should not, of course, unduly prejudice us towards the

substantivalist, but it is indicative of the kind of difficulties the relationist needs to work through, to convince us that these ways of thinking (and talking) really are just features of thought (and language), and hold no bearing on ontological commitment.

Let us take a simple sentence by way of example: 'put that object (o) in that space (x)'. For the substantivalist, x represents a genuine point in absolute space, regardless of whether it is occupied by any object, or even if there are no objects in existence at all. The substantivalist says to the relationist that the very terms of such simple direction implicitly admit the existence of x, and therefore space-as-object. The relationist responds that x actually represents a set of possible spatial relations which an object *could* bear to other existent objects. This set of relations is defined, and each unoccupied location (point) is differentiated from other points, by reference to geometric laws. The premise implicitly relies on geometric mathematical truths being *necessary* truths - they would be true regardless of the way the world obtains. The relationist can therefore talk about spatial points without admitting of their existence, and without being contingent upon the way the world actually obtains - 'put that object (o) in those geometric relations with other objects (x)'.

However, the emergence of papers which successfully advance the logical consistency of non-Euclidian geometries makes the premise that geometric mathematical truths are necessary doubtful: if space is curved, Euclid's laws will fail to identify midpoints, angular relations, parallels, etc., in the definitional function that the relationist requires in order to talk about points. Indeed many contemporary cosmological theories hold that certain observable phenomenon indicate that space is curved. Now this is not immediately disastrous for the relationist, who can claim that the peculiarities non-Euclidian geometry seems to introduce are somehow intrinsic to the relation between the two objects.[1] Poincaré's 'doubling universe' experiment, which has traditionally been used as a *reductio ad absurdum* proof by relationists, can in fact be used by the substantivalist in conjunction with notions of non-Euclidian space to promote his position.

Poincaré asks us to consider the following: if everything in the universe (including distances) doubled in size over night, would we notice a change? Relationists have typically used the experiment to argue that no discernible

[1]This emerged from a conversation with Professor Le Poidevin.

change would occur, which demonstrates the non-existence of space. Nerlich insightfully critiques this argument, saying that it implicitly relies on what he calls the inconsequentiality principle: "IP: 'inconsequential properties' are not properties".[2] A universal doubling in a non-Euclidian space would result in consequential, perceptibly evident changes, most obviously in the shape of objects. Not even an appeal to something intrinsic in the nature of a relation between two objects can defend the relationist from this objection, as the change would be consequential, and therefore indicate mediation with absolute space.

Robin Le Poidevin raises further issues of geometry which the relationist faces in terms of overdetermined truthmakers. Le Poidevin's argument depends on what he calls the explanatory principle:

> a natural extension of the truthmaker principle [is] *the explanatory principle*: Where p entails q, there is a corresponding connection between the truthmakers of p and q that explains the entailment.[3]

He considers the following geometric situation:

1. A and C are two objects on a flat surface which are at a distance of 10" from each other.
2. The relationship of the proposition 'AC = 10' is represented by R_1, and exists independently of any other object.
3. On the straight line AC there is an object, B, which is 4" from A and 6" from C.
4. There are two further relationships: R_2 (AB) and R_3 (BC).
5. 'AB = 4"' and 'BC = 6"' entail 'AC = 10"'.
6. According to the explanatory principle, there is a corresponding connection between the truthmakers of 'AB = 4" and BC = 6"', and its entailment, 'AC = 10"', that explains the relationship that is entailed, R_4.
7. R_4 expresses the proposition 'AC = 10'. This relationship "is wholly supervenient upon R_2 and R_3".[4]

The problem for the relationist is that the simple proposition 'AC = 10' is apparently entailed by two independent truthmakers, R_1 and R_4. The relationist obviously wants to admit only of the existence of R_1, but the explanatory

[2]Nerlich [11] p. 171.

[3]Le Poidevin [7] p. 191.

[4]Ibid. [7] p. 193.

principle necessitates the existence of R_4. 'AC' therefore represents a situation of *overdetermined* truthmakers. To clarify, the supervening and non-supervening relations are co-variant, they are existentially contingent upon each other. Therefore, if 'A' and 'C' are moved further apart, the new relations which obtain exhibit the same co-dependence. The relationist cannot consistently maintain that 'AC' exists independently of any other object. This dilemma is of course no trouble to the substantivalist, who states that an object's only fundamental relationship is its absolute location in space, and is therefore unaffected by the existence (or *non*-existence) of other objects.

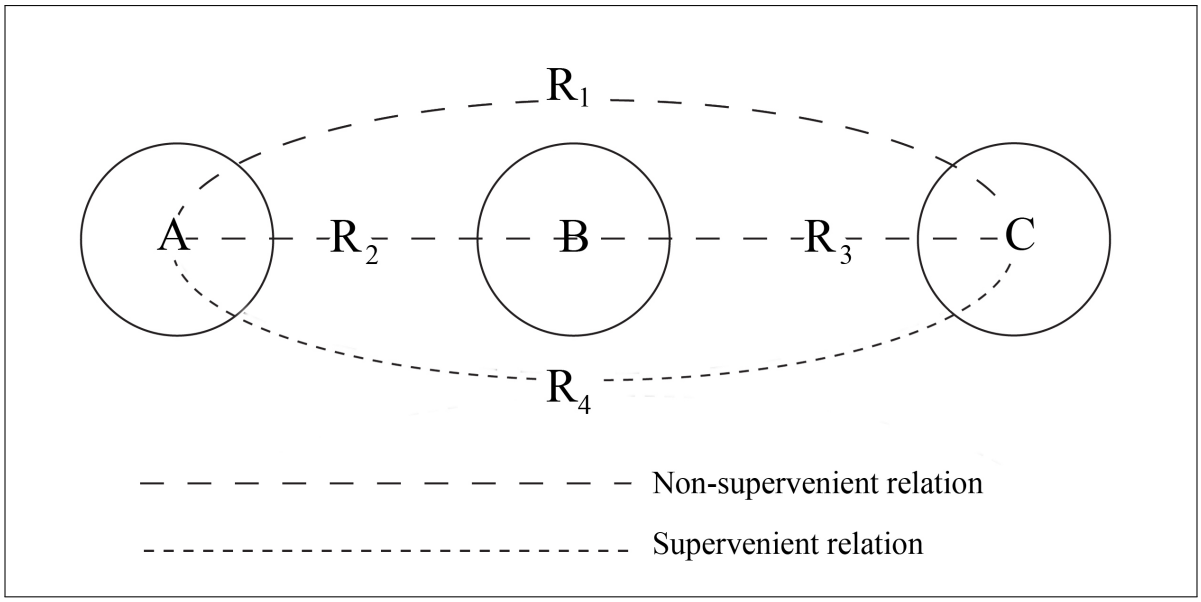

Figure 2: Supervenient and Non-Supervenient Relations [5]

There are two significant replies to this line of argument, from Christina Conroy[6] and Sophie Gibb[7], which I shall consider in turn.

Conroy objects to the way in which Le Poidevin understands relations to exist. She argues, "Le Poidevin implicitly requires that the relationist be committed to the 'only x and y' principle regarding spatial relations".[8] Conroy claims that Le Poidevin's commitment to the 'only x and y' principle leads him to mistakenly assume that the relationship R_1 persists when object B comes to exist. She argues that the introduction of B represents an internal or intrinsic change - a Cambridge-change - to the relationship, such that R_1

[5]Le Poidevin [7] p. 193.

[6]Conroy [2].

[7]Gibb [3].

[8]Conroy [2] p. 367.

ceases to exist, and is replaced by a *new* relationship, R_1'.[9] The existential dependence of R_1 and R_4 dissolves, and the relationist is in a position to deny there is supervenience, and in turn that the truthmakers of 'AC' are overdetermined. She uses the Leibnizian analogy of a 'childless couple' to illustrate her conception of persistence.[10] The weakness of the analogy reveals the conceptual weakness which underlies Conroy's position. I do not think that 'childless couple' effectively reflects spatial relations as the relationist would conceive them - it is a relation whose existence is dependent on the *non*-existence of a third object, and thus it is implicitly supervenient. Regarding Le Poidevin's assumption that the relationist would accept the 'only x and y principle', I fail to see why Conroy believes the relationist would reject such a principle.

In fact, to deny the principle would violate the relationist's essential notion that spatial relations exist without mediation. Conroy's argument, in its eagerness to utilise theories of persistence, seems to have lost relevance to the discussion at hand.

Gibb criticises Le Poidevin's explanatory principle as "ontologically extravagant"[11], and suggests that a more modest modal strict implication conception of entailment (as formulated by C. I. Lewis) is sufficient:

'$P \Rightarrow Q$' iff '$\Box(P \rightarrow Q)$'

She argues primarily that Le Poidevin misconstrues a mathematical entailment for an ontological one. Using the above construction, she asserts that 'if 'AB + BC', then 'AC" represents a mathematically *necessary* truth. Gibb says that the demand of Le Poidevin's explanatory principle to account for truth-making principles is simply unnecessary, and it is on this point that I find fault with her argument.

As I will demonstrate, Gibb misinterprets the function of formal languages, and by doing so confuses ontological entailment for its modal equivalent. Barcan Marcus offers a valuable assessment of the function we should expect from modal languages:

> An ideally adequate interpretation of a formal language would be [...] that truth as well as meanings are preserved [...] informally

[9]Mortensen [9].

[10]Conroy [2] p. 370.

[11]Gibb [3] p. 175.

> valid arguments would go into formally valid arguments [and] meaning would be preserved in translating out of the artificial language *back* into those segments of discourse for which it serves as a formalized equivalent.[12]

It is on the latter point that I believe Gibb does not appreciate the essence of Le Poidevin's argument. The proposition 'p' represents the following geometric truths 'AB = 4" and BC = 6"' (and ABC is a straight line). Necessarily, for the truth-functional connective '$\rightarrow$' to hold, the fundamental truths contained in 'p' are sufficient to make 'q' ('AC = 10') true also. The proposition 'q' and the truths it represents are true by virtue of the complex set of truths (and *meanings*) which the proposition 'p' *represents*. I am unsure how Gibb would satisfactorily de-modalize the entailment back in to ordinary language, without *informal* allusion to the constituents of 'p'. It seems that she permits the proposition 'p' to represent some state of affairs, but restricts the implication of the entailment 'q' to a merely formal function, a sort of vacant signifier. Gibb's formal constructions are insufficient to disprove the necessity of truth-making principles.

In his response to Gibb, Le Poidevin admits the shortcomings in his formulation of the explanatory principle, and replaces it with a more refined version:

> *The correspondence principle*: Where $\mathrm{p}_1 \ldots \mathrm{p}_n$, entails q, and $\mathrm{p}_1 \ldots \mathrm{p}_n$, are true, the truthmakers of $\mathrm{p}_1 \ldots \mathrm{p}_n$ constitute a truthmaker for q.[13]

The reformulation strengthens the truthmaker principle by cementing the tie between geometrical inferences and the modalization which Gibb found fault with. I would also add that I consider her objections to be aimed at issues in the philosophy of logic, not metaphysics.

I hope to have illustrated that the apparently simple geometric premises which relationism depends upon necessarily produce regressively more convoluted stances. The relationist's boast of a simpler ontology is outweighed by the unwieldy excesses which his philosophy demands of him.

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Is An Ontological Formulation Of The Knowledge Argument Against Physicalism Warranted?

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Introduction

"*Imagine a person, Mary, who has spent her whole life in a black and white room. Mary has spent her life studying the various facts concerning human colour perception, and knows, let's suppose, all the physical information about the neurological processes governing how humans perceive colour. Along with this, we suppose, Mary knows how these neurological processes can also, via the central nervous system, lead to vocal chord contraction and air expulsion to form utterances such as, 'the sky is blue'. In short, Mary has all the physical information regarding colour perception in humans.*"[1]

This is Frank Jackson's 'Mary the colour scientist' thought experiment. So the reasoning runs, when Mary leaves the room we cannot escape the claim that she will learn something new; namely, what it is like to experience colour. But, if we can't escape the claim that Mary will learn something new upon her release, then nor can we escape the claim that the knowledge she had prior to her release was incomplete. She had all the physical information, so there must be more than just physical information concerning the perception of colour. This is the qualia problem,[2] and it is supposed to show the falsity of physicalism, for it suggests that the physical information is not all the information there is.

The 'Knowledge Argument', as this line of attack against reductive physicalism is known, will be the concern of this paper.

1 Two Interpretations

The knowledge argument as outlined by Jackson is somewhat ambiguous, and can be interpreted in two different ways[3]: the strong version and the

[1]Jackson [3] p. 130.

[2]Ibid. [3].

[3]See Horgan, T. (1984) 'Jackson on Physical Information and Qualia', in *Philosophical Quarterly* 32(127):136.

weak version. The strong version is as follows:

(1) Mary knows all the *physical facts* concerning human colour vision before her release.
(2) But there are *some facts* about human colour vision that Mary does not know before her release.
(3) *Therefore*, There are *non-physical* facts concerning human colour vision.[4]

This is contrasted with the weak version:

(1′) Mary has complete *physical knowledge* concerning facts about human colour vision before her release.
(2′) But there is some *kind of knowledge* concerning facts about human colour vision that she does not have before her release.
(3′) *Therefore*, There is some *kind of knowledge* concerning facts about human colour vision that is non-physical knowledge.[5]

The distinction is subtle but important. The strong version makes an ontological claim: the physical facts are not a sufficient account of the facts concerning qualia. Contrastingly, the weak version makes an epistemic claim: a completed physical knowledge is not sufficient for a complete knowledge of qualia, as this would involve knowing how x feels. I shall refer to the strong formulation as the ontological knowledge argument, and the weak version as the epistemic knowledge argument.

Jackson's argument is interpreted as the ontological knowledge argument, as it is this version that poses a threat to the reductive physicalist. I propose that this line of attack is unwarranted, for there is insufficient warrant for the required new and non-physical facts to be supposed.

2 Knowledge Distinctions

In order to deploy the knowledge argument as an attack against reductive physicalism, the bearer must force a formulation of the ontological version that is not circular. One means of doing so is to deny knowledge distinctions.

Gilbert Ryle [6] sought to draw a distinction between two types of knowledge: knowledge-that and knowledge-how.[6] Ryle first outlines what he takes

[4]Nida-Rümelin [4].

[5]Ibid. [4].

[6]Ryle [6].

to be the standard view of intelligence, objecting to it on the grounds of it invoking an infinite regress. The standard view of intelligence, says Ryle, holds that:

> [. . .] doing things is never itself an exercise of intelligence, but is, at best, a process introduced and somehow steered by some ulterior act of theorising.[7]

Ryle's objection runs that this standard view of intelligence leads to a regress because (i) if intelligence is credited because of some ulterior act of intelligently considering propositions then no intelligent act could ever occur, for what would credit the intelligence of the ulterior act? Or (ii) there would be a gap between the required consideration of the relevant propositions and their application, which would be linked by some process which itself could not be deemed intelligent.[8] Ryle claims that such problems occur because philosophers have not paid due diligence to the distinction of knowledge-that and knowledge-how.

To explain his proposal, Ryle uses the example of the intelligent and the stupid chess players. We imagine two chess players, each knowing all the rules of movement and the various tactics that one can deploy against an opponent, yet one always beats the other.[9] Why is this? If Ryle's objection to the traditional view of intelligent action holds, we cannot appeal to one player being able to intelligently apply the rules, whilst the other cannot. The 'intellectualist', (a defender of the traditional view) might wish to claim that the stupid player did not *really* know the rules, not fully nor properly anyway.[10] Ryle will think this analysis perhaps as close to the mark, yet it not only misses, but doesn't even see the real target. The two players do indeed have differing knowledge; while they may have the same knowledge-that, the intelligent chess player has a more robust knowledge-how.

We can think of knowledge - how as being the replacement of the traditional view of intelligent application. I may know that bishops can move diagonally across the board, but this doesn't strictly entail that I know how to use this movement effectively. This is because my knowledge of chess is not complete; I have knowledge-that, but not knowledge-how. To better understand the

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[7]Ryle [6] p. 1.

[8]Ibid. [6] p. 2.

[9]Ryle sets the scene a little differently, but the point is that the knowledge of these rules and tactics are equally available to both players.

[10]Ryle [6] p. 5.

distinction, Ryle talks of museum-knowledge, corresponding to knowledge-that, and workshop-knowledge, corresponding to knowledge-how; but I shall come to this later. As this paper is concerned with the mind, experience and qualia, think of knowledge-that as propositional knowledge, knowledge that certain things are the case (this would be what Mary knows before her release), and knowledge-how as experiential knowledge, knowing how things *feel* (which is what Mary learns after her release).

The real point to understand here is that, on Ryle's view, no new facts need to be supposed in order for us to understand why one chess player plays well, and another plays poorly. Admitting knowledge distinctions allows for new knowledge to be gained about the same fact[11]; knowing-that P is not necessarily the entire knowledge one can gain about P. That is why appealing to knowledge distinctions is an attractive means of defence against the knowledge argument, for it undermines the anti-physicalist's appeal to some new and non-physical facts. Mary does not gain knowledge of some new facts; instead she simply gains new knowledge of the same facts.

The debate over whether knowledge distinctions are legitimate is not over, and I am not going to end it with this paper. Where I sit on the issue will become clear, for this paper is interested in whether the anti-physicalist really has just warrant for formulating the knowledge argument in its ontological form, and so positing new and non-physical facts.

3 Bridging the Divide

One thing that requires some consideration, if we admit the anti-physicalist's ontological knowledge argument, is the divide between the physical and the non-physical. An ontological formulation of the knowledge argument argues for dualism; the physical is not all there is. Yet it would be a strange and unattractive theory of mind that supposed the pain I feel when I tread on a nail is unrelated to the act of treading on the nail. Whether or not my experience is a physical or non-physical one, we would still hold that it is, in part at least, an experience *of* stepping on a nail. That we wish to retain interaction between the two ontological realms I take to be evident, given the scarcity of theories of pre-established harmony in contemporary metaphysical debate, and even the language of the thought experiments concerned, for they all

[11]Think of this as similar to the Leibnizian metaphor of viewing the same town from many angles.

seem to give at least some importance to the physical facts. Whether or not the interaction between the physical and non-physical, or mental, is two directional or one way, as with epiphenomenalism, is not the concern of this paper, nor is a discussion of the various theories concerning substance interaction. What is relevant is simply that even if we accepted the anti-physicalist's argument, we would still wish to retain interaction between the two realms, and so I ask the reader to keep this in mind for what follows.

4 Facts and Knowledge

So far we have seen the knowledge argument unpacked into its two forms; the epistemic and the ontological versions. To succeed as an attack against reductive physicalism, the non-physicalist must force an ontological formulation of the argument, and one means of doing this is to deny a distinction between knowledge-that and knowledge-how. By denying this distinction, the physical facts are pulled apart from the non-physical facts, and so when Mary is released from her black and white room, the new knowledge she gains about what colour is like is supported by new, non-physical, facts. My concern is that the anti-physicalist simply does not have just warrant for positing these new facts.

On the anti-physicalist's account of things, the new knowledge Mary gains following her release is knowledge-that, for they must deny the knowledge distinctions and claim that all knowledge is knowledge-that. My question here is what is this knowledge-that of? Suppose that upon Mary's release, someone presents her with a red apple, the first coloured thing she has ever seen, and Mary learns what the experience of redness is like. She knows that the apple has a certain physical arrangement that triggers certain neural responses in her brain, but now she finally knows that redness feels a certain way, namely, it feels like *this*. Mary, according to the anti-physicalist, has gained new knowledge-that, specifically she has gained knowledge-that redness feels the way it does.

I am not happy with this, and I think any being that experiences qualia should not be happy with it either. I am not denying that Mary has gained new knowledge-that, but she has gained new knowledge-that concerning new knowledge-how. This is the answer to my question above; the new knowledge-that is knowledge-that of knowledge-how. Mary knows-that redness feels

a certain way *because she has knowledge-how redness feels*.[12] The experience of redness that Mary feels cannot be encapsulated simply with a claim of knowledge-that. For sure Mary has gained new knowledge-that, but in the same way that I can utter propositions concerning my own knowledge, such as 'I know-that Marmite is foul'; I possess this piece of knowledge-that *because* I have knowledge-how Marmite tastes.[13] Ryle states that:

> [...] the propositional acknowledgement of rules [...] is not the parent of the intelligent application of them; it is a step-child of that application.[14]

We should see the qualia problem in the same manner; the knowledge-that the anti-physicalist supposes is certainly there, but it is knowledge-that of knowledge-how, and the knowledge-how does not reduce to the knowledge-that.

5 Museums and Workshops

I mentioned that Ryle introduces a distinction between 'workshop knowledge' and 'museum knowledge', and it is time unpack this distinction, for it is particularly relevant to the case of the knowledge argument. The point Ryle is trying to convey here is that museums and workshops can present the same facts in different ways[15], that is, a museum of carpentry and a carpenter's workshop both access the same facts. What distinguishes between them is that in the carpenter's workshop, the facts are *occurring*; if the museum listed the fact that a circular saw is the most effective means of sawing planks, the carpenter would be using a circular saw to saw planks. If we account for this notion of occurrence with the case of Mary, then we seriously damage the anti-physicalist's warrant to posit new facts and so damage physicalism. Before her release, the relevant physical facts did not occur in Mary; she was never presented with a coloured object and so her brain was simply not stimulated in the way required to give rise to them. What Mary has before her release is possession of museum-knowledge concerning the facts of colour perception, and we surely would not claim that this ought to be sufficient for

[12]Young [8] p. 353.

[13]Ryle seems to hold that knowing-how is in fact always prior to knowing-that, but I do not wish to pursue this thought here.

[14]Ryle [6] p. 9.

[15]Ibid. [6] p. 16.

an experience of qualia. If someone had only ever read about chillies, but not eaten one, we would not expect them to know the sensation.

Objections to Rylean knowledge distinctions centre on whether or not a given task constitutes a case of knowing-how can be reduced to a case of knowing-that. Snowdon [7] claims that cases such as playing chess well, and getting from London to Swansea before midday, are all explicable in terms of knowing-that[16], and claims to interpret knowing-how as knowing-how-to[17]. The motivation behind these claims seems to me to be that, because in such cases there is an objective, a goal in mind, knowing-how to achieve that goal is wholly explicable in terms of knowing-that one must do x, y, and z. Yet qualia do not seem to fit this format. For one, we do not choose to experience qualia. By this I do not mean to say that we don't seek out certain experiences and sensations over others, for of course we do, I mean only that if I hold my hand over a fire, I cannot help but feel pain. Of course there is knowledge-that in play here; if I want to put my hand in the fire I know-that I must light a fire, and I know-that I must extend my hand, but this is the extent of the control I have over my experiences. Once my hand is in the fire, I'm going to experience pain. In a less morbid case, if someone shows me a red cube, I cannot help but experience it as red and cube-like, all other things being equal.

I do not wish to enter into the debate of knowledge by acquaintance here; I simply want to show that qualia do offer themselves as peculiar articles of knowledge at the least. In the case of Mary the colour scientist and the claims made against physicalism by the knowledge argument, it is my view that when we consider that the point of Ryle's distinction is that the same facts can be known in different ways, and we consider that the relevant facts here do not occur in Mary before her release, then we can seriously undermine the anti-physicalist's warrant for pushing an ontological formulation of the knowledge argument.

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Fundaments of Existential Psychoanalysis – Unconscious and the Fundamental Project?

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'*Here I stand; I can do no other . . .*'
Martin Luther

Introduction

One question concerning phenomenal ontology is how to treat the statements of the sort given by Luther - is there a possibility of not being able to do otherwise? For Sartre the answer is 'no' - absolute freedom of human being makes every condition we make ourselves our own choice. Even emotions - usually considered as imposed on us - are chosen. Behind every immediate choice there is a freely chosen set of aims which we strive towards and which serves as the basis of all of our less basic values - this is known as the *fundamental project*.

However, we do not seem to be aware of this project. We do not know every action we will undertake in the future, we do not seem to know why we have chosen certain actions or when our fundamental desires were set. We are even told that this is to be 'uncovered' by existential psychoanalysis.[1] It almost seems as if we are not conscious of this fundamental project.

To be more precise: it seems that this fundamental project is a certain structural substratum of our minds which influences all of our decisions, values and emotions and does not seem to be present to our consciousness at the time of our decision. However, all this seems very familiar to a certain more popular view on human psyche - the one of the Freudian unconscious - the view rooted in claims categorically incompatible with existential psychoanalysis.

The aim of this paper, then, is to investigate whether the notion of a fundamental project can be seen as a plausible theory without recourse to the Freudian (or similar) notion of unconsciousness.

[1]Sartre [6] p. 592.

1 Freud and the Unconscious

Although not the only one (we could also mention Adler, Jung, or Lacan)[2], Freud is the figure most commonly associated with the notion of the unconscious mind. However, the exact exposition of a Freudian interpretation of the unconscious is not as widely known. What is the unconscious? On the first glance the answer seems simple: that which is not conscious. However, this wide definition would include events far from outside our reach - those in other rooms or countries - but no one would be tempted to say that my inability to know what my neighbours are doing, since I cannot hear them through the wall, constitutes what we would call the unconscious. So the unconscious needs to be connected with my mind, with my psyche - it would need to be that part of the mind which I am not conscious of. This raises several very important questions, for example: whether memories which I am not at the moment mentally presenting to myself count as the unconscious memories; whether the unconscious influences my conscious decisions and whether it is suitable to say that the psyche is divided. All these questions will need to be put on hold for the moment and addressed later in the paper. For now, let us explicate the Freudian concept of the unconscious.

For Freud, the psyche is primarily structured by conscious and unconscious parts. Freud uses the term conscious to describe 'immediate awareness' - similar to the Sartrean notion of pre-reflective consciousness. Everything which could not be seen as conscious (here including both unreflected, but easily available memories and repressed urges) could be seen as latent or capable of becoming conscious - and therefore unconscious. Although not conscious, all of these constitute the mental dynamics - powers that create our conscious ideas but do not become conscious because a certain psychic force, which Freud calls resistance, opposes them.[3]

The unconscious comes to exist as a product of two separate systems called descriptive and dynamic unconscious. Descriptive unconscious (known as PCS or pre-conscious) corresponds to all psychic elements which we simply are not consciously aware of at that moment. The PCS escapes our momentary awareness, but can easily be brought into consciousness. The dynamic unconscious (UCS), on the other hand, signifies the deep motivating force behind our conscious experience and is inadmissible to consciousness - at

[2]Raycroft [5] p. 3; Ward & Zarate [8] p. 172, 175.

[3]Freud [2] pp. 13-14.

least without the help of psychoanalysis. If we would imagine our mind as a room it would be divided into a UCS part and a consciousness part, separated by a thin curtain of PCS.[4] The events from the UCS would, although directly inaccessible to consciousness, manifest themselves as the shadows on the curtain of PCS and therefore influence the consciousness indirectly, but successfully. In that way PCS works as a mediator, but also a censor for the disturbing UCS thoughts.

2 Sartre and Freud

Sartre is not categorically against Freudian psychoanalysis although they do disagree on the key point - the existence of the unconscious element as the deciding factor of human action. Sartre even points out several key similarities between existential and psychodynamic psychoanalysis.

Both Freud and Sartre, for example, rely on deeper structures of the psyche to give the explanation of an act - the difference of origin between one climber's hatred and other climber's love for climbing is not sufficiently explained by simply stating that their preferences differ. Both Sartre and Freud would explain it by reference to certain mental structures underlying their preferences: Sartre in term of their fundamental project[5], Freud (most likely) in terms of repression of memories.

Sartre himself says that psychodynamism - the idea that our choices depend on structures - has to be taken as an inspiration to avoid seeing a person as a "horizontal flux of phenomena"[6]. He also advances that we have to focus our search on discovering our "fundamental attitudes which cannot be simply logically expressed since [they are] priori to all logic"[7].

But besides this, the two approaches differ and Sartre has few kind words for Freud. He argues that we should focus on the future - the redefinition of our fundamental project through actions - rather than to be "occupied by the past"[8] by blaming everything on the influence of repressed memories. Existential psychoanalysis is about "original choice"[9].

[4]Freud [1] p. 614; Gardner [3] p. 136

[5]Sartre [6] p. 480.

[6]Ibid. [6].

[7]Ibid. [6] p. 590.

[8]Ibid. [6] p. 480.

[9]Ibid. [6] p. 590.

Another problem arises from incompatibility of Sartre's notion of action with the dynamics of Freudian UCS. Sartre separates action into *motif* - the rational reason for action, *fin* - the goal of an action, and *mobile* - the agent's act.[10] Freudian UCS obviously cannot be the motif, since the rationalising motive needs to be conscious in order for the reasoning to be applied to it. Sartre would be more allowing in giving the fin the UCS basis - but Freud requires UCS to be the mobile - to choose for us, instead of us, and leave it on PCS and consciousness to fool us by rationalizing our choice as something already chosen by our unconscious mind. This is something which Sartre cannot allow, and he criticises Freud on various accounts arguing, for example, that the Freudian split of the psyche into conscious part, censor (PCS) and the Unconscious (UCS) can only be held together by a "magic unity"[11] since there is a question of what in this 'mixture' constitutes 'me' - is it my consciousness or the censor which seems to act as an independent for-itself? One is tempted to say 'all of it together' - but this seems to require that aforementioned 'magical unity'.

However, our question here is not whether Freud is right in his exposition of the unconscious, or whether Sartre is right in criticising Freud for it. What we are concerned with is whether the fundamental project, resembling on the first glance Freudian UCS, can be conceived without yielding to the notion of the unconsciousness. And this is what we will try to see.

3 Fundamental Project

We have mentioned the notion of the fundamental project on multiple occasions, however, we have not given a proper explanation of what the term accounts for. This explanation is necessary since, once given, it will be clear where the similarities between Freud and Sartre lie and why the notion of the project by its nature invokes the imagery of the unconscious.

We have already mentioned how Sartrean psychoanalysis focuses on the notion of the original choice. This original choice - the one which serves as the basis of all our other choices, values, moral and emotional responses, aims and decisions - is our fundamental project. But how does it come into existence?

[10]Webber [7] pp. 30-31.

[11]Sartre [6] p. 77.

Our *realite humaine* 'consists' of two modes of being: in-itself and for-itself. In-itself is our facticity: it is objective, complete, determined - all objects are beings in-itself. For-itself is pure transcendence, free, self-regulating. Consciousness is for-itself - it never is anything set and factual. It always projects itself into the future, it is incompleteness, a 'lack'. The aim of all of our fundamental projects is to try to 'fill' this lack, to reconcile in-itself and for-itself [12] - to become factual transcendence, for-itself-in-itself, complete self-grounded consciousness: God[13].

But how can this explain the way we form our preferences or aims in life? Even if it can, would it not make all our aims identical since the fundamental project is the same for everyone? Maybe the way to explain the difference of preference is to refer to the way one would try to bridge that gap.[14] The difference in choosing could be partially influenced by the factual surrounding in which consciousness finds itself. Since there is no transcendence without facticity for Sartre, a different facticity surrounding one consciousness could influence that particular motif for a certain project - one would transcend only what there is to transcend.

However, my fundamental project cannot be explicitly known by me.[15] It cannot ultimately be chosen by deliberation.[16] It causes specific emotional responses to the world around us but we cannot remember choosing one project over the other and it seems we cannot know and change our project without analysis. It seems more deeply and unconsciously hidden, repressed and steadfast than Freudian UCS. But Sartre cannot allow this - the thing which has the most influence over us needs to be consciously chosen - can it be, being the way it is? To see that, we must refer to the notion of the unconscious once again.

4 Sartre and the Unconscious

We have seen what Freud thinks of the unconscious, and what Sartre thinks of Freudian unconscious, but could we use certain pre-theoretical notion of the unconscious to help us in our search?

[12]Gardner [3] p. 36.

[13]Sartre [6] p. 587.

[14]Webber [7] p. 108.

[15]Sartre [6] pp. 591-2.

[16]Ibid. [6] pp. 472-3, 483.

One factor of the psyche which seems to go hand-in-hand with the unconscious and seems to be, at the same time, crucial to the fundamental project is memory. If we would not have memory of our original choice then we would not be able to be guided by it. It is easy to imagine a person with retrograde amnesia not knowing whether he likes certain food or not, or changing their moral outlook on life from the pre-amnesiac times. But we do not seem to be conscious of all of our memories all the time. If we were it would seem that our thoughts would be a constant mess of reflective imagery. It looks more likely that memory operates through different 'layers' of consciousness, rather than being susceptible to a single overarching conscious experience.

Let us suppose that I am telling you a story about the history of the Knights Templar and tell you that they were all executed by a French king on Friday the 13th October 1307. At this point my, what Sartre calls, pre-reflective consciousness is focused on me telling you the story and only the facts I have given to you: 'French King', 'Knights Templar', 'all executed'. If you then ask me what the king's name was I can answer you, without any trouble: "Philip le Bel" - although I was not thinking about that fact at all during my initial monologue. My thoughts did not brush onto the name of the king before you've asked me, although I have had this information in my memory, and easily accessible. Even if you do not ask me, and I later reflect on our conversation, I will be aware that I knew all the time the name of the king, but never 'summoned' it into the pre-reflective experience. It seems as if that had somehow been 'deeper' - under my conscious experience. Let us then imagine that you ask me what was the king's title and I simply cannot remember, but that I am certain I've had this information. Let us suppose that I am uncertain whether he was Philip IV or V, although I am certain that I knew this, but simply cannot remember at this point and let us assume I remember after some 'digging'. This information seems to have been buried even deeper. Finally, we can imagine that I love telling this story because of the repressed hatred of my father and the story of a weaker king successfully outwitting and conquering powerful order serves me as a manifest content of my Oedipal fantasy of my weaker self conquering over my father.

For Freud there would not be much of a problem for explaining this. Phenomenon present during the telling of the story would count as conscious experience, knowledge of the name and the title would belong to the PCS and repressed memory would be the part of the UCS. Admittedly, this example favoured Freud's model rather than Sartre's since it gave explanations in

terms of repressed memory and not fundamental project, but the question is still obvious - how to account for this phenomenon of 'layers' of consciousness in memory, and the idea that all our conscious choices are based on a more basic choice which we do not seem to be aware of and which cannot be fully known? How could Sartre claim, as a phenomenologist, that all this does not rest on certain notion of the unconscious, at least descriptive PCS?

Fortunately, Sartre has the answer. Probably in the anticipation of an argument linking the fundamental project and the unconscious Sartre tells us that fundamental project is conscious, but not known.[17] But what does that mean? We must recall that for Sartre consciousness is thetically aware of an object and non-thetically aware of itself and that for him consciousness, such as the one of self-awareness, is not the same as self-knowledge.[18] We have said that we were not conscious of the King of France being called Philip le Bel until reflection - but for Sartre we were, as we were conscious that we are not our correspondent and that we are standing on the floor in a specific place and time - the only difference was that, prior to reflection, that specific knowledge was not thematised, did not become the object of consciousness, but was the part of the non-thetical pre-reflective consciousness.

The similar applies to the fundamental project. We constantly have non-thetical awareness of it, but we cannot grasp it as knowledge since we encounter it only as desires[19] in the actions of pre-reflective consciousness and can proclaim judgements about it in the only way that we can generally proclaim judgements: reflectively. But then, it is obvious that we cannot have a glance into the fundamental project since we can only reflect on the instances of pre-reflective following of it. Therefore, the only way to know the project would be through the reconstruction of our behavioural patterns by existential psychoanalysis. Sartre's account of 'conscious ignorance' seems to explain memory as well. It was not the case that certain memory was deeper, or less conscious. What was happening was that memories which were not present in thetic were part of the nonthetic consciousness and the lack of thematisation was what made them seem more or less accessible.

[17]Sartre [6] p. 591.

[18]Ibid. [6] pp. 7-8.

[19]Ibid. [6] p. 588.

5 Conclusion

Sartre seems to have an account of eliminating the intuition that the idea of a fundamental project requires certain elements of the unconscious to work. It seems that the introduction of distinction between knowing and being conscious and the distinction between thetic and non-thetic consciousness helps Sartre to give a sound defence of his theory. However, some questions still remain unanswered.

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How Should Philosophers Interpret Quantum Mechanics?

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Introduction

At the core of the philosophical interpretation of quantum mechanics is the measurement problem, or the macro-objectification principle. If we solve this problem we can go some distance towards painting a picture of what goes on at the quantum level, and gain some understanding of how the quantum level and the macroscopic level interact.

The measurement problem is this:

Schrödinger's equation represents the quantum state of light in the double-slit experiment as a wave function. This fits with the experimental data below. The peaks and troughs[1] cohere with the bands of brightness and darkness[2]. However, when slowing down the propagation of the light a great deal we initially never see a wave pattern! Particles of light are released in quanta called photons, one by one.[3] The particles cluster almost randomly until they form a banded pattern. Why does the banded pattern form? Surely we need waves to make the interference patterns that we see, not particles; how could a particle interfere with itself? If these quanta exhibit a sort of wave-particle duality, we need to explain why large-scale objects appear not to. Macroscopic objects like humans and tables and chairs are composed of quantum objects – why do we not exhibit phenomena like duality and interference? If we manage to answer these questions, we have solved the measurement problem.

Max Born interpreted the wavefunction probabilistically - the peaks are the points in which the particle has a higher likelihood of appearing, and the troughs show where the particle has a lower chance of appearing. Schrödinger's wave function reflects the probability of a particle appearing where it does. However, when we set up a measurement for some observable A at a moment when the state vector of that system does not happen to be

[1]See Figure 1. p. 68.

[2]See Figure 2. p. 68.

[3]See Figure 3. p. 69.

an eigenvector of the observable property, we never observe a superposition. In simpler terms, the best available theory may predict that a particle has the combination of there being an 80% chance of it being in one location and a 20% chance of it being in another location. However, when we measure the particle, it is always definitely in a location: we don't measure probabilities or superpositions, we measure particles that are 100% there.

So, what can we do? One option is to abandon the notion of superposition and probability wavefunctions. Instead, we affirm that the particle is always collapsed and merely a particle. However, the interference effects observed in the double slit experiment are explained by modelling these supposed particles as complex plane waves.[4] We would be ignoring our best available theory of predicting and explaining quantum phenomena if we were to disregarded Schrödinger's equation. Additionally, in quantum mechanics (hereafter QM) one must often model systems as the superposition of two or more possible outcomes. Superpositions can produce interference effects, and it is these that are currently the best available way of explaining the phenomena in the double-slit experiment. But the question remains: how does a superposition of different possibilities resolve itself into some particular observation? This is the heart of the measurement problem.

1 Why is Measurement a Problem?

It remains problematic because there is no scientific consensus on how or if quantum collapse occurs. A solution to the measurement problem would demystify, or at least explain, if and how the wavefunction collapse occurs. I will use the remainder of this paper to consider two solutions to the measurement problem. Firstly, I will discuss the 'consciousness causes collapse' interpretation of the measurement problem. This is the view that most people come across when learning about quantum physics for the first time. It purports to provide an explanation of how collapse occurs.

Secondly, I will give credence to the many-worlds interpretation. This theory denies the existence of collapse, and instead posits that the superposition remains intact over many worlds.

[4]The other explanation is the Pilot Wave theory, but I won't be this discussing here.

2 Consciousness Causes Collapse

According to this interpretation, what provides the collapse of the wave function, what allows for the quantum and the classical to intermingle, is consciousness. We know that collapse occurs when the system is observed, and for some, the ultimate observation is observation by a conscious observer, rather than the interaction between the measured system, and the measuring device (the measuring device is another sort of observer). Von Neumann[4] argued that it is arbitrary whether the boundary between the observed and the observing system is posited between the measured system (i.e. the double slit experiment) and the system S1 < the measuring device + the person who observes it > or if the boundary lies between the system S2 < the quantum experiment + the measuring device > and the conscious observer.[5] If the boundary lies between S2 and the conscious observer, it would indicate that there is something special about conscious observers that causes the quantum to collapse into the classical.

The 'consciousness causes collapse' interpretation is motivated by the conceptual difficulties surrounding 'stopping places' in macro-objectification. If we treat the measurement apparatus in experiments as a quantum system on particle spin, we need more apparatus to measure what state the initial apparatus is in and so on, until we have an infinite chain of measuring devices in order to ensure collapse of the 'relevant' wavefunctions.

If all measuring devices obey quantum laws, as would be indicated by their composition of quantum particles as well as interference phenomena being demonstrated by molecules as large as Buckminster-Fullerene[6] this could add credence to the consciousness causes collapse argument. If their are no non-quantum 'ingredients' within the system, there can be no stopping place, and no collapse - components of the system will remain in a fuzzy state between existence and non-existence at any particular point. Obviously this is not the case, collapse must be triggered somewhere, as evidenced by the lack of our observation of superposition. The last possible place where wavefunction must collapse is not in measuring devices but in our conscious awareness of the measurement. We never experience what it is like to be in a superposition of belief or observation, or observe it in measuring devices. Because our consciousness is the *last possible* site of the collapse of the wave function into

[5] Atmanspacher [1].

[6] Nairz, Arndt & Zeilinger [3].

a definite particle, this is why it's suggested that it causes the collapse.

Consciousness causes collapse has independent motivation too. If we subscribe to a dualist account of the mind and body, the mind, being non-physical, does not need to conform to quantum laws. Not only do we not experience superposition, it is not necessary for us to be bound by quantum laws and experience it. We are the point in which the classical and the quantum combine. However, this theory has some unpalatable consequences. It does provide some explanatory force to the question 'why does the wave function collapse into a definite state', the answer being that consciousness triggers it. But this seems to iterate the need for further explanation: why does consciousness trigger collapse? Many have not accepted the answer 'it just does' as an acceptable brute stopping place.[7] Additionally, regardless of the mechanisms of collapse, it seems that if many different minds are observing collapsing wave functions there would be a tendency towards a multiply expressed collapse. Why when two people are measuring the spin of an electron does only one result manifest? Surely, if the mind triggers collapse, many-minds would lead to many collapses (the many-minds hypothesis touches on this theory). Additionally, the measurement problem rests on the fact that laws governing large scale objects, such as polarisers and detectors appear not to be consistent with laws that apply to the microscale.[8] Consciousness collapse theories seem to manufacture another artificial distinction – if collapse is caused by consciousness, what level of consciousness is sufficient to cause collapse? A child's? A mouse's? More clarification is certainly needed for this to be an adequate explanation to the measurement problem. Finally, it just seems very odd to say that some measuring devices on a macroscopic scale - cats for example, do actually remain in superposition until a conscious observer looks at it. Though as quantum phenomena is a breeding place of weirdness, do not take this objection too harshly.

3 Many Worlds

Many-worlds adherents say that wavefunction collapse never occurs - both the particles involved and the observer are in multiple states. After observation, the multiple states of the particle are now entangled with the multiple states of the observer. In the double-slit test you would have the two states: 'photon

[7]See, for example, Rae [5].

[8]Ibid. [5].

goes right and observer sees it go right' and 'photon goes left and observer sees it go left'. Both states persist, and the particles remain superimposed, when you calculate superposition from the sum of the branched worlds.

The many-worlds interpretation constructs a view of reality that branches. Every time a wave function appears to collapse, every possibility of its collapse is manifested in a different branching world. For example, in Schrödinger's cat experiment we only see one part of the wave function – alive cat, or dead cat. This contradicts the postulate of superposition, we should be seeing a superposition of an alive cat and a dead cat (something that is, incidentally, very hard to visualize). As collapse never occurs in the many-worlds theorem, superposition remains and the laws of quantum mechanics remain consistent. The particles remain superimposed, but just across different, self contained worlds.

4 Criticisms

We have seen how 'consciousness causes collapse' has difficulties, now I will turn to the many-worlds theorem. Firstly, it is not a complete theory. An interpretation of the measurement problem needs to have a theory of complete physical behaviours. It needs to tell us why we would only see one state of the wavefunction and to explain the mechanism of world branching. Additionally, there is also the problem of understanding probability. As it is a deterministic theory it becomes senseless to ask "What is the probability that I will get A instead of B?"[9] as all possibilities are manifested. To rise to this challenge the many-minds theory has been offered. In this, a continuum of minds exists, when the quantum wave of the universe develops into a superposition containing two different possible perceptions, the minds of sentient beings evolve randomly and independently into mental states corresponding to these different states of perception with probabilities equal to the quantum probabilities for these states. It now makes sense of probability – 'I' will correspond to one world-path. Probability is the likelihood of your personal 'I' following one world-path out of a set of world-paths.

[9] Vaidman [6].

5 Conclusion

The idea of collapse being triggered by consciousness seems be rather ad hoc, and still leads us to an iterative process of further consciousnesses being superposed. A many-worlds interpretation of the measurement process sees all systems, even at the macro-level being superposed, and no collapse occurring. The many-worlds solution is a complete explanation of how the observation of collapse is compatible with the wavefunction, as it denies collapse. However, it does not seem to be a complete theory, and though self-consistent, it does not seem to be empirically falsifiable. To be complete, it would have to give a description of world branching. Even if that had been done, how would we ever determine if the world branches or not? It does not seem to be something that could be tested for. Additionally, positing a continuum of minds seems to maximise one's ontology further above an already infinite amount of branching worlds. Philosophers seem to be stuck between a rock and hard place here in deciding how to interpret quantum theory.

I think two good options are available here for philosophers. The first is inspired by Carl Friedrich von Weizsäcker: "what is observed certainly exists; about what is not observed we are still free to make suitable assumptions. We use that freedom to avoid paradox".[10] It may be wise for philosophers to incorporate the findings of quantum mechanics into their total theory as a way of further systematising it, and avoiding contradictions with the results of QM. For example, David Lewis might argue that the branching of worlds provides credence for his plurality of universes. A Dualist could select the consciousness causes collapse theory to bolster his belief that the mind and the brain are separate. Philosophers may select their interpretation of the physical world based not only on the evidence available but also on theoretic virtues. David Lewis's ontology does not necessarily expand if he adopts the many-worlds model of quantum mechanics so many objects to the many-world theory are swept away.

The second option for the philosopher, perhaps one who is more prone to avoid falsity rather than seek truth, would be to wait. The glory of science is that the sum of evidence needed to select between rival theories is not always to hand. By waiting, experiment may be able to determine which of the interpretations of the quantum world is true, or at least most probable – and then the philosopher can either include it into his total theory, or dispute it.

[10] von Weizsäcker [7] p. 26.

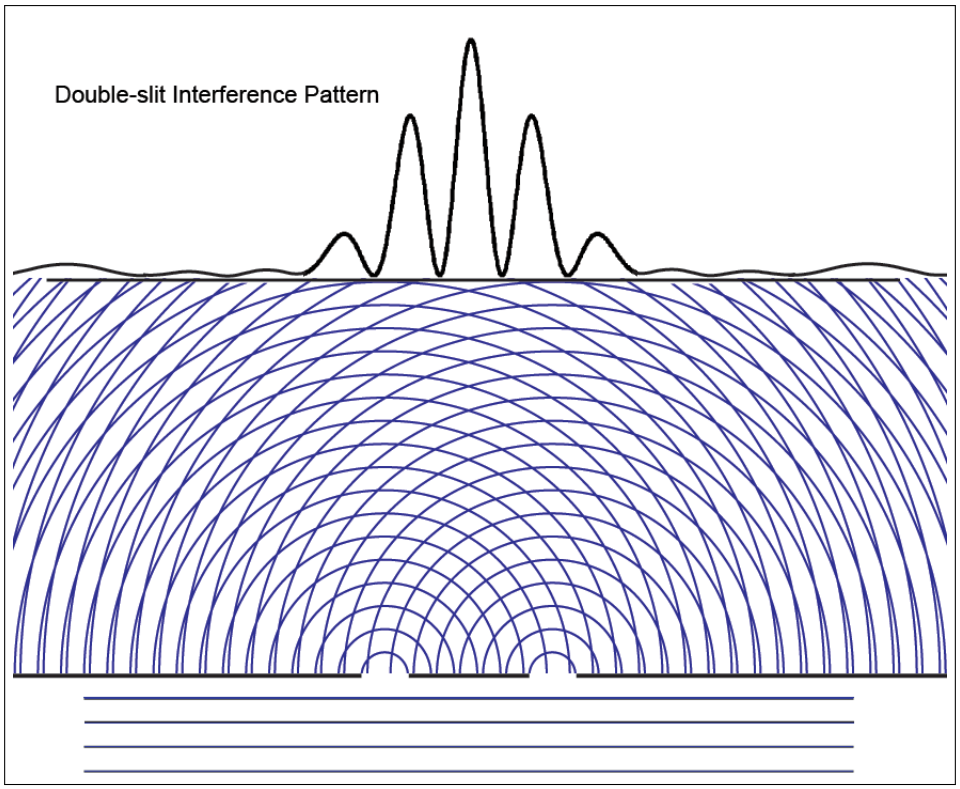

Figure 1: Diagram of the probability wave-fronts as predicted by Schrödinger's equation.[11]

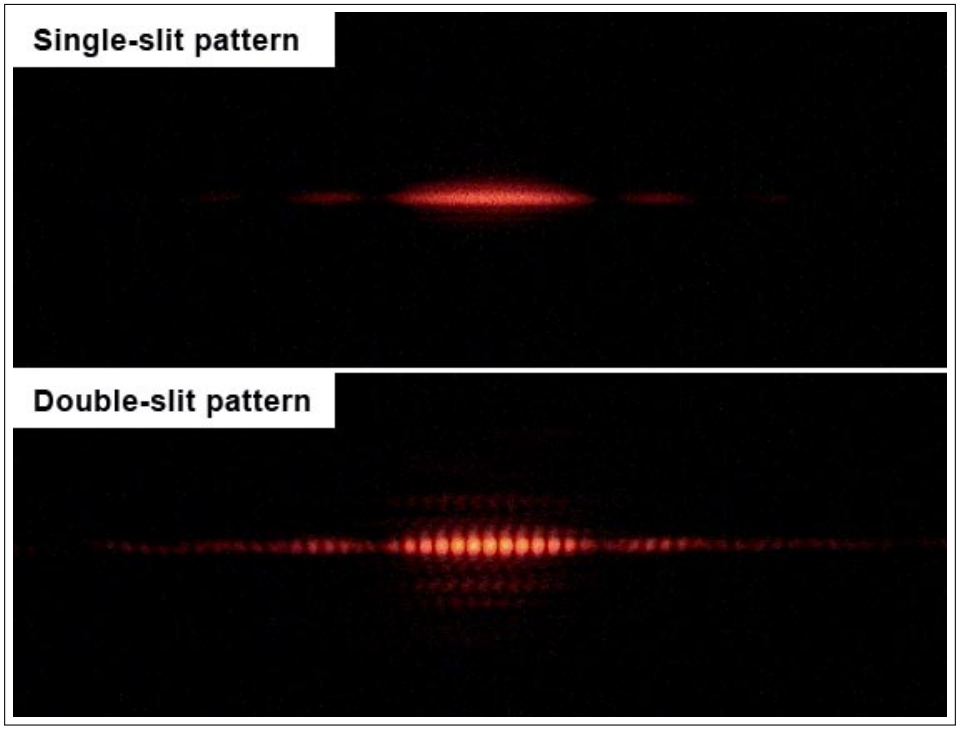

Figure 2: Photograph of a single- and double-slit pattern.[12]

[11]http://www.informationphilosopher.com/solutions/experiments/two-slit-experiment/

[12]http://upload.wikimedia.org/wikipedia/commons/c/c2/Single_slit_and_double_slit2.jpg/

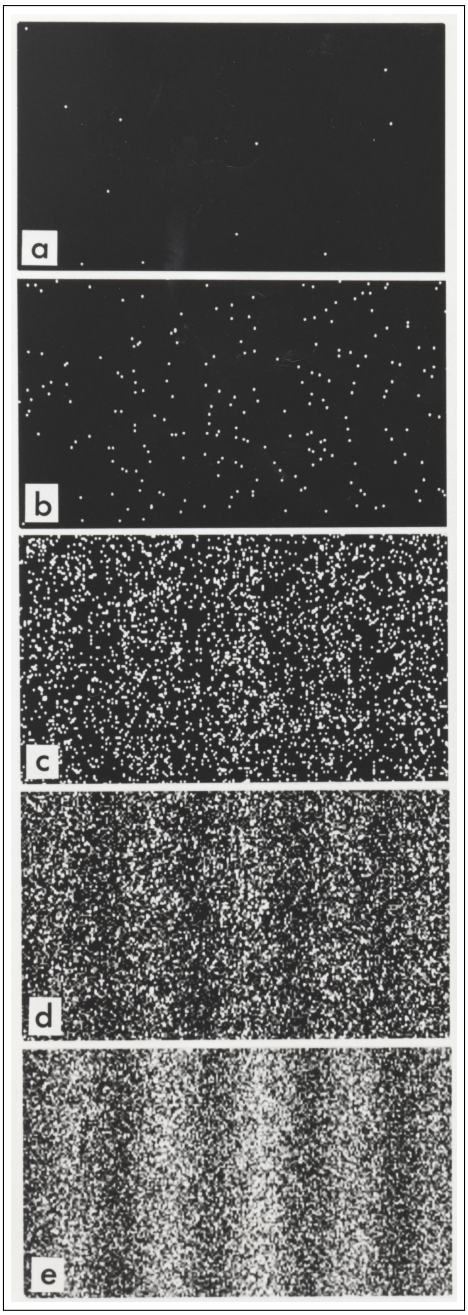

Figure 3: Results of a double-slit-experiment performed by Dr. Tonomura showing the build-up of an interference pattern of single electrons. Numbers of electrons are 11 (a), 200 (b), 6000 (c), 40000 (d), 140000 (e).[14]

[14]http://upload.wikimedia.org/wikipedia/commons/7/7e/Double-slit_experiment_results_Tonomura_2.jpg/

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